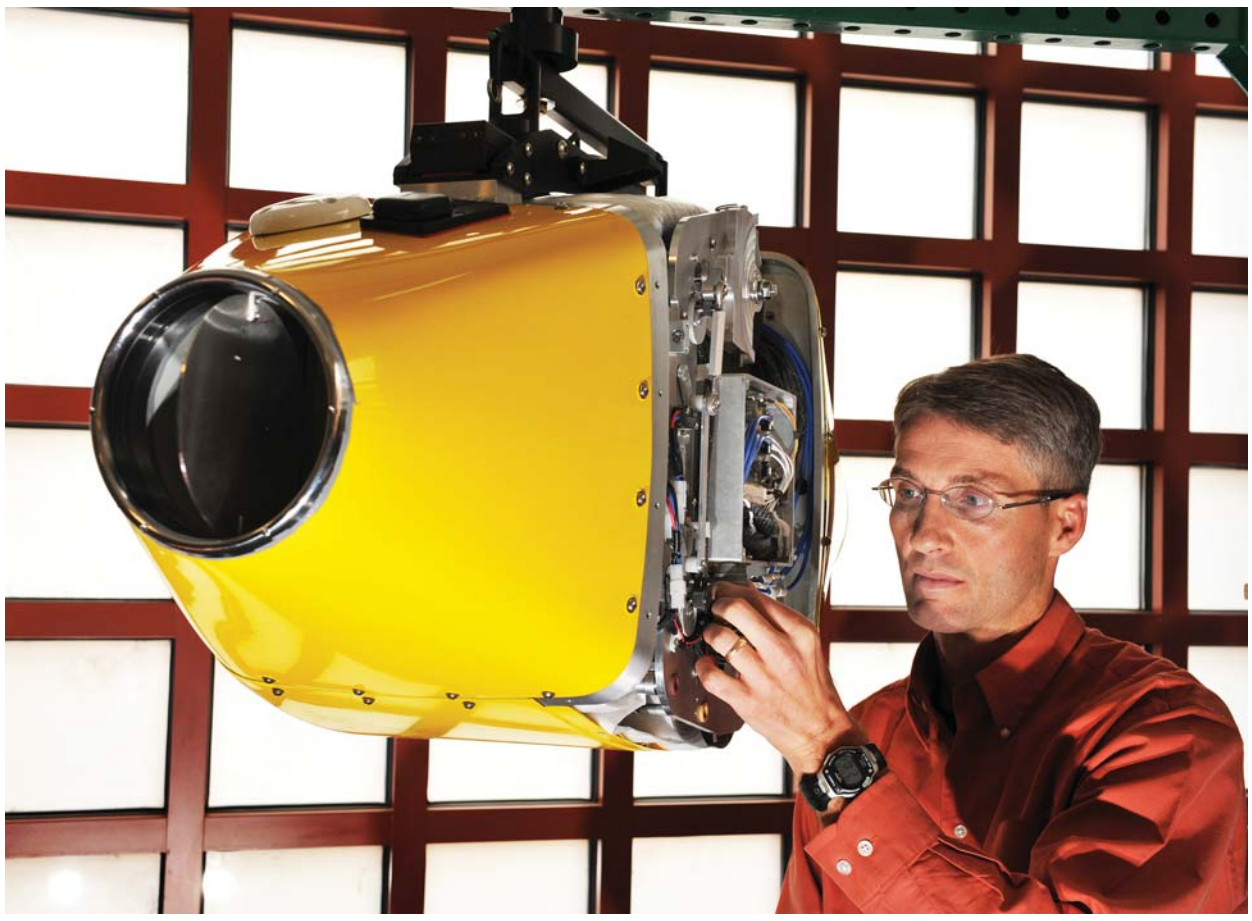
Sandia technology comprehensively supports CTBT

By Neal Singer

Somewhere in the world on Oct. 9, 2006, a low-yield nuclear device exploded underground.

In 48 hours, the sensors of the Comprehensive Nuclear Test Ban Treaty's (CTBT) International Monitoring System (IMS) — globally distributed — were able to pinpoint the location of the blast to an underground area in North Korea only 10 kilometers across.

The ability to detect and quickly pinpoint the location of the relatively small explosion — many times smaller than the Hiroshima bomb — suggests that any gaps in worldwide sensing capabilities have diminished greatly over the past decade, say Sandians involved in global efforts to detect nuclear explosions wherever they may occur.



IT ONLY LOOKS LIKE STAR TREK — Joe Sanders (5924) examines the shell of a next-generation airborne radionuclide particle collection pod designed at Sandia. The pod's sensors detect short-lived radionuclides released into the atmosphere in the wake of an underground nuclear detonation. The modernized system replaces technology dating from the 1950s and 1960s. (Photo by Randy Montoya)

This year, in response to President Barack Obama's April 5 speech in Prague in which he stated that his administration would seek CTBT ratification "aggressively and immediately," a team of five Sandians journeyed to Vienna to the CTBT Organization's (CTBTO) International Science Studies Conference. The Sandians presented three posters that demonstrated improved technical capabilities to detect underground nuclear blasts.

"We went there," says Tim McDonald (5736), "to reestablish our presence in an international community rejuvenated since the president expressed his determination to get the CTBT ratified. I was surprised by the intensity of the reaction to President Obama's outreach. The interest level was astounding."

Tim was also "very pleased with the number and quality of scientific presentations."

The Sandians were, besides Tim, Christopher Young (5527), Sandy Ballard (5527), Joe Damico (6723), and Jim Arzigian (6723).

In addition to showing the world computationally

(Continued on page 4)

