Labs embarks on ‘cost austerity’ effort to help fund pension contributions

By Neal Singer

While it’s sometimes difficult to separate real calls to action from the chaff of daily news, Sandia’s current move to cut its costs — the preferred term is “cost austerity” — seems definite enough to affect every Sandian.

“The term ‘wartime austerity’ has been used to describe a severe and rigid economy necessary to fund the cost of war,” says Bonnie Apodaca, director of Sandia’s Business Management Operations Center 10600. “Now every member of the Sandia workforce will be called upon to engage in cost austerity, in order to fund pension contributions for the Retirement Income Plan.”

With the value of Sandia Corp.’s pension funds declining with the stock market, the corporation faces difficult challenges in funding the future requirements of the Retirement Income Plan.

Even prior to the recent market decline, Sandia management had been preparing to make legally required contributions to its pension fund within the next several years. Sandia also was planning to make additional early contributions to help manage those future required monies. But the recent and extensive stock market reversals significantly reduced assets for most investors. Sandia was no exception.

No Pollyannas here

“To make up the shortfall,” says Bonnie, “some people think, like Pollyanna [a literary character who found something positive in every situation], that eventually the market will right itself. That’s not a reasonable assumption in the timeframe we face. Our latest projections indicated that Sandia could be required to make contributions to the pension fund by 2010, which does not give us a reasonable time for the market to recover enough for Sandia to avoid this. It also wastes time we could use to contribute now, in amounts that could help mitigate long-term pension funding needs. We’re designing a plan at Sandia to deal with the problem to make sure our pension fund stays solvent. But it’s going to take everyone’s help and it’s not going to be easy. It’s called a cost austerity program.”

Wrote Div. 10000 VP and Chief Financial Officer Matt O’Brien in a letter to all vice presidents and directors, “[Austerity] is a departure from past practices, and will need true leadership to help each person see the long-term benefits to both Sandians and to Sandia. We can’t do it without your leadership and commitment. There are additional contribution increases that will come after this one. This is the first step in a journey that will take us several years to complete.”

The last time Sandia Corporation found it necessary to contribute to its pension

(Continued on page 4)

AS ONE OF MANY possible measures to reduce costs as part of Sandia’s austerity initiative, departments across the Labs are looking at the number of cell phones, pagers, and BlackBerrys they’re using. (Photo by Randy Montoya)

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Sandia National Laboratories

Biorefinery in a plant — the next step in biofuel production

BRACHYPODIUM may look like a common weed, but plant geneticists such as James Thomson of the USDA, pictured here, are using it and other model plants to develop techniques to express extremophile enzymes into biofuel crops. (Photo by Randy Wong)

By Patti Koning

Sometime in the not-so-distant future, agricultural waste, weeds, and other plant products that are typically discarded or destroyed may fuel our cars. But going from the ground to the fueling station is not a simple process . . . yet. Sandia researchers are partnering with the US Department of Agriculture (USDA) on a project that aims to create a consolidated biorefinery process within plant cells.

Called “A Trojan Horse Strategy for Deconstruction of Biomass for Biofuels Production,” this project seeks to embed into the plant cells synthetic genetic circuits constructed using parts from extremophilic organisms that can break down the complex carbohydrates of plant biomass into fermentable sugars. The result would be a significant reduction in the cost and complexity of the process currently used to deconstruct biomass for biofuels processing — a savings of as much as $1 per gallon of biofuel by some estimates.

Masood Hadi (8621), principal investigator for the Trojan Horse project, explains that breaking down complex carbohydrates into biomass involves many physical processes — raising the temperature, subjecting the biomass to acid treatment followed by washing, and then enzymatic digestion.

“The pretreatment and enzymatic hydrolysis steps represent about 40 percent of the cost, which could be cut in half if the enzymes are embedded into dedicated biofuel crops,” he says. “Our idea is to consolidate this entire process and have it all take place within the plant. To put it simply, we’d move certain aspects of the biorefinery process inside the plant cells.”

(Continued on page 5)

Economic summit

More than 200 business, education, and civic leaders learned firsthand recently about Sandia’s impact on the state of New Mexico’s economy during the Labs’ first-ever Economic Impact Summit held at the Albuquerque Convention Center. Story on **page 4.**

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Oppie’s ride

The National Atomic Museum has acquired and is in the process of restoring the 1941 Packard sedan used to ferry Robert Oppenheimer and other Manhattan Project leaders to the Trinity test site in 1945. Story on **page 8.**

That's that

This year is a milestone one for Sandia; it was 60 years ago this May that President Harry S. Truman sent a letter to Leroy Wilson, president of American Telephone and Telegraph Co., with a special and urgent request: "I am informed that the Atomic Energy Commission," Truman wrote, "intends to ask that the Bell Telephone Laboratories accept under contract the direction of the Sandia Laboratory at Albuquerque, New Mexico. This operation, which is a vital segment of the atomic weapons program, is of extreme importance and urgency in the national defense and should have the best possible technical direction."

All Sandians know how Truman ended his request: "In my opinion you have here an opportunity to render an exceptional service in the national interest."

Of course, AT&T took up the challenge and for the next four decades and more managed Sandia at a fee of $1 per year. During the years of AT&T's stewardship, and in the subsequent years under the leadership of Lockheed Martin, Sandia and Sandians have made enormous contributions to the nation: We helped deliver victory in the Cold War; we have advanced the state-of-the-art in a wide range of engineering and scientific disciplines; we responded to the nation's call with a variety of technologies after 9/11.

When I try to explain to my mother the scope of what we do, I say that whenever you hear about a national problem or challenge, if it has any kind of technological aspect to it, scratch the surface and the chances are you'll find Sandia involved. We're always there for the nation.

Over the next few months, there'll be a number of 60th anniversary-related activities. One of the first, and perhaps one that Sandians are most looking forward to, is Family Day, which will probably be held in May. Last time we had one, 10 years ago (when we were marking our 50th anniversary), it was a huge success.

* * *

Speaking of the Cold War, over the past year or so, I've had the pleasure of becoming friends with retired Sandia senior scientist Arlin Cooper. Arlin was honored recently for his work in ensuring the safety of our nuclear weapons stockpile. I write about that recognition on page 6, and I hope you get a chance to read the story. In it, Arlin reflects on the work he did and the contributions of many, many other Cold War-era Sandians who dedicated their entire careers to making this country safe during an extremely dangerous time. One would almost think they were the last of a breed — *until* you meet some of our newest Sandians. I had the chance a few days ago to talk with a postdoc who's been here just less than two years. His interest is energy, and believe me, he brings all the passion and conviction and training and intellect to this urgent national issue that Arlin and his colleagues did to the challenges of an earlier day. We are, in short, in very good hands as we move into our next 60 years.

* * *

Last issue, I wrote about the format wars that happened back in the 1920s over the paper rolls used in player pianos. Got a note from Marion Wilde (5932) reminding me of similar format wars. He wrote, "Interesting to extend it to other items as well: the RCA video disk format vs. Laserdisc (1970s); the Betamax vs. VHS video recorders (1970s and 1980s); HD DVD vs. Blu-ray (~2007); and several others that were directly competing formats. I'm sure there are many others."

