Sandia creates mechanized microfluidic device

Pac-Man-like microstructure interacts with red blood cells

By Neal Singer

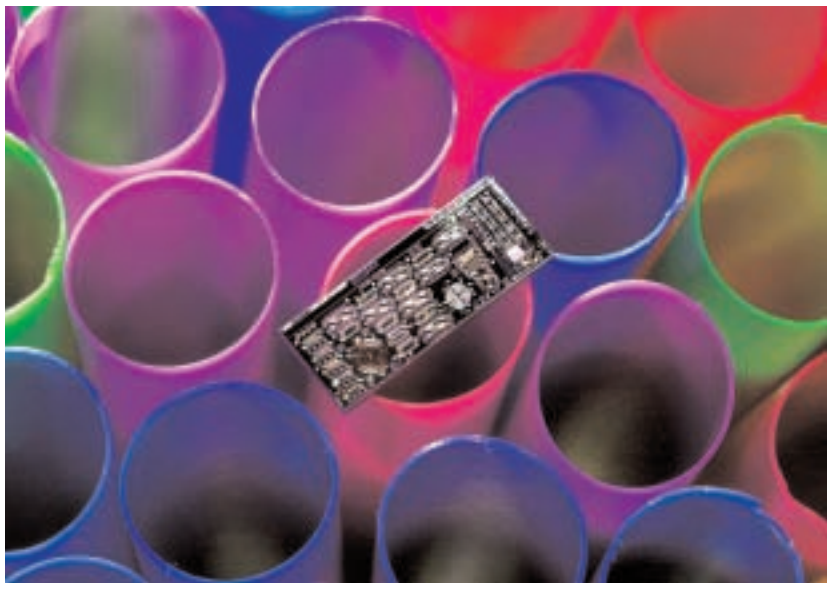
Inexpensive silicon microteeth that open and close like jaws to harmlessly deform red blood cells have been developed at Sandia.

The patent-pending microdevices, because of their constant munching, bear a strong resemblance to the computer game hero Pac-Man as their upper teeth slide back and forth in piston-like action across microchannels to momentarily trap unaware red blood cells against the lower teeth.

"We've shown we've created a micromachine that can interact at the scale of cells," says Sandia researcher Murat Okandan (1749).

The capability could add an extra tool to the growing capabilities of microfluidic devices, a billion-dollar industry. Microfluidic devices typically are limited in capabilities to examination of materials. But, says Murat, "We're trying to create conditions in which, on a massive scale, cells may be altered as well as examined."

The prototype device offers the possibility of considerable mechanical intervention at the cellular level because it operates rapidly and is so small that many units could operate in parallel in a small space. Ten complete units can fit in an area smaller than a household electric plug prong, and each microdevice can puncture 10 cells per second.



WATCH WHAT YOU'RE SIPPING! — Eight separate cell-altering devices fit on the tiny module resting, to provide scale, on these 1/4-inch-diameter soda straw ends. (Photo by Randy Montoya)

An immediate goal of Murat, who developed the device with Paul Galambos, Sita Mani, and Jay Jakubczak (all 1749), is to see whether the masticated red blood cells absorb fluorescent material.

If the material is readily absorbed, it means that Sandia researchers have created the first example of a continuous flow, mechanical cellular-membrane disrupter ever reported.

Enter, the needle

A near-time goal is to replace the microteeth with a hollow silicon needle now in development. The needles would rapidly inject DNA, RNA, or proteins (including drug molecules) into living cells at precise points of their anatomies and in large numbers, possibly changing the course of a disease or restoring lost functions.

Even if punctures have not occurred, "We've created a demonstration tool with very flexible technology that we hope will enable many designs and concepts," says Murat. "This device itself may generate considerable interest from the agriculture or genetic engineering marketplaces."

The cells punctured do not need to be blood cells but could be, say, stem cells — cells able to change, given suitable direction — possibly by gene implantation — into many of the tissues of the human body, says Murat.

In terms of the number of living cells altered, the method potentially compares favorably with electrical or chemical techniques used to open

(Continued on page 5)

SAR tests

McIntosh, N.M., may have looked like World War III with 17 different military vehicles spread over a 160-acre area. But it was really a test of a sophisticated Sandia-developed synthetic aperture radar. Read about the test on **pages 6-7.**

Sandia LabNews

Vol. 53, No. 13 June 29, 2001

Sandia National Laboratories

Sandia researchers helping define technology for tomorrow's nuclear power plants

R&D budgets are small, but ideas — and prospects — are big

By John German

To envision the nuclear power plant of tomorrow, just look at the 103 plants operating in the US today.