Sandia LabNews

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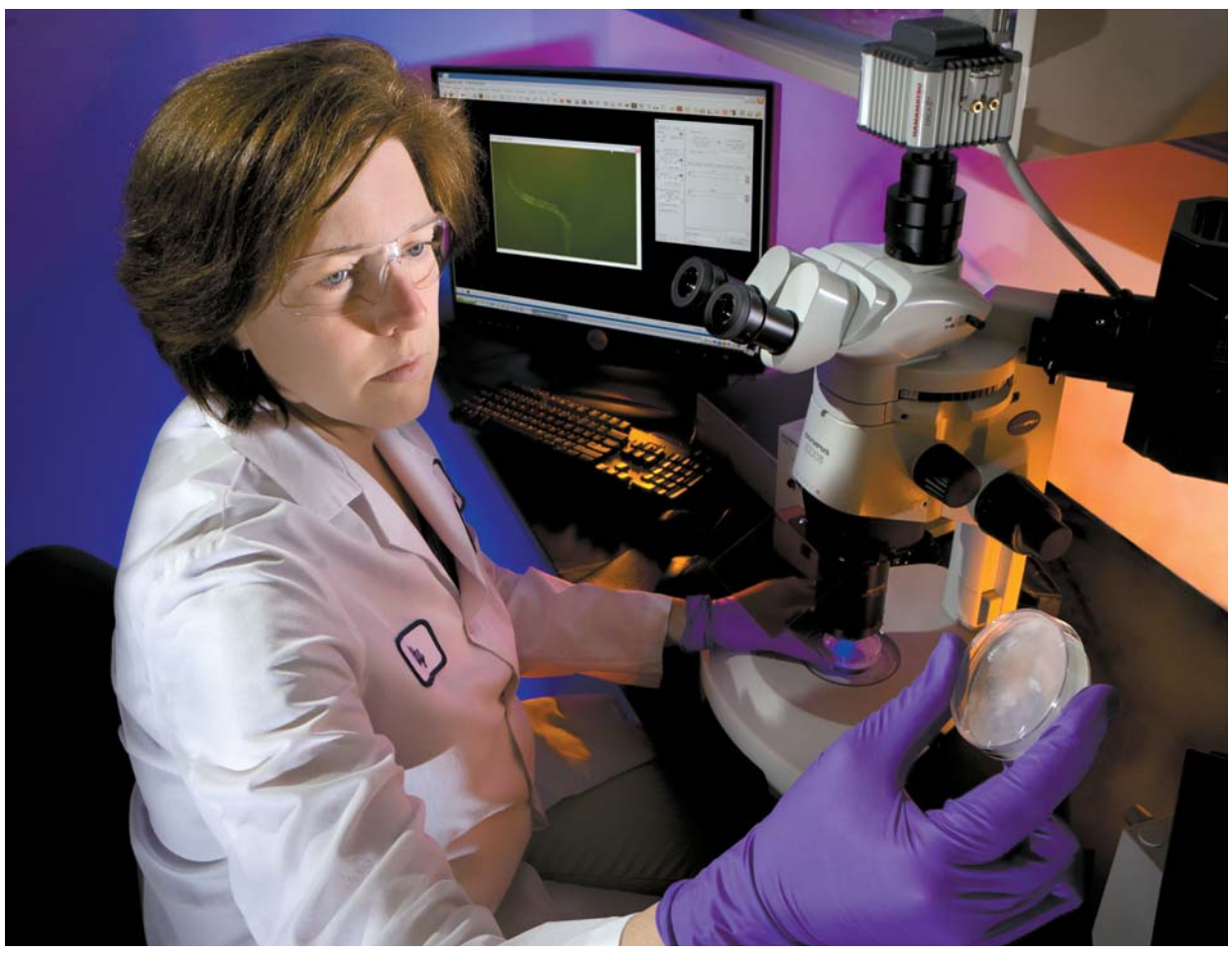
Sandia National Laboratories

Managed by Lockheed Martin for the National Nuclear Security Administration

A *C. elegans* solution to clearance sampling



By Patti Koning

After a biological attack, how do recovery teams know for sure that a site is sufficiently decontaminated and safe once again for people? Turns out, it's not an easy or fast process, but one that biologist Cathy Branda (8621) is hoping to revolutionize with a rather amazing nematode, *Caenorhabditis elegans*.

Cathy is working with Mark Tucker (6327), who for many years has led Sandia's efforts in developing methods, procedures, and technologies to remediate facilities contaminated in a terrorist release of a biological agent. Mark's team found that testing for residual live virus or bacteria following initial decontamination efforts, a process called clearance sampling, can be the longest step in the remediation process. Detection of residual live virus is particularly problematic and time-consuming, as it requires evaluation of replication potential within a eukaryotic host such as chicken embryos.

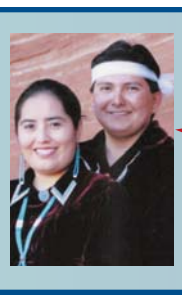
Currently, clearance sampling involves collecting swab samples from across a site and transporting them to a suitable laboratory for measurement of biological activity. Depending on the agent, the samples may need to be processed at a biosafety level 3 or 4 laboratory. In the aftermath of the Senate anthrax attack of 2001, the US Army Medical Research Institute of Infec-

(Continued on page 3)

CATHY BRANDA watches for fluorescent expression in a strain of *C. elegans* that, with a little work, may someday be used for on site clearance sampling. (Photo by Randy Wong)

Essay contest winner

Sam Felix (10640) has won first place in an essay contest sponsored by Lockheed Martin's Hispanic Leadership Committee. The topic: "Being a Hispanic at Lockheed Martin means . . . ." Read Sam's winning essay on **page 2.**



Inside . . .

Gerry Yonas retires

Sandia VP and Chief Scientist Gerry Yonas is retiring after a Labs career of almost 35 years. But he says he's not *really* retiring; rather, he's moving on to a new area of inquiry: the human mind. Read about Gerry's career and future plans on **page 6.**

That's that

Out in some of our more remote areas, you'll sometimes see signs warning people to watch out for rattlesnakes. Who'd have thunk, though, that we'd have to put out signs telling visitors not to pick them up? Here's what happened: A week or so ago some of the folks from my group escorted some visitors to a popular facility near Area 3. As the group was getting back into their bus after a presentation, one of the visitors noticed a three-foot rattlesnake lying right in the parking lot, sunning itself. The guy gets very animated, dumps everything out of his backpack, and starts heading straight for the snake. The escort, getting rather alarmed says, "W-w-what are you doing?" "I'm gonna catch that rattlesnake," the guy says. To which our well-trained, safety-conscious escort says, "Like heck you are!" or words to that effect. "This is federal property. You can't just go around picking up rattlesnakes." The guy, visibly deflated, gets back in the bus; I guess he maybe intended to put the snake in his backpack and take it home. There's no punch line here, but people sure can be funny sometimes. Funny strange.

* * *

Not long ago, a survey conducted by Marist College asked people which phrases in common English usage annoyed them the most. The results — at the end of the day — were interesting, to say the least. Anyway, they were interesting enough or humorous enough — whatever — to generate a bit of national media coverage. Nowadays, though, I find that the media get interested in the most unlikely and inconsequential things, you know? I mean, how can you really make a story out of the phases that annoy people most. The English language isn't exactly static. It moves. It evolves. It is what it is.

By the way, in the paragraph above, I was able to work in the top five annoying phrases plus a couple more I tossed in for good measure. I'll let you figure 'em out. And also by the way, are there words or phrases that really bug you? If you pass them along to me, I'll try and share a few of them in an upcoming column.

* * *

My wife and I are baseball fans, go to a lot of Isotopes games, watch the playoffs and World Series every year. Just love the game for its own sake. But as a couple of writers, we take a silly delight in listening to the commentators and the player interviews. Nobody, but nobody, slings a cliché like a sports announcer, coach, or player.

Of course, it's easy as pie to get some cheap laughs in a column like this by tossing out a few evergreen clichés and holding them up to ridicule. I won't do that, though. If the truth be told, I find those recurring sports truisms to be rather comforting. It's nice to know, isn't it, that there's someone out there giving 110 percent. And to know that your favorite team has come out to play; that the pitcher has his game face on and that there's no quit in him. It's enlightening to find out that your team has to put some runs on the board to win. As I've said here before, who knew?

Not a cliché, but one of my very favorite sports quotes (not counting everything Yogi Berra ever said), is this marvelous comment from NFL coach Bum Phillips. Speaking of fellow coach Don Shula, Bum said, "He can take your'n and beat his'n an' he can take his'n an' beat your'n." From one Super Bowl coach to another, that's high praise. The highest. (In the world according to Bum, "There's two kind of coaches — them that's fired and them that's gonna be fired.")

* * *

Say, did you see that note in the *Sandia Daily News* a few weeks back? The one about green burials? It was filed as an environmental tip. Turns out that modern American burial practices aren't all that environmentally friendly and there's a movement afoot to green up the process, sort of a return to the days of the pine box and no preservatives. Sounds fine and reasonable to me. I don't want anything excessive. But let me paraphrase St. Augustine here: "Lord give me a green burial. But not yet."