Yep. It seems to be an iron law of technological development that there will be a period when several different approaches to a technical problem will be tried in the marketplace before one approach prevails. Heck, the law even applies as far back as the late Pleistocene Age. According to a Wikipedia entry, around 10,000 BC, "a new type of fluted projectile point called Folsom seems to emerge, replacing the Clovis-style points over much of the continental United States." So the Folsom point won *that* format war, but I'll bet, people being who we are, the tried-and-true Clovis point probably had its diehard fanboys, who'd never be caught dead using a dandified Folsom projectile.

See you next time.

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

Steven Chu sworn in as DOE secretary

Steven Chu was sworn in as the new secretary of the Department of Energy on Jan. 21, the day after being confirmed on a voice vote by the US Senate.

Chu, who shared a Nobel Prize in physics in 1997 for his work in developing methods to cool and trap atoms with laser light, was director of Lawrence Berkeley National Laboratory prior to being tapped by President Barack Obama to helm DOE.

STEVEN CHU

Under his direction, LBL has become a center of research into biofuels and solar energy. Chu has been eloquent in expressing his conviction that the greatest danger faced by humanity is global warming. His wide scientific interests have earned him the title of professor of physics and molecular and cellular biology at the University of California, Berkeley. He was selected to speak at Sandia as a Truman Distinguished Lecturer.

In remarks made during a department-wide webcast the day after assuming his new position, Chu expressed his confidence that DOE will have an essential role to play as the nation addresses the new security challenges of the 21st century. "The Department of Energy will have to be the go-to organization for all kinds of [challenges] we face in this nation," he said.

Chu, the recipient of numerous awards in the course of a distinguished professional career, earned undergraduate degrees in mathematics and physics from the University of Rochester in 1970 and a doctoral degree in physics from the University of California, Berkeley, in 1976. He was a postdoctoral fellow at UC Berkeley from 1976 to 1978, when he joined AT&T's Bell Labs. He moved to Stanford University in 1987, where he was a professor of physics and applied physics. He joined Berkeley Lab in 2004.

The Nobelprize.org website features a 3,500-word autobiography by Chu that offers a number of insights, particularly in the area of the events that shaped his scientific career. The autobiography is at: http://nobelprize.org/nobel_prizes/physics/laureates/1997/chu-autobio.html.

Nominations sought for 16th Annual Employee Recognition Awards

The Employee Recognition Awards program is a way for Sandians to recognize individuals and teams whose work or contributions in support of Sandia's mission and values has been exceptional. Nominations for this year's awards are being accepted through Feb. 2.

The ERA program recognizes excellence in four categories: three for individual nominees and one for teams.

The individual categories are: technical excellence, which recognizes individuals whose innovative science and predictive, science-based engineering capabilities contribute to the transformation of Sandia's business practices and provide solutions to national security problems; exceptional service, which recognizes those who are distinguished by their commitment and efforts to enable others to succeed; and leadership, which recognizes those who demonstrate exceptional creativity, courage, and integrity in leading others to the successful accomplishment of Sandia's work.

The team category recognizes teams whose exceptional achievements are critically enabled by teamwork and model the value of people working together toward a common goal.

Nomination forms with detailed instructions are available from Sandia's Techweb homepage or at www-irn.sandia.gov/era/09era.htm.

Each division has an ERA coordinator who is also listed via the link above. Any current, regular Sandia employee may nominate individuals or teams. A separate nomination form must be submitted for each individual and team nomination. A combined total of 122 individuals and teams will receive corporate Employee Recognition Awards.

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Sandia National Laboratories

http://www.sandia.gov/LabNews

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Got opinions?

Pulse Survey offers Sandians a chance to build a better workplace

By John German

Would you spend five minutes helping make Sandia a better place to work?

Beginning Feb. 9 one in every four Sandians will have that chance when an email from Lockheed Martin asks them to participate in the first Sandia Pulse Survey.

The 20-question, confidential survey probes employees' feelings about their immediate management and job satisfaction, with questions about manager effectiveness, career development, recognition, feedback, and retention, for example.

Then, three months after the first survey, a different quarter of the Sandia population, about 2,100 people, will be asked to take the next survey, and so on each quarter until each of us has been surveyed once and only once for the year.

And then the survey cycle begins again next year.

In this way, the information Sandia's senior management is receiving about employee satisfaction is frequent, statistically significant, trackable, and actionable, says Sandia HR & Communications VP John Slipke (3000). That will shed light on where the management team is succeeding and where it needs improvement, he says.

The Pulse Survey itself is not a Sandia-grown product. Lockheed Martin began requiring its use in the company's Electronic Systems business area earlier this year, with positive results, he says.

Making opinions count

The survey's frequency is one improvement over past employee satisfaction surveys at Sandia, says Pulse Survey project lead Deborah Mulligan (10630).

Another major difference is a formal plan for making your opinions count. Within eight weeks of the survey's closure Sandia's management team will receive the results. Level 1 managers will be asked to discuss the results with their staffs. The *Lab News* will provide employees with a synopsis of the Labs-wide results, as well.

VPs and directors will be required to develop action plans for their organizations with measurable goals.

Results will be incorporated into strategic planning to help shape future Sandia HR initiatives, policies, and training, says John (see "How the Pulse Survey might change your workplace" at right).

Leadership measures

Although Sandia is in many ways different from a Lockheed Martin business unit, John says, employees' satisfaction with their jobs and with management is something about which all employers are concerned. For measuring those parameters, the tool is a good one, he says.

The survey has another tie with Lockheed Martin. Its questions are designed to support the goals of a leadership development program, Full Spectrum Leadership, or FSL, that formalizes how managers get better at their jobs. Lockheed Martin has adopted FSL across the corporation, and since 2006 Sandia managers have been encouraged to use it to help them become better leaders (*Lab News*, Aug. 15, 2008).

The heart of FSL is a set of five leadership attributes that guide a manager's development of knowledge, skills, and abilities. The Pulse Survey's questions are tied directly to these attributes. The survey supplements other FSL measures, such as 360-degree assessments of participating managers.

Thoughtful input

"This survey is a major indicator of how our leaders, as a whole, get better at leading," says John. Although the HR team will be on the lookout for evidence of leadership improvement, he cautions that true improvements take time.

"People don't change overnight. My hope is that two years from now, when employees look back on how they are and were led, they'll notice a positive difference."

With all the changes taking place here of late, John is expecting Sandians will have plenty on their minds when they sit down to take the survey. He asks that employees think carefully about their responses.

"Use this tool to tell us how we're really doing," he says. "Your honest and thoughtful input matters. We can't change what we don't know."

How the Pulse Survey might change your workplace

Here's a hypothetical example of how the Sandia Pulse Survey might improve your workplace.

You are selected to take the first survey and you note concerns about the quality and frequency of the feedback you receive about your job performance.

Eight weeks after the survey closes, Sandia managers learn that performance feedback is a widespread concern. In a department meeting your manager discusses the findings and says she will begin providing more frequent and substantive feedback.

The next day she stops by your office and says she's pleased about your project generally but is concerned about the hours a contractor assigned to it is charging. The two of you agree to a solution.