See you next time.

— Bill Murphy (505-845-0845, MS0165, wtmurph@sandia.gov)

Sandian Sam Felix wins Lockheed Martin essay contest

Note: Sam Felix, a senior manager in Dept. 10640, Div. 4000 Business Operations, was awarded first place in the essay contest sponsored by Lockheed Martin's Hispanic Leadership Committee. The essay topic was "Being a Hispanic at Lockheed Martin means . . . ." The contest was held in conjunction with National Hispanic Heritage Month (Sept. 15-Oct. 15). Here is Sam's essay:

SAM FELIX

Lockheed Martin has allowed me to work for three very different business units, where I have grown as a technical expert and a leader. It is exciting to know that a Hispanic boy from a small town in southern New Mexico can have the opportunity to become a leader for the largest defense contractor in the world.

Of course throughout my career I have worked hard and sought out opportunities, but it is only through the eyes of other leaders that I was nourished and then flourished. As a Hispanic I was given the latitude to succeed regardless of my ethnicity. What I have realized in this stage of my career is that I am being watched by everyone. My manager examines my process and delivery; my teammates evaluate my ideas and contributions; my peers encourage my drive and commitment; and my subordinates evaluate my integrity and modeling. Consequently, I am proud not only to be Hispanic, but moreover to be an example and a role model.

In fact, I was sought out for my first leadership role based on my contribution as a staff program cost analyst. My past supervisors referred me to the hiring management team based on my performance. In that role I hired five accountants to replace 16 and transferred an accounting system from Houston, Texas, to Albuquerque, N.M. My team successfully transitioned the system without losing a single staff member and working an average of 65 hours per week. Through that process I was able to hire a Hispanic staff member to do accounts payable and for whom I ultimately became a role model. For the whole team, which was a very diverse group, it was the greater sense of purpose that bound us together and ultimately made us successful. I believe I could go back to each of those team members and they would all say that we accomplished something larger than we all imagined.

As with any career, I have encountered my fair share of challenges. For me, first impressions have usually been difficult given my heritage, which tends to play down oneself within the culture. Thankfully, my director recognized this cultural trait and continues to mentor me through this challenge.

What is it like to be Hispanic at Lockheed Martin? I hope it is no different to be any other ethnicity working for this great company. When I see other staff members or leaders I look for their value of contribution and integrity. That is exactly what I hope others look for in me. Professionally, I want to be known as a leader, a coach, a trusted business partner, a technical expert, and someone the corporation can rely on. Personally, I want other Hispanics to look to me as an example of corporate success whose diverse background was an asset to the corporation.

Sandia LabNews

Sandia National Laboratories

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LOCKHEED MARTIN

For the record

Brent Burdick (1031) was inadvertently left off the list as an early leader in the NINE project in the article "Sandia, SRC win Licensing Executives Society award for NINE program outreach" in the Oct. 23 issue of the *Lab News*.

Thunderbirds club meets Dec. 8

The Coronado Thunderbirds, Sandia's retiree club, will hold its monthly meeting Dec. 8, 1 p.m., at the Mountain View Club on Kirtland Air Force Base. The meeting will include a presentation on making Christmas decorations. Many of the demonstration projects will be given as door prizes. A holiday sing-along will follow the meeting, with Eddie Reyes playing guitar. For more information about the meeting or about the Thunderbirds, go to http://coronado-tbirds.tripod.com.

Great American Smokeout is Nov. 19

Do you smoke? HBE can help you kick the habit. Join the Great American Smokeout and make Thursday, Nov. 19, your quit date. Get a free smoking cessation packet at HBE. Details can be found at the HBE Smokeout website at http://tiny.sandia.gov/3uzef on Sandia's internal web.

Feedback

PeopleSoft upgrade in the works

Q: *I saw a small graphic in a recent issue of* Lab News *advertising "Upgrade Coming in 2010." It didn't say much, other than "Upgrading HR information solutions and business processes." What is going to happen?*

A: This graphic symbolizes a significant upgrade to Sandia's human resources information system — also known as PeopleSoft — that will be coming in 2010. Whether they realize it or not, every Sandian interacts with PeopleSoft on a weekly, and oftentimes daily basis. Viewing HR information, Benefits Open Enrollment, creating a job opening, viewing paycheck information or leave balance information, submitting/approving timecards, and applying for a job are just a few examples of PeopleSoft's functionality. The upgrade will modernize the current PeopleSoft system that has become unnecessarily complex for users and maintainers.

To ensure that Sandia's business systems support the Labs' mission in the most efficient, simple, and cost-effective manner, PeopleSoft v9.0 will be implemented with as few customizations to the system as practically possible. PeopleSoft users will notice changes to the upgraded system's appearance and functionality. Expect to see more information in the coming months about the upgrade and the changes that will affect users. (Tana Lucy, 9540)

C. elegans

(Continued from page 1)

tious Diseases (USAMRIID) performed more than 30,000 individual assays on more than 10,000 samples, processing more than 700 per day at the peak.

The Hart Senate Office Building was closed for three months, more than half of which was for clearance sampling. Some of the postal facilities affected in the attack were closed for years. While closing office buildings and postal facilities is of relatively low consequence — the work can be moved elsewhere — the closure of a major transit center such as an airport could have devastating economic impact.

"As all of our prior work on remediation has shown, the time required for clearance sampling really limits our ability to return facilities or even entire cities to operation," says Duane Lindner (8120). "Having a rapid method of clearance sampling would relieve a fundamental roadblock to rapid restoration."

"To revolutionize this process, you need to bring the host to the site of contamination and have an on-site, rapid assay process so you don't have to take swab samples, transport them to a laboratory, or do culturing. That's the utility we are trying to bring to C. elegans*."*

— Sandia biologist Cathy Branda

Cathy's answer is to turn *C. elegans* loose on the problem and perform clearance sampling on site using the nematode. This Laboratory Directed Research and Development (LDRD) project is attempting to use modified C. elegans that would fluoresce in the presence of live virus. Clearance sampling could be as simple as spreading a *C. elegans*-laden gel on the affected area and shining a UV light to see if the virus had initiated replication within the animal. Remediators could have their answer in as little as eight hours.

"To revolutionize this process, you need to bring the host to the site of contamination and have an on-site, rapid assay process so you don't have to take swab samples, transport them to a laboratory, or do culturing," she says. "That's the utility we are trying to bring to *C. elegans*."

Naturally, this process is easier said than done. But Cathy and her team — chemical engineer Mark Tucker (6327); virologist Oscar Negrete (8621); data analyst Joe Schoeniger (8621); and laboratory technologists Julie Kaiser (8621, year one) and Carrie Kozina (8625, years two and three) — can leverage what is already known about *C. elegans* and viral replication. They'll also draw on Mark's work with decontamination foam in developing the gel.

A worm by any other name

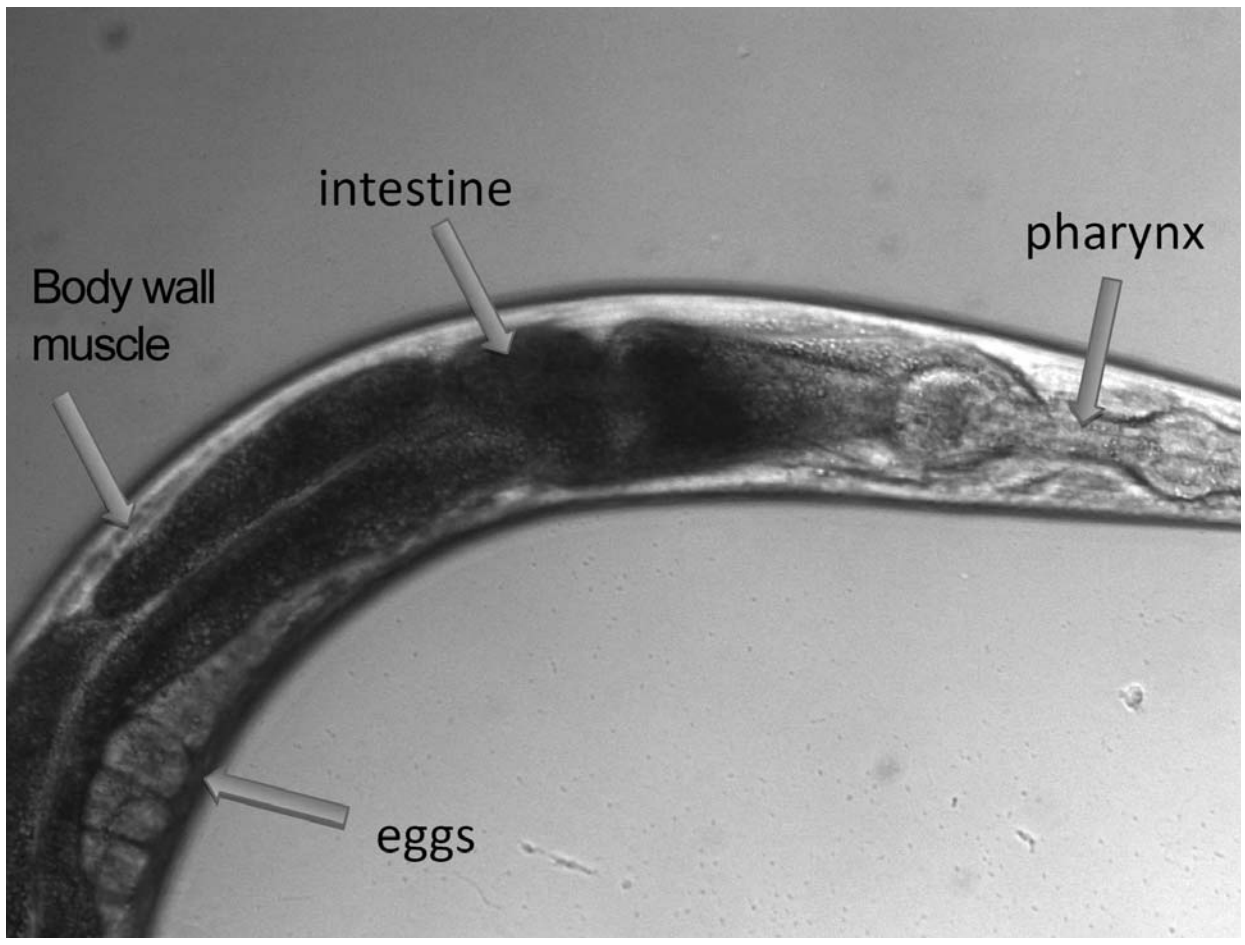
Let's get one thing straight: *C. elegans* are roundworms, but they aren't the parasitic sort that can make people sick. In fact, *C. elegans*, which are present in large numbers in the environment all around us, have already made significant contributions to medical research.

C. elegans is one of Cathy's (along with many other scientists') favorite lab animals for a number of reasons. Despite being just a millimeter long, they are multicellular organisms with complex biology and a well-developed nervous system. They are genetically well-characterized, optically transparent, and replicate in just a few days, producing large brood sizes.

Another advantage of *C. elegans* is that they are eukaryotes, sharing cellular and molecular structures and control pathways with higher organisms. That's not all it shares — about 35 percent of the little worm's genes have human homologs, or, in other words, common ancestry.

They are extremely adept at living in harsh environments and even have an alternative life form called the dauer larval stage, in which they can survive without food or water for months. *C. elegans* survived the space shuttle *Columbia* disaster in 2003. This heartiness poses a problem for Cathy's grand plan — while they are susceptible to infection, they also have a strong antiviral response and natural defenses, such as a strong outer cuticle.

"To make this application sensitive enough for clearance sampling, we need to render these animals as susceptible to viral infection as possible," says Cathy. "This poses a significant challenge, but I believe it's possible. There is no doubt we need to use a lot of creativity in our approach."



AS THE WORM TURNS — Image of most of the front half of an adult *C. elegans* hermaphrodite. The whole animal is one 1 mm in length; the pictured portion here measures about 500 micrometers.

The team is testing a large number of *C. elegans* mutants and experimenting with different chemicals and pressure gradients to see if they can take those natural defenses down a notch. They are also working with Creg Darby, an assistant professor at the University of California, San Francisco, who is using *C. elegans* to research biofilms of *Yersinia pestis*, the causative agent of bubonic plague. Darby has shared his library of identified mutations that render the cuticle fragile.

Shine a light

The other half of the *C. elegans* solution is to modify the animal's metabolic signaling pathways with a "molecular tag" so that when a specific virus replicates within it, the animal acts as a sensor and fluoresces. Again, the team has the advantage of previous research, but still needs to break new ground.

The team is working with mKate2, a fluorophore that fluoresces red when exposed to green light. Since most background autofluorescence glows green when exposed to blue light, similar to the popularly used green fluorescent protein (GFP), the team's use of mKate2 should help to eliminate false positives.

As a proof of concept, Oscar is developing molecular tags for two viruses: Rift Valley fever virus (RVFV) and vesicular stomatitis virus (VSV). Here at Sandia, he's using attenuated, nonvirulent strains that fully conform to Sandia's rigorous biosafety requirements.

Getting the molecular tag into the animal is not the difficult part — reading it is. "Because *C. elegans* is only a millimeter long and we are talking about a subset of their cells, the ability to amplify that signal is critical if we are going to be able to detect it," says Cathy.

Fortunately, another of *C. elegans*' talents is communication via a pheromone signaling pathway. The response of the animal depends on the pheromone concentration it detects — enough will send it into the dauer state. This trigger involves an insulin receptor pathway similar to that found in humans, so it has been studied extensively.

The idea is to manipulate the *C. elegans* so that it produces the dauer signal in cells that have been infected. Instead of sending the recipient into the dauer state, the modified signal would trigger an amplification of the fluorescent response. "While much is known about this trigger, no one has tried to take advantage of its properties for an application," Cathy says. "To trigger the amplification of the signal is novel, and determining the right way to do that is a challenge."

"There is a lot of excitement about this project because it is such a fresh approach. If it works — and there is every indication that it will work — this clearance sampling method will revolutionize restoration."

— Duane Lindner

Many milestones

By the end of the LDRD project, Cathy aims to have modified strains of *C. elegans* that can be used as sensors for RVFV and VSV. Her other objective is to develop sufficiently immune-compromised *C. elegans*. Between these goals and where the researchers are now, there are several significant milestones.