Meanwhile, your director asks center managers for actions they will take to improve the quality and frequency of feedback. The managers agree to improve the center's survey score by five percentage points over the next year. Following subsequent surveys your director reports on these scores to the center managers and asks them to share their own examples of and ideas for providing feedback.

A year later, you are asked to take the Sandia Pulse Survey again. This time you're satisfied with the feedback you are receiving from your manager, but you use it as an opportunity to note new concerns.

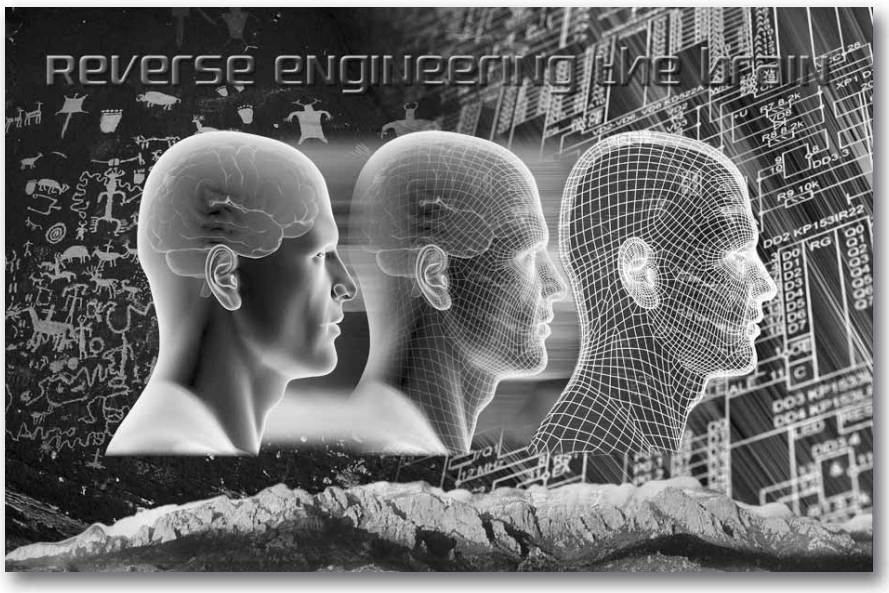
Cognition symposium boggles mind

More than 200 scientists learn the future of mind research at Sandia-sponsored event

By Chris Burroughs

More than 200 scientists from throughout the country gathered at a resort just north of Albuquerque earlier this month and spent three days peering into the future of cognition research. What they heard was mind-boggling.

It's a future of new treatments for diseases such as Alzheimer's, Parkinson's, depression, and schizophrenia, and cures for people with traumatic brain injuries; the creation of new machines, like super-powerful computers that will enhance the way people perform and think; and dramatically improved robotics.



The scientists were attending the fourth Decade of the Mind symposium, sponsored by Sandia and cosponsors Krasnow Institute at George Mason University, Los Alamos National Laboratory, Santa Fe Institute, the University of New Mexico, MIND Research Network, and the Potomac Institute for Policy Studies. Subtitled "Reverse Engineering the Brain: Sowing the Seeds for Technology Innovation," the symposium was held at the Hyatt Regency Tamaya Resort and Spa on the Santa Ana Pueblo.

"Our goal was to obtain a glimpse of the technologies emerging in the areas of reverse engineering of the brain, computational neuroscience, cognition modeling, and massive neuronal simulations," says John Wagner (6341), manager of Sandia's cognition department and symposium chairman. "What we got was a world-class symposium that left everyone who attended awed about how far cognition research has come — and how far it needs to go."

Al Romig, Sandia executive VP and deputy Laboratories director for Integrated Technologies & Systems and interim chief operating officer, said at the symposium that the move to understanding the brain is not unlike what occurred 15 years ago when scientists were first interfacing biology and physics into the new science of biotechnology.

"It's a multiscale problem that is going to take a multidisciplinary effort to solve," he said. "A better understanding of the brain will have great benefit to the nation and humankind."

The research may result in reducing armed conflict, countering terrorism, understanding the mechanisms of dementia, and addressing the human elements of energy security and climate change problems. Some of the disciplines that will have to come together are computing and mathematics, neuroscience, engineering sciences, micro and nano technologies, psychology, social sciences, material sciences, physics, chemistry, biology, and physiology, Al said.

Jim Olds, director of the Krasnow Institute for Advanced Study and the Shelley Krasnow University Professor of Neuroscience at George Mason University in Virginia, organized previous Decade of the Mind symposiums. He noted that his belief in an advanced cognition future is rooted in the Human Genome Project, which showed that "large challenges can be cracked."

Olds told conference-goers that he and a team of researchers are working on establishing a cross-disciplinary and multiagency project to consolidate new science, inspire new technologies, and try a new assault on understanding how the mind emerges from the brain. The project would cost $4 billion over 10 years.

At the symposium Olds emphasized that for such a project to be successful, it has to be international in scope. And, in fact, European researchers have already joined forces with American scientists on the mind project. The next Decade of the Mind symposium will be in Berlin Sept. 10-12.

Other speakers at the New Mexico symposium talked about ethics and cognition research, what is consciousness, research on brains of fruit flies, and cognition modeling.

Austerity

(Continued from page 1)

fund was in the mid-1980s. Favorable investment experience during the 1980s and 1990s eliminated the need to make contributions to the pension fund for more than 20 years. However, the benefit obligations of the pension fund continued to grow and current Sandia executive management decided to contribute an extra $25 million a year starting in 2008, with amounts continuing to escalate through 2012 to offset expected future required contributions. But additional amounts are now needed to lessen the need for still larger contributions later, says Matt.

"The liabilities of our pension plans increase by about 10 percent every year as employees earn additional pension benefits," he says, "but the expected investment return on our pension assets in most years is lower than the growth in benefits being earned. The pension fund will experience an investment loss for 2008 and somehow we must make adjustments."

The question is where those funds will come from.

Cost austerity is one answer.

Other options had more drawbacks, in the opinion of Sandia management. These options included additional contributions from NNSA, raising rates to customers, benefit reductions, mandated employee contributions to the pension plan, and changing the terms of the pension plan.

While all of these options are possibilities and the long-term solution may be some combination of them, management decided that a cost austerity program in which all Sandians will be asked to conserve resources is the right first step.

The program is major and could have an immediate and permanent effect on the culture in which Sandia's basic work is embedded.

Sandia's Cost Reduction Team, sniffing out savings by excising excess

Matt O'Brien, VP champion

Joe Polito
Kathleen McCaughey
Jeff Quintenz
Art Hale
Bonnie Apodaca
Jennifer Crooks
Carol Yarnall
Len Napolitano
Sid Gutierrez
Dori Ellis
Bruce Davis
Mike Maurer
Gary Zura
Bruce Criel

Cost austerity means discipline in spending, rigor in purchasing, and consciously determining to "do without."

"The call to all of us is to look at how we can reduce costs every day," says Bonnie. "Little things add up. We should be considering how to minimize utility usage, reduce unneeded space and return it to facilities, be selective on what travel is needed, reduce overtime pay, determine how to do Sandia's work with fewer people, and reduce the costs of procured items."

Such measures are expected to provide funds to contribute an additional $25 million to the pension fund in 2009. This will total $50 million this year when combined with the initial $25 million already planned.