"Even if we can't render the *C. elegans* susceptible enough for clearance sampling, the strains we will generate will still be useful tools for both homeland defense and research," says Cathy. For example, she envisions a pool of *C. elegans* sensor strains that could be used to quickly identify the viral agent employed in an attack.

The immune-compromised *C. elegans* could also serve as a model to study questions such as how a virus spreads through tissues, what tissues are targeted, the receptors for viral infections, and mechanisms for limiting infections.

She's also excited about the potential to share the research within Sandia. *C. elegans* are an incredibly useful tool that could be applied to many research areas relevant to Sandia's missions, including cell-cell signaling, genomics, proteomics, environmental and particle toxicity, identification of antimicrobial and antifungal agents, etc.

"There is a lot of excitement about this project because it is such a fresh approach," says Duane. "If it works — and there is every indication that it will work — this clearance sampling method will revolutionize restoration."

Sandia CaliforniaNews

CTBT

(Continued from page 1)

that global sensing of an underground nuclear explosion is a reality, Sandia also is responsible for ensuring the proper installation and testing of US-sponsored CTBT International Monitoring System stations. Randy Rembold (5736), the US configuration manager in these efforts, has a personal letter of commendation from the CTBTO to prove it.

Finally, Sandians have actively worked to improve the keystone of nuclear test confirmation: airborne sampling of nuclear debris.

'An impressive though unusual venue'

In what Tim McDonald described as "an impressive though unusual venue" — the (former) emperor's palace in Vienna — 400 researchers, diplomats, and foreign service personnel from many countries convened to present or review the latest methods of detecting underground nuclear explosions.

The meeting's technical exchanges were intended to advance efforts to develop more sensitive sensors and better data processing and analysis methods. The ultimate goal is to drive explosion detection to lower and lower thresholds.

"The idea is to combine computing, signal processing, and sensors to achieve the goal of making it impossible to explode a nuclear weapon anywhere in the world without it being sensed," says Tim. "Sandia is very much a leader in this."

While Sandia routinely assists the National Data Center (NDC), "We're also exploring work with the International Data Center (IDC) to help them do as good a job as they can. It's in our national interest," says Tim.

One Sandia poster, sponsored by NNSA's Office of Nonproliferation and International Security (NA24), titled "Simulations of IMS Detection Effectiveness as Deployed vs. Planned," was a kind of map intended "to show the world that we could detect an illegal test," says lead Jim Arzigian. "We made a map to show how well we can detect explosions around the world."

The map program is simple enough to run on a laptop. It models information obtained from the four main vehicles of remote nuclear sensing. These are hydroacoustic (water), radionuclide (radioactive materials), seismic (earth), and infrasound rumble (air).

"We had a very benign statement on our poster that we wanted to make an announcement to the international community," Jim says.

Says Joseph Damico, "Our model integrates all four main technologies and is portable. It doesn't need a supercomputer. It was very effective in establishing the point that this can be done and be useful." An earlier version of the model helped determine initial placements of IMS sensors.

While the Sandia team did not discuss the latest technologies, Joseph says, the model elicited positive responses by foreign representatives, including a nation that — like the United States — has signed but not ratified the pact. Signatories that have not yet ratified include China, Israel, and Iran. Countries that have neither signed nor ratified the CTBT include North Korea, Pakistan, and India.

The poster showed that for a 10-kiloton underground explosion "both the certified stations and the full complement of stations are predicted to detect the event. The addition of the auxiliary stations to the certified stations improves the location accuracy predicted."

Eighty percent of the agreed-upon IMS stations are now deployed and certified. Demonstrating the effectiveness of the current distribution is important because requiring more sensors will require more money and possibly different locations than the 10-year-old treaty had specified. This would open the door to unwanted new negotiations.

The second and third posters, sponsored by NNSA's Office of Nonproliferation Research and Development (NA-22), involved enhanced methods for seismic detection.

One, hosted by Sandy Ballard, discussed improved methods of correctly modeling seismic waves passing through the Earth.

"Locating seismic events [like nuclear tests] depends on accurate knowledge of the structure of the Earth and how waves travel to reduce uncertainties in interpretation," he says. Today's high-performance computing capability enables 3-D simulations that provide more accurate information on wave propagation than earlier 2-D models that overly simplify the true structure of the Earth by assuming it is laterally symmetric.

Accurate interpretation of seismic events is crucial because thousands of shocks a day pass through Earth's crust. Within this background noise, sensors and programs have had to locate the only two detected nuclear explosions that occurred during the last decade.

A third poster, "Applying Machine Learning Methods to Improve Efficiency and Effectiveness of the IDC Automatic Event Detection System," by Christopher Young, Michael Procopio (both 5527), and Jack Gauthier (6342), described a method to improve the rapidity and effectiveness of interpreting seismic data of interest.

Sandia helps install sensing stations

More than 300 monitoring stations around the world make up the International Monitoring System that collects data for verification of the CTBT. Of these, the US is responsible for 37: five primary seismic stations, 12 auxiliary seismic stations, 11 radionuclide stations, eight infrasound stations, and one hydroacoustic station.

An ARCS pod undergoes flight testing on a Berkut Technology Demonstrator aircraft over the California coast near Santa Monica.

Randy Rembold, configuration manager for all the International Monitoring System stations in the US, received an individual acknowledgement from CTBTO Radionuclide Engineering Officer Luis Cello for Randy's service in installing and assisting in the certification of these sensing stations.

An integration configuration manager ensures that stations meet the technical requirements of the CTBT in Vienna, allowing these stations to be certified by the CTBTO. Once so certified, the data from an IMS station can be accepted and processed by the International Data Center (IDC).

The occasion for praise was the certification of a Midway Island radionuclide particulate station that was the final US agreed-upon station to monitor radionuclide particles, "making [the US] the first nuclear-weapon state and the second of those having four or more facilities to accomplish such a goal," wrote Cello. "Congratulations to all for the excellent job, especially . . . Randy Rembold, who took part in all the certifications, always supporting the PTS [Provisional Technical Secretariat] staff before, during, and after the certification visits."

Randy has visited almost every US station from Antarctica to the Arctic, including sensor sites on Guam, Midway Island, Wake Island, Alaska, and Hawaii.

"We're in the shadows; our name doesn't get mentioned," he says of Sandia's involvement. "We don't run the stations, we just certify that the stations meet CTBT design and operation specs."

As a part of the inspection, Sandia conducts both system and component testing, currently done by Darren Hart (5736) at each of the stations. Randy says that "Sandia is known all over the world among the seismic monitoring community for our FACT [Facility for Acceptance, Calibration, and Testing] test facility and the sensor, digitizer, and system evaluation performed there." A digitizer is the heart of a data acquisition system that measures a voltage signal, converting it into a binary file consisting of ones and zeroes. Because seismic signals of interest may be quite small with respect to the background, the digitizers have very high resolution, usually with the capability of resolving one part in 16 million of the full-scale signal.

Airborne nuclear debris collection, analysis

The gold standard for confirming that an explosion observed by seismic, hydroacoustic, or infrasound sensors is of nuclear origin is by detection of short-lived radionuclides produced by the event.

Historically, aircraft equipped with special collection equipment have been the most effective at accomplishing this task. Aircraft have the mobility to fly "downwind" of the event, which may require searching over a broad ocean area. Fixed land-based radionuclide sensors do not have this option, and might not be located in the path of the debris plume.

Airborne evidence is difficult to mask, says Joe Sanders (5924). Even when the scrutinized nation goes to great lengths to contain the radioactive explosion products from an underground nuclear test, telltale radionuclides can still leak out and be detected downwind. Radioactive debris from poorly contained events often escapes immediately and in large quantities, making airborne collection and detection quite feasible.

Well into the current decade, the primary US aircraft nuclear collection capability consisted of nuclear debris collection and analysis equipment developed in the late 1950s and early 1960s. This equipment was installed on military aircraft, which underwent extensive fuselage modifications to carry the bulky equipment. This pre-computer era equipment used vacuum tubes and chart recorders and required pencil-and-paper data logging. In the late 1990s, Sandia was tasked to develop an upgraded airborne sampling suite to replace the still-operating 1960s-era system.

"Locating seismic events [like nuclear tests] depends on accurate knowledge of the structure of the Earth."

The fully computerized system, which went operational in 2004, represented a major modernization over the earlier system, but "it still required permanent modifications to the aircraft," says Walt Caldwell (5923).

The modular solution

Recognizing that permanent modifications to aircraft are expensive and limit the number of platforms on which sampling systems can be flown, Sandia has been developing modular hardware since early this decade. The currently favored modular solution consists of pods that can be attached on hardpoints beneath the wings of manned or unmanned aircraft, says Joe. Research to develop and test these pods has been supported by NA-22 and DoD.

To date, Sandia and its Albuquerque industrial partner Mechtronic Solutions, Inc., have developed technology demonstration units for three types of pods: a particulate collection pod (known as ARCS), a whole air sampling pod (known as WASP), and a directional gamma sensor pod (known as DGRS) that can identify the direction of peak radiation intensity in the nuclear debris plume. "The ARCS pod has been successfully tested on both manned and unmanned aircraft," says Joe.

Says Bob Huelskamp (5730), "Sandia is a great example of what a national lab can do in support of a presidential objective to improve world security."

Take a moment, look to the west, and enjoy a beautiful sunset

FRIENDS AND HEROES — Sandia Protective Force members, proving they are all one big family, pitch in to spread gravel around the backyard of the Carrillo household, one of several projects they undertook for the family.

By Iris Aboytes

When was the last time you saw a crew of 30 to 40 young people with a tractor pull up in front of your house? They then proceed to winterize it, tear up grass in your backyard, and put in rock landscaping. In addition to all that, they put up a fence, add a gate, pull weeds, and clean out a work shed.

Imagine all this work; then they leave and there is no bill. Who are these people? Where did they come from?

That is exactly what happened recently when members of Sandia's Protective Force prepared Judith Carrillo's home for the winter. Judith's husband Phillip had been a member of the Pro Force and in September lost his three-year battle with prostate cancer. Phillip was 44 years old when he died and in addition to Judith is survived by his sons Phillip, 12, and Bryan, 6.

PHILLIP CARRILLO and his family: wife Judith and sons Phillip and Bryan.

"We often look to television to find heroes," says Phillip's sister-in-law, Diane Nakos (3503). "Most of us pass by Sandia Security Police Officers every day and pay little attention to who they are. They are heroes to my family."

"Phillip was incredibly proud when he was hired by Sandia and eventually became part of the Special Response Team (SRT)," says Diane. "Little Phillip and Bryan thought their dad was a hero for working at a national laboratory and wearing 'a special uniform.' Phillip, too, felt honored to be part of a Pro Force team tasked with protecting the nation's most precious assets. He loved the camaraderie the Pro Force offered him and always talked about his Pro Force brothers."

Members of the Pro Force made several visits to the Carrillo house during Phillip's illness; it was not just a one-time affair.

"In the last year of his illness with his body failing, he dreamed of returning to work," says Diane. "He agonized over not being able to 'be with his guys' at work. 'His guys' never let him down.

"'His guys' constantly visited with him throughout his struggle. They provided constant moral support, even when it was heartbreaking to see him. They continued to find ways to help him. When Phillip no longer had the strength to perform basic tasks, they worked around his home. They encouraged him through the pain, and helped him financially."

"Phillip and I came to Sandia at the same time," says his best friend Diego Trujillo (4211). "We were concerned for Phillip, but he was worried about us. On one of the times that we all went to help him, he tripped before I got there and broke the femur in his leg. The ambulance and I arrived at the same time. Phillip was not worried about his fracture. He felt embarrassed because it had happened."

"Phillip and his family thought we were his heroes," says Diego, "but it was Phillip who was a hero. We all admired his strength. He and I carpooled. One day the pain in his back was so bad I had to carry him from the truck. His passion for his work made it possible for him to even be at work. It was easy for us to be there for our friend. Phillip was like a brother to me. He was my strength and always will be."

A Thanksgiving story

PHILLIP CARRILLO practicing skills at the CTA firing range.

Phillip's family is not the only family helped by the Pro Force. If one of their members needs help, the Pro Force is there. Phillip wanted to go help when he heard that they were cleaning up someone else's place even though it was not possible.

"They are unbelievable," says Judith. "They are their own little family and take care of their own. Our home looks great thanks to these guys coming and cleaning up."

"Phillip was a sensitive romantic," says Diego. "He would always tell us 'No matter what you are doing or how busy you are, there is always time to take a moment, look to the west, and enjoy a beautiful sunset with someone you love.' Phillip was special."

"The Pro Force carried Phillip in every way," says Judith. "At the funeral celebration, members of the Pro Force were at the end of the procession taking him for his final ride. They carried him in more ways than they knew."

SANDIA PROTECTIVE FORCE members pose for a group photo after a day's work at the Carrillo home.

PRO FORCE members present Judith with a large plaque commemorating Phillip's service with Sandia's Protective Force.

Sandia VP and Principal Scientist Gerry Yonas to retire

'Yoda-like' executive's next move: seek the brain's light saber

By Neal Singer

Sandia VP and Principal Scientist Gerry Yonas is retiring from Sandia Dec. 1 — but he's not retiring.

It's not a koan [a paradoxical anecdote], says Sandia's creative vice president, sometimes referred to as Yoda and Yonastradamus by Sandia staff for his occasionally startling intuitions into the shifting directions of future research. "I've given myself five years to master the next challenge — the rules by which the brain functions and how to influence it . . . or maybe not."

That Gerry chooses to move on to investigating the brain (in conjunction with the Albuquerque-based Mind Research Network) rather than simply fade away into retirement is no surprise to those who know him.

He's already lived one of the more exciting lives possible for a physicist and engineer.

Gerry served as chief scientist for President Ronald Reagan's' Strategic Defense Initiative — the so-called Star Wars campaign, which ostensibly aimed to develop space-based chemical and X-ray lasers to render nuclear weapons unable to perform.

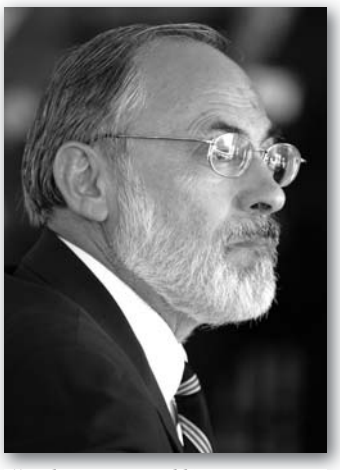
He presided over the largest single year of output increase from Sandia's extraordinary pulsed-power groups.