Areas for potential savings

Specifically, the team working on this initiative has identified the following areas from which potential savings could be realized. (Since some of these will not help business development efforts or meet customer requirements, each division will determine what makes sense for their operations.)

- Consolidate senior manager, manager, and team supervisor positions, along with related support (average saved per division: approximately $1 million)
- Reduce travel by 10 percent.
- Reduce number of computers, servers, printers, licenses, etc.
- Reduce space used ($18/square foot on office space; the goal is greater than 90 percent utilization), remodels, utilities (turn things off, or set up sleep mode operations) [if all lights and equipment are turned off at night the laboratory will save $500,000 annually], etc.
- Reduce paid overtime 10 percent
- Reduce incidentals
- Reduce Just In Time purchases 10 percent
- Eliminate pet projects
- Reduce number of vehicles and carts
- Reduce duplicates on cell phones, pagers, and BlackBerrys
- Better manage Sandia-provided personal protective equipment (glasses, safety shoes)
- Eliminate/reduce coaches, nice-to-have contractors, contracts with former Sandians

Each division has been given a cost-cutting target amount that it must meet.

The team will work on more sustainable changes to implement beyond this fiscal year.

Says Matt, "Cost austerity is on the tip of the tongue and the top of the minds of Sandia's Laboratory Leadership Team all of the time. All areas of Sandia are looking for ways to contribute their share of the $25 million. In the Div. 10000 office we have stopped ordering bottled water, are using ceramic cups instead of ordering paper, shutting off lights in copy rooms and office spaces whenever unoccupied, consciously using existing supplies even if they aren't the exact brand or matching color we're accustomed to, and giving up unused facility space."

Cost reductions mandated from all divisions in FY09:

Div. 0000	$500K	Div. 6000	3,000K
Div. 1000	4,400K	Div. 8000	2,900K
Div. 2000	3,200K	Div. 9000	1,300K
Div. 3000	500K	Div. 10000	1,600K
Div. 4000	1,900K	Div. 11000	100K
Div. 5000	4,800K	Div. 12000	800K

According to figures from Sandia's Energy Management Program (www-irn.sandia.gov/facilities/energymgt), turning off a computer overnight and on weekends can save $100 in energy bills a year.

"Multiply that by 10,000 members of the workforce," says Kristin Flores, manager of Division Management Planning and Support Dept. 10601, "and you can see the impact that each individual can have in contributing to the pension and perpetuating a cost-austere approach to doing business. Sandia spends approximately $690,000 per year on copy paper. We could reduce that cost significantly if everyone began printing double-sided. These may seem like inconsequential things, but when you add them up across Sandia and the workforce, the potential savings are substantial."

"In summary," says Bonnie, "all programs at Sandia will contribute equally to the effort to become more spartan. Total budgets will not be impacted by the contributions, nor will deliverables be negatively impacted. All Sandia divisions will have ownership of cost savings through setting targets. Sandia will monitor our progress throughout the year.

"This is a proactive approach to finding efficiencies that can mitigate problems that might be caused by other options."

Targets (see box above) were set based on the amount of labor in each division. Since pension contributions are a portion of fringe costs, themselves a part of labor costs, targets set by labor are the fairest way of distributing target requirements, says Bonnie.

Just the same, she says, "The reality is that each Sandian is needed to engage in changing our culture and practicing cost austerity."

Sandia's impact on the state's economy put on display at summit

More than 200 business, education, and civic leaders attend first-ever event

By Chris Burroughs

More than 200 business, education, and civic leaders learned firsthand Jan. 22 about Sandia's impact on the state of New Mexico's economy during the Labs' first-ever Economic Impact Summit held at the Albuquerque Convention Center.

"The purpose of the summit was to make the greater Albuquerque business and civic communities aware of the economic impact Sandia has on the state, which is believed to be about three times the total amount it spends on purchases and salaries," says Don Devoti, manager of Sandia's Small Business Utilization Dept. 10222. "Most people attending the event already knew that Sandia plays a key role in New Mexico's economy. They just didn't know the extent."

At the event Labs officials — including Matt O'Brien, chief financial officer and VP of Business Operations Div. 10000, and Carol Yarnall, Supply Chain Management Center 10200 director — rolled out the new Sandia Economic Impact brochure, which outlined the full scope of the Labs' impact on the state's economy last year.

Carol informed the gathering of the importance of New Mexico community and business groups to Sandia's future.

"Sandia's suppliers are considered strategic partners, and this is the first of many venues the supply chain center will be sponsoring," she said.

Also on hand to provide insight to Sandia's economic effects on the community, all outlined in the brochure, were Karen Gillings, acting director of Human Resources Center 3500; Jackie Kerby Moore, manager of Sandia's Technology & Economic Development Dept. 1033; George Friberg, senior director of Technology Ventures Corp. (TVC); and Bruce McClure, manager of Sandia's Community Involvement Dept. 3652.

Among the information discussed at the summit and in the brochure are:

• Last fiscal year Sandia employed 9,137 regular and temporary employees including 8,158 at the New Mexico site.

BY THE NUMBERS — Karen Gillings, right, acting director of Human Resources Center 3500, discusses aspects of Sandia's economic impact on the community during the first-ever Sandia-sponsored Economic Impact Summit. With Karen on the dais are, from left, Jackie Kerby Moore, executive director of Sandia Science and Technology Park, Sandia Community Involvement Manager Bruce McClure, and Technology Ventures Corp. Senior Director George Friberg. (Photo by Randy Montoya)

• Sandia maintains a diverse workforce. At the New Mexico site, the FY08 workforce comprised 68 percent men, 32 percent women, and 30 percent minorities.

• Last year Sandia spent nearly $1.02 billion on labor and noncontract-related payments, nearly $71 million on procurement card purchases, more than $54 million on the New Mexico corporate tax, and nearly $987 million on contract-related payments. New Mexico businesses received 35 percent of Sandia's contract-related payments.

• Last year 57 percent of Sandia's payments on contracts went to small businesses, significantly exceeding Sandia's negotiated goal with NNSA of 48 percent. Here is a breakdown of Sandia's FY08 contract-related payments made to specific socioeconomic business categories in New Mexico:

- $59.7 million to women-owned small businesses
- $32.2 million to small disadvantaged businesses
- $12.1 million to veteran-owned small businesses
- $2.2 million to service disabled veteran-owned small businesses

• As of Oct.1, 28 organizations made the Sandia Science & Technology Park their home, employing 2,284 people in direct jobs. Total investment in the park exceeds $306 million. The average wage in the park is $70,400, compared to the Albuquerque metropolitan area average of $37,300 for a full-time job.

• In 2007 there were 315 small businesses participating in the New Mexico Small Business Assistance Program (NMSBA). The NMSBA program helps small businesses throughout the state. All participants receive technical support from Sandia.

• Sandia is the largest corporate contributor to the United Way of Central New Mexico, contributing more than $3.7 million in 2008. Also, Lockheed Martin, on behalf of Sandia, donated more than $1 million to nonprofit organizations in the community during FY08.

To obtain a copy of the brochure and for more information about Sandia's economic impact on the economy call 1-800-765-1678 or email supplier@sandia.gov.

Biorefinery in a plant

(Continued from page 1)

The potential of the extremophile organisms is well-understood, thanks to Sandia's research on using enzymes produced by *Sulfolobus solfataricus* as a means of breaking down lignocellulosic biomass (*Lab News*, June 12, 2007). But bringing organisms that exist only in harsh environments, such as sulfur cauldrons and hot springs, into living plants is not a natural fit.

Synthetic biology

This is where synthetic biology comes in: taking engineering design principles and applying them to the cellular structure of plants. "We're taking a circuit that doesn't necessarily ever exist in a tractable organism, putting it into a plant, and having that plant do something it couldn't do before," says Masood.

The goal is for the circuit to become part of the plant genome and be passed onto future generations through seeds. This is the Trojan Horse aspect to the project; the embedded circuits are, in a sense, stealthily brought into the plants where they lay dormant until activated by extreme heat.

Masood and his team are taking several approaches to the circuit construction — freely expressing the enzyme genes within the cell and targeting the genes to be near the complex carbohydrate material, minimizing mass transport and localization issues. Mary Bao Tran-Gyamfi (8621) and other Sandia microbiologists have developed constructs with different localization signals (kind of like zip codes) in different parts of the cell.

Two model plants

Initial work is being done on two model plants: *Arabidopsis*, a small flowering plant that is a member of the mustard family, and *Brachypodium distachyon*, a grass species related to the major cereal species (wheat, barley, oats, maize, rice, rye, sorghum, and millet). Using model systems in plants is akin to biological experiments with mice or fruit flies for translational research in humans: Model plants have well-understood genetics and are easy to transform, with small statures and short life cycles.

For help with the plant genetics side of the problem, Sandia is partnering with two scientists at the USDA's Western Regional Research Center (WRRC) in Albany, Calif. — James Thomson, a bacteriologist and *Arabidopsis* expert, and Roger Thilmony, a molecular biologist and *Brachypodium distachyon* expert. The WRRC is home to the Brachypodium Genome Resources Project.

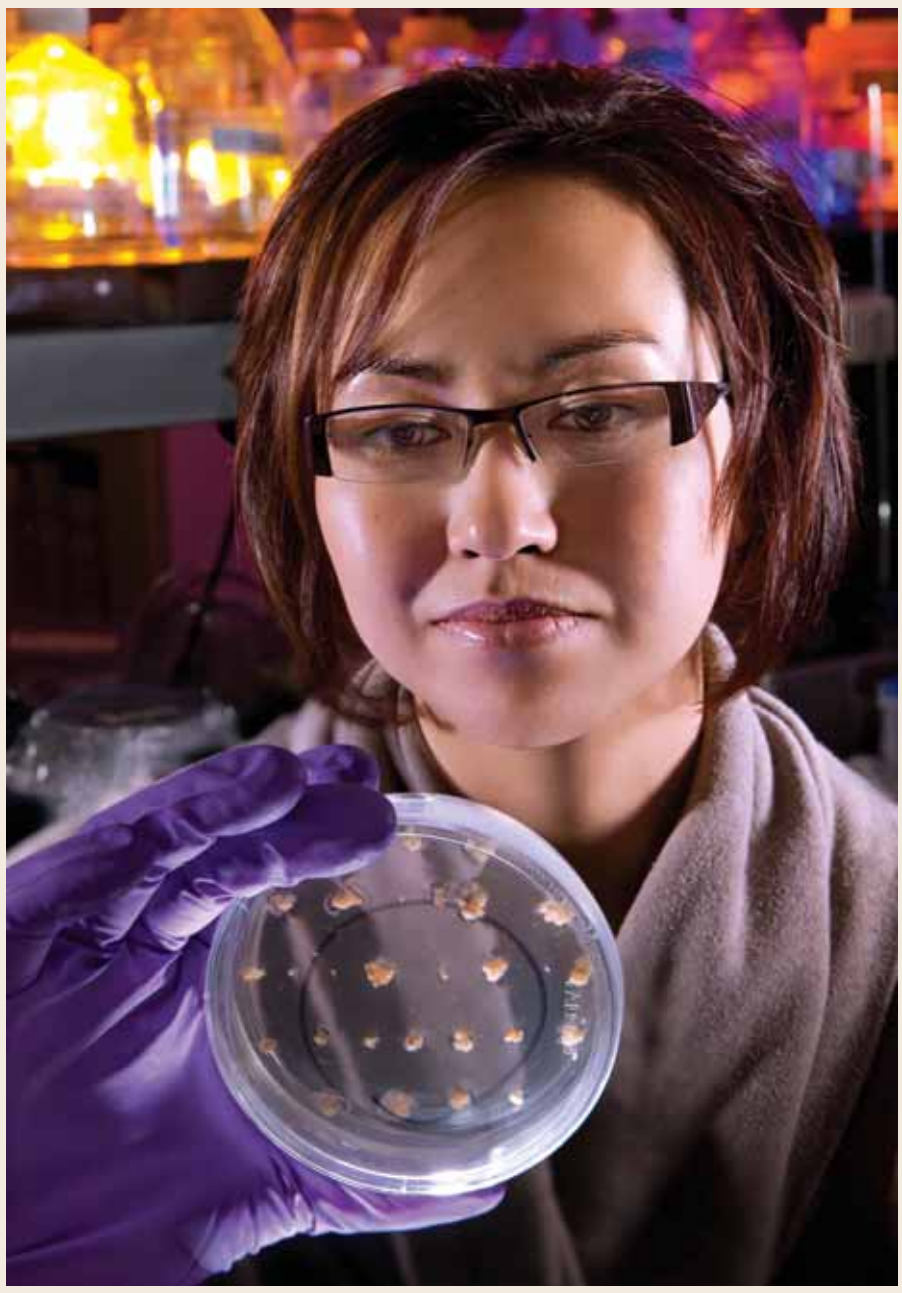
Thilmony and Thomson are now, through biotechnology tools, expressing these genes of interest, the engineered circuits, in the model plants. The process to grow plants with the genes will take five to six weeks with *Arabidopsis* and three to four months with *Brachypodium*.