'Big hairy audacious goals'

Gerry envisioned, organized, and led Sandia's Advanced Concepts Group, which explored alternative political and scientific futures and came up with possible responses to deal with what they revealed.

Now he has taken up with the Mind Research Network to pursue, in words he uses often, further "big hairy audacious goals."

But mentioning only his intellectual passage would omit what he refers to as the most important event of his life: meeting his wife-to-be Jane in 1956, when Gerry was a high school junior and she a sophomore in Shaker Heights, Ohio.



"That satellite [Sputnik] was what led America to refocus its efforts nationally on science and engineering."

— Gerry Yonas
VP and Principal Scientist

"That [eventual] marriage certificate was the most important achievement of my career," he says.

Another — though obviously less important — factor was the Russian success the following year in sending the world's first artificial satellite, called Sputnik, into low Earth orbit. Circling round and round the globe like a highly visible, oft-repeating advertisement for Soviet science and technology, it was a major propaganda coup for a country then very much an American adversary.

"That satellite was what led America to refocus its efforts nationally on science and engineering," Gerry says. "Today there's a profound desire by young people to be actors or athletes. Fifty years ago, after Sputnik, it was okay to be a technogeek. All the students at that time knew that science and technology was important. My career as a Cold War warrior began there."

In Gerry's junior year in high school, he built his first accelerator — a Van de Graaff generator to display at science fairs. "I learned from that experience," he says humorously, "that I was very good at talking about science — in fact, better than at doing it."

Though he remembers being good only at talking about science, he somehow managed to remain No.10 in his 50-person class the entire time he was at Cornell's highly regarded Engineering Physics program. Then he was offered a fellowship to Caltech, where he achieved a doctorate in four years.

The rapidity of his success, he says, "was only because I was working at the Jet Propulsion Lab," he said, "so I could use my research results there for my doctoral work."

He was hired on by JPL to continue his work on magneto-fluid dynamics, only to be fired a year later. "The reason I got fired was that the Ranger spacecraft crashed into the moon many times . . . but failed to take even a single photo on the way in," he says. Images were needed to gather information for the moon landing of Apollo 11 a few years later. "Everyone not contributing to that effort was considered surplus and let go.

"I thought I would be there [at JPL] my whole life," he says. "I had a new baby and a house and I got fired."

He forsook magneto-fluid dynamics, ignoring offers from several large companies, to take up with Physics International, then a small company in San Leandro, Calif. His focus would be the creation of big pulsed-power machines and high-current relativistic electron beams. "I knew nothing about this, of course, but neither did anyone else."

In a short time, he learned about beam physics.

"The beam current was so high that it was believed a beam couldn't exist," Gerry says. "Such work had never been done before. I had to invent it all in six months, and we used the result for shock physics."

In five years, marketing intensely, he nursed the project from a $50,000 contract to a $5 million business.

In 1972, he came to work at Sandia.

"I entered the national lab sector because I decided that Sandia had a lot more money than we had in the private sector to build really big experiments needed for fusion."

That wasn't quite the case, he found out — there was a layoff soon after he arrived.

But, hired on as a first-level manager (a rare event for an outsider in those days), Gerry spent the next 10 years trying to achieve controlled nuclear fusion from pulsed power technologies that used electron-beam generators.

He also was increasingly working on beam weapons he felt might make nuclear weapons "impotent and obsolete," he says, quoting Ronald Reagan.

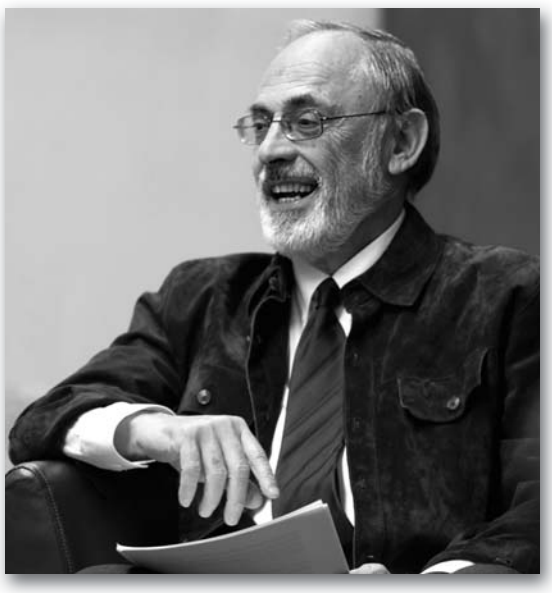
In 1983, he was summoned to Washington to write a plan to achieve that goal for SDI and was selected the following year to become SDI chief scientist and acting deputy director.

Attempting fusion

The opinion of many at the time was that the science behind the program was unproven. But Gerry says that Star Wars wasn't just about technology — "our reports never said anything about it working as a leak-proof defense — " but also about strategic social and political effects. "Strategic deterrence is in part a mind game," he says. "It still is."

After another try at the private sector, he returned to Sandia in 1989. That plus his original time at Sandia totaled almost 35 years.

"The most exciting thing in my career was the attempt at fusion and building the big machines to bring it off," he says. "I naively thought we'd have it in a few years easy." By the late 1990s, his goal was to build X-1, a massively larger version of Sandia's Z machine with input amperage of 60 mega-amps instead of the 18 mega-amps available to Z at that time. But the funding wasn't there. "It wasn't to be," Gerry says.



"The most exciting thing in my career was the attempt at fusion and building the big machines to bring it off. I naively thought we'd have it in a few years easy."

The most challenging part of his career was working on so-called wicked problems — problems without clear solutions, "where the rules of the game change out from underneath you," he says.

He faced these problems first at the Pentagon working with SDI and then later with his Sandia creation, the Advanced Concepts Group.

Among the ideas that sprang from the group was a strategic plan for the laboratory in dealing with terrorism.

THREE TITANS — In this drawing by Sandia illustrator Jim Walston (ret.), Everett Beckner, left, Gerry Yonas, and Al Narath look to the future. All three went on to play key leadership roles at Sandia, with Al serving as Labs Director from 1989-1995.

Another was the beginning of a research laboratory to be built directly on the US-Mexican border — the BiNational Sustainability Laboratory — that would deal with common problems: immigration, resources, new technologies. The presence of the lab would attract infrastructure that would make the border a destination rather than a pass-through point. Though Sandia since has minimized its role, the laboratory still exists, and Gerry's elder statesman-like advice there is still sought.

The 'geezer threat'

The ACG group also considered possible interdictions of the terrorist threat that ranged from an electronic net of cheap, tiny, widespread sensors to sociological analysis of countries from which terrorists sprang, with an eye to altering those conditions to prevent the problem from arising in the first place.

The group foresaw the aging of the industrialized world's populations ("geezer threat," the group dubbed it) and theorized how to help the elderly not only be safe by electronic and programmatic means but contribute economically to the world's well-being. Sample opportunities included placing elders online to serve as consultants, or as electronic afterschool grandparents, and even as monitors of computer screens during wartime to free up young people for more active duties.

Gerry feels a new field — neurosystem engineering — is needed to focus on national security problems. "The focus should be on solving real problems, exploiting the knowledge base, not on expanding it," he says. "The kind of microsensors Sandia has already developed could play an important role in, say, neuroprosthetics."

He's led two courses at UNM over a two-year period on the field he's attempting to create.