Proof of concept

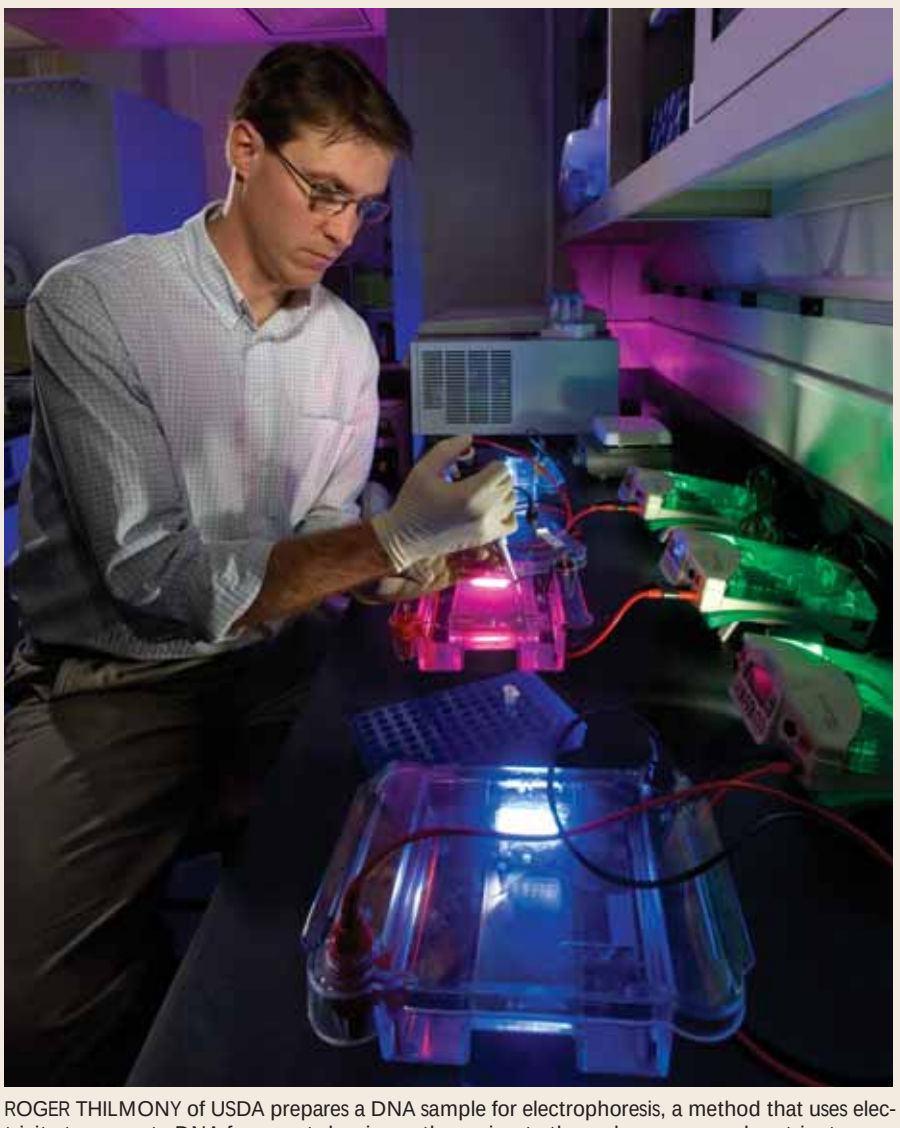
The USDA researchers already have successfully transformed onion cells as a proof of concept. Because onion cells are white and the genes are blue, it's quickly apparent if the transformation took place and the circuit worked in the plant cell.

Getting the genes into the plants is an amazing process. For *Arabidopsis*, Thomson creates an agrobacterium, to which he feeds the DNA encoding the circuit. Then he literally dips the plant flowers into the bacteria solution and the bacteria take it from there.

"The bacteria serve as a shuttle vector that takes the DNA into the plant — it does the hard work. We just wait a few weeks to see if the plant seeds are transformed as we hope," explains Thomson.



MORE THAN MEETS THE EYE — Sandia microbiologist Mary Bao Tran-Gyamfi (8621) examines precursor plant cells grown in tissue culture that have been genetically modified to include a gene for extremophile enzymes. This is the first step on the road to genetically optimized biofuel plants. (Photo by Randy Wong)



ROGER THILMONY of USDA prepares a DNA sample for electrophoresis, a method that uses electricity to separate DNA fragments by size as they migrate through a porous gel matrix, to confirm that plasmic vectors are being transformed into *Brachypodium*. (Photo by Randy Wong)

The process is more complicated with *Brachypodium*; the bacteria must be introduced to plant stem cells, but the general principle is the same.

Advanced imaging

Sandia is also drawing on its expertise in advanced imaging and analysis techniques developed by Jeri Timlin in Biomolecular Analysis and Imaging Dept. 8632. "Our techniques in hyperspectral fluorescence imaging with multivariate curve resolution enable researchers to remove the background of chlorophyll and locate the proteins of interest," she says.

Her work, along with that of colleagues Michael Sinclair and Ryan Davis (both 1816), helps Masood and other researchers see results quickly and clearly. This information is then used to modify and enhance future experiments.

If the circuits are successfully introduced into the model plants, the process will be repeated with dedicated biofuel plants such as switch grass, which is closely related to *Brachypodium*, and poplar, a close relative of *Arabidopsis*. "If we are successful in *Brachypodium*, I'm quite confident we can express the genes in switchgrass," says Thilmony.

In parallel, the researchers are also investigating rice straw as another potential dedicated biofuel. "About 50 percent of the world's protein comes from rice, but rice straw is discarded and even burned," says Blake Simmons (8655), manager of the energy systems group and the Trojan Horse project manager. "So we'd be making energy from something that typically goes to waste."

Not competing with food crops

This is an important point — the biofuel crops do not compete with agricultural crops used for human or even animal consumption, thus avoiding the "food versus fuel" debate. Another important point is that the synthetic biology is not being done on food-source plants. In other words, these aren't genetically engineered foods.

"With rice straw, this enzyme will not be expressed in the grain. It will only be in the stalks and leaves, which are not even used for livestock because the silica content is too high for any animal system consumption," says Masood.

Blake explains that in this three-year project, Sandia and USDA will not create a new class of dedicated energy crops that are ready for commercialization, but rather develop a method to make that possible. "Our goal is a system and technology demonstration that shows that we can put these extremophile enzymes into plants, activate upon a thermal trigger, and achieve hydrolysis of the polysaccharides into fermentable sugars," he says. "That would be a substantial impact to the community."

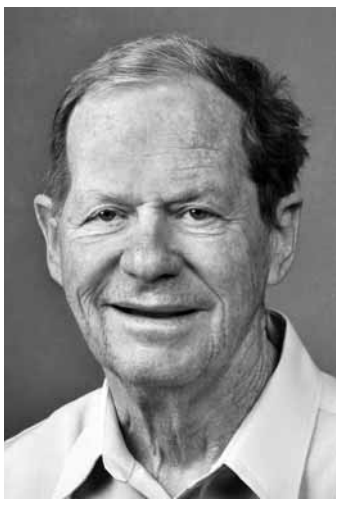
Sandia CaliforniaNews

Retired Sandian Arlin Cooper accepts recognition on behalf of weapon safety pioneers

By Bill Murphy

In the 60 years Sandia has been involved in nuclear weapons work, there is only one thing that has been more important than ensuring a weapon will function as designed if ever called upon to do so: that is, ensuring that it never detonates unintentionally under any conceivable set or combination of circumstances.

Among her last official acts, former US Rep. Heather Wilson, R-N.M., recognized and honored Sandia's accomplishments in nuclear weapons safety. As part of that recognition, she had two American flags that were flown over the US Capitol building at her request — a perquisite for members of Congress — presented to retired Sandia senior scientist Arlin Cooper. The flags, conveyed to Arlin by Jeff Brewer, were accompanied by a certificate noting Arlin's "tremendous contributions to ensuring the safety of nuclear weapons over a career spanning more than four decades." Arlin played a key role in development of the lightning arrestor connector and other weapon safety-related measures. He was presented with the flags during a celebration at Sandia in his honor.



ARLIN COOPER

While appreciative of the personal recognition, Arlin says he considers himself the representative of countless Sandians who contributed important efforts to the cause of weapon safety during the course of the Cold War and beyond.

"Significant achievements," Arlin says, "are usually achieved 'on the shoulders of giants,' and that was certainly true in our case." Also, he adds, "the value of collective synergistic efforts of team members working toward a common goal is undeniable."

Arlin cites the contributions of a talented team of managers — Bob Peurifoy, Jack Howard, Bill Stevens, Stan Spray, Herm Mauney, Rush Robinett, and George Rodgers (among others) — to Sandia's remarkable track record in the area of weapon safety. These key leaders, he says "demonstrate the value of management skills and persuasion in goal-oriented efforts. Most of us have also discovered the value of serendipity. All of these were factors in the nuclear safety program over the past 45 years."

The Lab News *asked Arlin to describe some of the work he and his colleagues were involved in, activities that proved to be essential to ensuring the safety of the nation's nuclear weapons. Here is his account of some of the areas where he made key contributions. (Note: Many of the individuals Arlin mentions in his account are retired; some still serve as Sandia contractors and some are still active Sandians. Also, Arlin talks here about only certain aspects of weapons safety; there are other elements of this complex challenge that aren't directly addressed here.)*

In the late 1950s and early 1960s, the Air Force — specifically the Air Force Weapons Laboratory — joined Sandia in electromagnetic theory research, which was to serve as a major foundation for much of our future electrical safety work. AFWL contributed personnel (e.g., Carl Baum), equipment (e.g., a Marx generator lightning simulator) and financial support.

At Sandia, Charles Harrison utilized Sandia and AFWL support to become one of the foremost electromagnetic theorists in the world, publishing hundreds of papers and books. Other contributors at Sandia during this period included David Merewether, Leonard Licking, George Schnetzer, Charles Vittitow, Frank Nielsen, and Mike Baumgartner. Our team, under George Rodgers' direction:

• Published a handbook, *Electromagnetic Pulse Handbook for Missiles and Aircraft in Flight*

• Designed a protective component, the lightning arrestor-connector (electrical surge-diverting connector, Patent no. 3,702,420, Nov.7, 1972) — now known as the LAC

• Began to interface with other component designs (e.g., stronglink safety switches)

At about this time, Jack Howard tasked Bill Stevens to organize an assessment of our nuclear weapon safety approaches and determine whether improvements were appropriate.

Bill instructed Stan Spray to assemble a core team. Among those Stan selected were Jay Grear, Gene Church, Wally Crammond, Dick Worrell, and later Curtis Mueller, John Covan, Ron Pedersen, and Marvin Morris.

The team developed or applied a number of tools that could be used in nuclear safety analysis, including state-of-the-art fault-tree and event-tree software, Latin Hypercube Sampling strategies, and probabilistic analysis metrics. Later on, cutting-edge analysis approaches (e.g., fuzzy and possibilistic mathematics) were derived to incorporate subjective inputs coordinated with objective information.

Serendipity and first principles

An unexpected dose of serendipity led to the invention of the LAC. Here's how it happened: One of our 60s-era safety tasks was to test electronic component response to lightning striking missiles. We did this by applying Marx-generator simulated lightning through a missile connector. The results caught us by surprise: Most of the energy arced from the connector to the missile skin. This was interesting. We asked ourselves what the implications of this unexpected protection might be if a more principle-based component were designed to protect against actual lightning. Could this protection approach the standards necessary for nuclear weapon safety?

The basic functionality chosen was "surface-arc response" in various forms, which greatly enhances the accidental arcing we observed in the field tests.

Another dose of serendipity may have led to the "first principles" — isolation, inoperability, incompatibility — that are basic to our safety implementations. These principles are considered inarguable, which is necessary to ensure desired component response. The approach is known as ENDS (enhanced nuclear detonation safety).

Many analysts were working on techniques to measure safety by metrics such as conductor separation, when Stan's team decided to test these theories with actual high-level voltage threats. The basic result was that it was surprisingly easy to bypass the presumed protective measures. It then became obvious to the team that a first-principle-based approach would be required.

The approach is to isolate a critical explosive by surrounding it with an "isolation" barrier, colocating "inoperability" features in recognition that the barrier can be caused to fail, and conveying intent to use the explosive by virtue of an unambiguous Unique Signal, a specifically engineered pattern of bivalued "events" communicated in a carefully chosen, separate-event, manner.

Weapons safety work is about more than weapons

Note: *Sandia's work in ensuring the safety of nuclear weapons has led to important applications and developments in safety areas far afield from weapons themselves. Arlin Cooper, the retired Sandia senior scientist recently honored by former US Rep. Heather Wilson for his contributions to weapon safety, recounts some of the other applications of Sandia's groundbreaking safety work.*

• **Training**

In the early 1980s, it became obvious that courses being taught around the country could benefit from the lessons we were learning in our safety activities. Stan Spray, with the support of Dick Schwoebel, who was director of Safety Assessment, and Dick Brodie initiated interactions with other training and conference activities, publications, and initiated a "National Surety Training" (NST) program, which continues to grow and strengthen today under the tutelage of Janet Philippsen (2916).

• **Information retrieval**

"Lessons learned" were becoming so important that Stan, assisted by Debra Buttry (10694), Tonimarie Dudley (10660), Diana Gonzales (12334), and others, developed an automated information retrieval system (known as the National Surety Information Center, or NSIC).

• **Emergency response**

The only feature lacking at that time (mid-1990s) seemed to be response to accidents, so an emergency response activity was initiated and is still active.

• **Spin-off applications**

"Commercial" unique signal patterns: Because of the success of the first-principles safety approach, there were numerous requests to emulate it in other applications. To assist in some of these efforts, we designed "commercial" unique signal patterns that could be used in other applications without interfering with our mainstream safety application. Variations of the LAC were also licensed for commercial use.

• **Management use of unique signal methodology**

In an interesting application of unique signal processing, Rush Robinett, now acting director of Center 6300, suggested an adaptive management unique signal strategy that led to a series of widely popular conference papers and articles in *The System Safety Journal* in 2005.

• **Aircraft algorithm analysis**

An important skill we learned in investigating our interfaces with missiles and aircraft was to trace communications of various forms through algorithm analysis. This led to system-wide safety improvements. A similar activity helped improve a software-controlled rail transportation system.

KAFB, NNSA/SSO, Sandia sign energy proclamation

Sandia President and Labs Director Tom Hunter, left, NNSA Sandia Site Office acting manager Kim Davis, and 377th Air Base Wing Commander Mike Duvall display the energy conservation proclamation they signed Jan. 14 on behalf of their respective organizations. The proclamation reads, in part, "As members of the Department of Defense and the Department of Energy, we are the guardians of many our nation's precious resources, including energy. As good citizens and stewards, we must remain vigilant to apply our natural resources for the maximum impact while demonstrating leadership in preservation and reducing consumption. . . . We charge every member of the Kirtland community to ensure our mission success by minimizing energy use and reducing waste at every opportunity. Together we will secure America's future."

(Photo by Randy Montoya)

A ride to Trinity

OPPIE'S RIDE —This 1941 Packard Clipper, extensively modified, carried J. Robert Oppenheimer and others to the Trinity test in 1945.