The field has civilian applications as well. "We could have noninvasive brain stimulation to deal with loss of memory. Half the people over 85 have severe dementia; the effects are serious. But we could have wearable computers, neuronal implants, and remember where we put the car keys."

The questions, the predictions, keep on coming. They don't call him Yonastradamus for nothing.

"The challenges are enormous. The field is enormous. At a recent neuroscience meeting in Chicago, 30,000 people attended," Gerry says. "It's hard even for people in the field to keep up with advances that use magnetic and electric field tools to measure and modify brain function. Theoretical modeling will be very important. Major advances soon will take place in this field."

Gerry intends to be there, helping lead the way into the future.

Nizhoni

Michael Arviso thinks the land of his childhood is 'nizhoni'

By Iris Aboytes

If you have ever gone camping and slept in a tent, you know it is fun for a while. A tent was Mike Arviso's (1522) home as a toddler.

Mike was born in Shiprock, N.M., and was raised by his aunts and uncles in addition to his dad and mom, Paul and Hazel. Mike and his family moved to an apartment before living in a mobile home. Three years ago Mike and his sister and three brothers built his mom and dad their first home.

I went to school in Farmington," says Mike. "My parents knew how important it was for us to go to school. My father attended school up until eighth grade. My mom went to second grade. My father worked on cars. He was what is called a body man. He restored vehicles to their original condition."

One day while he and his friends were playing basketball, the principal pointed to each of the boys and told them what he thought they were going to be when they grew up. When he pointed to Mike, he told him he was going to be an electrical engineer. Even though Mike was only in second grade, it stayed with him. At first Mike thought an engineer drove an electric train.

MIKE ARVISO and his wife April on their wedding day. (Photo by Laurence Brown)

After graduating from high school, Mike attended DeVry Institute in Phoenix, Ariz.. It was there that he met with a Sandia recruiter. He received a job offer and began taking classes to get his electrical engineering degree. Once at Sandia Mike began using the Tuition Assistance Program to take courses at the University of New Mexico.

"To speed work along, I was able to use the University Part-Time program to obtain my master's degree in electrical engineering," says Mike.

Mike performs modal analysis in the Experimental Mechanics, Non-Destructive Evaluation, and Modal Validation department. Modal analysis is the study of dynamic characteristics of a mechanical structure; its data is useful in verifying and validating finite element models.

Mike and his wife April have two children: Lucas, 10, and Brittany, 12. A year ago Brittany celebrated her Navajo coming-of-age ceremony.

"The ceremony was held in Red Mesa, Ariz., where April's relatives reside," says Mike. "The four-day ceremony introduced Brittany to intricate weaving, food preparation, and beading and she got to hear many, many stories. She was cautioned — don't grow up too fast. Her maternal mother and grandmother made her outfit.

"The experience put me back in touch with my culture. I enjoyed seeing Brittany go with the flow as she learned how to harvest, grind, and steam corn the old way, to store for the dry winter months. Brittany's only wish during her ceremony was hoping she could talk in Navajo to communicate with my mother more closely. Although my mother speaks English she prefers Navajo."

This summer Lucas attended a local summer school program intended to help Navajo and Isleta Pueblo children stay connected to their heritage. Lucas was immediately hooked as he learned about the Navajo Code Talkers.

"Growing up I was exposed to Navajo medicine men and their healing ways," says Mike. "My father and mother would always go pray and contribute to the singing. I was proud that my dad was very involved. He has a beautiful heart.

"I enjoy going back to the reservation," says Mike. "I like the landscape, wide-open spaces, and the simple and basic lifestyle. Even though I have a home here, I feel like I am actually home on the reservation. I get to see not only my family, but my extended family.

"My parents live about three hours away," he adds. "That is perfect. I get to stay close to my roots."

If you enjoyed reading about Mike, write him and tell him "nizhoni," which means "beautiful" in Navajo.

BRITTANY ARVISO, daughter of Sandian Mike Arviso, celebrated her Navajo coming-of-age ceremony last year. The four-day ceremony introduced Brittany to many aspects of traditional Navajo culture, including bread-making and food preparation, intricate weaving, and beading. The poster at right includes photos of many of the activities conducted during the ceremony.

Poster by Linda Bennett-Begay

Special day honors veterans, celebrates Indian heritage

Photos by Lloyd Wilson • Story by Bill Murphy

On a perfect autumn day at Hardin Field, the Stars and Stripes at half-staff to honor the soldiers killed in the Fort Hood shootings, more than 300 Sandians turned out under the midday sun on Nov. 11 to honor America's military veterans and to observe national American Indian Heritage Month. The event was sponsored by Sandia's American Indian Outreach Committee.

RED ROAD CROSSING dancers, drummers, and singers at the Nov. 11 Veterans Day event at Hardin Field.

DANCING to honor veterans.

With the line of hungry Sandians waiting for Indian fry bread, Navajo tacos, and other popular fare stretching almost half the length of Hardin Field, Red Road Crossing Drum Group and Dancers performed a number of familiar and original music numbers, including the riveting favorite "Soldier Boy." Rick Chavez-Hatton (2997), master of ceremonies for the day's events, kept the activities moving smoothly, his comments helping to keep the focus on the nation's veterans and American Indian heritage.

After presentation of the colors and the Pledge of Allegiance, guest speaker George Rhynedance paid tribute to three generations of his family who have served in the armed forces. George spoke of the service of his father, a World War II veteran now residing in Las Vegas, Nev.; his wife, who flew helicopters for the Army during the waning days of the Cold War; his son, an Army officer currently deployed to Afghanistan; and his daughter, an Air Force officer stationed in Virginia. George, director of Public Relations and Communications Center 3600, is himself a veteran, having retired as a colonel after nearly 27 years in the Army.

"Service is not easy," George told the audience. "It requires determination and stick-to-it-iveness. It challenges you in ways you can't imagine, and it challenges those around you. I could never pass along this message without also recognizing the amazing support structure that our service members get from their families and the American public."

With costumed dancers displaying elegant footwork in dizzying swirls of color, and with the sounds of drums and singing rising up from the field, the hundreds of attendees were transported to a timeless place, able to contemplate timeless virtues.

Veterans Day tribute planning committee members: Benjamin Mar, Michael Arviso, Priscilla Altsisi, Yvonne Batchelor, Lucille Boone, Carmela Gallegos, Curtis Keliiaa, Karen McDaniel, Patricia Toya, Etta Tsosie, W. Rhoda Yazza, Maxine Norton, Sayan Mukherjee, Elizabeth Gonzales, Larry Yellowhorse, Nelson Capitan, Marie Brown, Laurence Brown, Machelle Karler, Esther Hernandez.

In an emotional high point of the day, Curtis Keliiaa (9336) recited a poem of his own composition. He dedicated the poem, "Brothers in Arms and Glory," to his father and uncle, who both served in World War II, and to all veterans who have served the nation. As the crowd grew silent, his poem began, "Brothers in arms and glory/forever honor bound/God bless the blood of our fathers/spilled on sacred ground."

Also performing during the day were the Sandia Singers and popular American Indian flutist Ron Hoskie (4842), whose haunting flute rendition of *Amazing Grace* wrapped up the formal activities.

RED ROAD CROSSING dancer displays intricate footwork and dazzling turns during Veterans Day activities at Hardin Field.