By Iris Aboytes

It has served its nation well, but its only reward is knowing it holds secrets that guaranteed our freedom. Left to rust and decay in a junkyard in Grants, N.M., the 1941 Packard Clipper that transported senior scientists such as Manhattan Project Director J. Robert Oppenheimer was destined to end up as scrap metal. But other events have ensured its place in history. The car was recently acquired by the National Atomic Museum and is being restored.

The museum commemorated the 60th anniversary of the Trinity Test in 2005 and invited a number of 1940s era antique car collectors to display cars at the museum.

"We learned of a military vehicle collector in our community who had acquired this car," says museum director Jim Walther. "We believed it to be the Oppenheimer car. The car was in extremely poor condition and the collector was not interested in it. He is primarily a collector of military tracked vehicles like tanks. We contacted the person and were able to see the car. We shared our desire for it. He donated it to us for restoration."

The 1941 Packard Clipper is a specially prepared limousine acquired for government use. It was modified that same year by the Fitzjohn Coach Company of Chicago, Ill. Several bench seats and doors were added. It was painted mil-spec green. Because it was a rush job, the additional length was achieved by using wood framing and masonite skin (a pressed board product). "It is absolutely huge," says Jim. "It is almost 25 feet long. It is bigger than the biggest SUV found on today's roads."

Once the car was acquired, the job of restoration began. Special Effects Restoration of Albuquerque has been restoring the car. A parts car was located in New England through an Internet search and shipped to New Mexico. From that car they took the drive train, brake, and trim components. Special Effects has restored the car including replacement of the badly deteriorated seats and wooden structure. Some 250 board feet of high-quality ash have been put into the car. The car will probably weigh about 7,000 pounds when it is complete.

After decades of neglect and deterioration the Packard's historical significance was ultimately realized and now the vehicle has been given the opportunity to assume its position among many important artifacts that help tell the story of the Manhattan Project.

"We hope to have the car completely restored by the opening of the National Museum of Nuclear Science & history on April 4," says Jim.

Visitors can view the work in progress Feb. 7, 1-3:30 p.m., at 901 2nd St. NW. Parking is available across the street. Refreshments will be served. Although viewing is free, the National Atomic Museum Foundation, a 501(c)(3) nonprofit, will accept contributions towards the restoration.

"This is a tremendously significant part of our New Mexico history and a unique component of the Manhattan Project era," says Jim. "We are very fortunate to be able to offer this to our visitors. One can only imagine what problems were solved in those seats."

Defendemos Nuestra Tierra — We defend our land

By Iris Aboytes

"I knew I wanted to start with the beautiful New Mexico sunset," says Emilee Sena, daughter of Sandian Pat Sena (2110), of her winning design of the crest for the USS *New Mexico*, SSN 779, the newest Virginia-class Fast Attack submarine. "The sunset represents the beauty that makes New Mexico the Land of Enchantment."

EMILEE SENA proudly displays the winning design for the crest of the USS *New Mexico*.

A total of 180 entries were submitted to the crest design contest by New Mexico students. Emilee's entry was an oil painting. The crew of the USS *New Mexico* selected the winning entry. She was notified that she won two days before Thanksgiving in 2006.

"It makes me happy to see that my love of art, which is an important part of me, is forever part of the submarine and the United States Navy," says Emilee. "I'm glad that I have been able to contribute in my own way and will always be connected to something so great. I strongly admire our military and their willingness to defend our freedom."

Emilee learned about the contest to design the crest of the USS *New Mexico*, sponsored by the New Mexico Council of the Navy League of the United States, when she was asked in the summer of 2006 to help classmates create a DVD presentation to promote the contest. She thought it would be fun to come up with an entry herself. Emily is currently a sophomore at Santa Clara University in California.

Emilee knew she wanted to incorporate the rich cultures of New Mexico. She designed the outer crest in the shape of a design commonly found in Native American blankets and pottery. She included the Sandia Mountains at sunset in the color that demonstrates why they are named the Sandias.

"My dad always wears caps that have Navy insignias on them, even though he was never in the Navy." says Emilee. "It was my grandfather who was in the Navy." That connection made it easy for her to design the Navy dolphins flanking a submarine. On top of the submarine sail she painted an American flag. "I had seen a photo of submariners standing on top of a submarine, waving an American flag, and I liked that idea because it said to me, 'We are proud to be Americans, and we will always defend our home,'" says Emily.

She included the Zia in the upper right to represent the state flag as well as the prominence of the sun in New Mexico. The atom symbol she included represents the nuclear research that has been done in the state that is home to Los Alamos and Sandia national laboratories. In addition, Virginia-class subs are nuclear submarines.

The roadrunner was not in her original design. It was added at the request of the USS *New Mexico* crew. She believes it symbolizes speed and the ability to swiftly kill its prey. The stars were added later to honor the ship itself.

"I love New Mexico. I knew what details I wanted to include before I started the design. I included what I love most — the sunsets, mountains, and culture," says Emilee. "Arranging the different components and choosing the overall shape are what took more time. The colors, however, I thought about more carefully. I researched the meaning of different colors. This was important to me, because as an artist I know that colors can be used for symbolism, and I like to place a deeper meaning in my work. I chose colors to represent the values that the Navy upholds. Purity and innocence are represented by white. Gold represents courage, confidence, and wisdom. Blue symbolizes justice. The red represents the red in our nation's flag, symbolizing valor and the blood that has been shed to protect our country."

Emilee's design was complete when she added the motto. "I am not completely sure how I arrived at it," she says. "I knew it needed to be in Spanish because that is so prevalent here and being from a Spanish family, the Spanish language, even if I am not fluent, is a part of me." So the crowning touch became — *Defendemos Nuestra Tierra* (We defend our land.) "For New Mexicans, the land, or *tierra*, is like life, to be loved and protected," says Emilee.

Emilee, her sister Christa, and her parents were at the christening of the USS *New Mexico* in December. "I liked seeing the traditions that the Navy upholds," she says. "The speeches given by Cindy Giambastiani, the ship's sponsor and wife of retired Navy Adm. Edmund Giambastiani, who served as the seventh vice chairman of the Joint Chiefs of Staff, and former Rep. Heather Wilson were amazing. What stood out to me the most was Mrs. Giambastiani's recognition of military spouses and families because they contribute to our nation's defense by supporting their family members who are in the military. I had never thought of it that way before and was immediately proud of them, too, for what they do."

Emilee's oil painting has been framed and will be displayed for the life of the USS *New Mexico*.

USS New Mexico ***SSN 779***

(Photo courtesy US Navy)

The USS *New Mexico* was built by a joint agreement between General Dynamics Electric Boat and Northrop Grumman Newport News. The $2.7 billion submarine has one million parts and 140 shipboard systems. Placed in the University of New Mexico football stadium, the USS *New Mexico* would completely fill the field and both end zones. Her bow would protrude 10 feet beyond the northern goalpost and her stern would be seven feet beyond the southern goalpost. It is 377 feet long.

The shiny bow dome houses a spherical sonar array. Tomahawk missiles will someday pass through the open hatches of the vertical launch tubes in the forward ballast tank. The USS *New Mexico* is on schedule for sea trials in July and for delivery in August, eight months early, and on budget. When the *New Mexico* is commissioned into the fleet in October, it will be the most technologically advanced submarine in the world.