Owners of current plants are petitioning the Nuclear Regulatory Commission (NRC) either to extend their current operating licenses by 20 years or to add capacity to existing plant sites.

"It can take 10 years or more to build a plant, and no utility has requested a new plant for two decades," says Paul Pickard, Manager of Advanced Nuclear Concepts Dept. 6424. "Although significant operational improvements have been made, basic nuclear energy technology hasn't advanced much since the 1970s."

So for the next 10 to 20 years, he says, proposed new nuclear power plants are likely to look like advanced versions of today's water-cooled designs, with significant engineering and safety improvements. Other new plants could be adaptations of designs drawn up during the 1970s and '80s, such as gas-cooled pebble bed reactors.

Despite the lack of progress on the construction front, Sandia's behind-the-scenes R&D programs in nuclear power safety and advanced reactor technology are improving how today's nuclear power plants operate and helping define what plants might look like 25, 50, and 100 years from now.

New reactor concepts

"For the first time in more than a decade, significant research on new reactor concepts is beginning," says Tom Blejwas, Director of Nuclear and Risk Technologies Center 6400. "Fortunately, at Sandia we've kept our research capabilities alive primarily through continuing work in reactor safety for the NRC.

"Also, with the support of some Sandia VPs, about two years ago we began focusing our program development efforts on a rebirth of nuclear energy, and, consequently, we are well positioned for the next nuclear era," he says. "So the mere discussion of new nuclear power plant construction is exciting for us."

The first signs of new opportunities for Sandia have been small programs supported by Sen. Pete Domenici and sponsored by DOE's Nuclear Energy Research Initiative (NERI), as well as power plant optimization studies under DOE's Nuclear Energy Plant Optimization Program, says Tom. Sandia is participating in these growing programs while continuing its traditional reactor safety work, he says.

Understanding safety issues

The ongoing research in nuclear power plant safety, funded primarily by the NRC, provides experimental data to help regulators and operators predict and understand failures in contain-

(Continued on page 4)

Bingaman on nuclear energy

Sen. Jeff Bingaman, who earlier this month became chairman of the Senate's Energy and Natural Resources Committee, shared his thoughts about nuclear energy and other energy- and Sandia-related matters during an exclusive interview with the *Lab News*. Read about Bingaman's views on these subjects in the **page 9** story by Bill Murphy.

This & That

Bingaman talks nuclear energy — Sen. Jeff Bingaman's already busy schedule got lots busier last month when he became chairman of the Senate Energy and Natural Resources Committee, so we especially appreciate his finding time recently to talk with *Lab News* reporter Bill Murphy for our continuing series on nuclear energy and about some broader energy issues (see page nine). We featured nuclear energy views of New Mexico's other US Senator, Pete Domenici, in the June 15 issue. (Our thanks to Gloria Zamora, Manager of Government Relations Dept. 12123, for helping arrange the interviews with Sens. Bingaman and Domenici.)

Both New Mexico senators are on the Energy and Natural Resources Committee, and New Mexico is unique in this regard. Sen. Dianne Feinstein of California is also a member. None is there primarily to promote Sandia and its energy programs, but it sure can't hurt.

* * *

Well positioned — Sandia is well positioned for the next nuclear energy era, says Tom Blejwas, Director of Nuclear and Risk Technologies Center 6400, in a page-one article. Although Sandia hasn't "made much noise" about its nuclear energy programs in the past few years, it's evident from reading John German's article that several savvy Sandians had the foresight to keep working hard to retain and build the Labs' expertise and reputation in nuclear energy during a long "down" period. "For the first time in more than a decade, significant research on new reactor concepts is beginning," Tom says, and it's evident that he and those other savvy Sandians are making plans to participate. Interesting.

* * *

His cup runneth late — Speaking of John German, he reports one of the gasoline stations outside our Wyoming Blvd. gate evidently got a real deal on some soft drink cups. When he bought a soda there recently, he noticed the cup had a promotional sticker on it for a free admission to the New Mexico State Fair ... to the *1994* New Mexico State Fair.

* * *

Anyone have a manager a year? — Given Sandia's propensity for change, Stan Kawka (2345) thinks he may have the dubious distinction of having the most managers in the fewest years, but we'll try to find out for sure. Depending on how you count 'em, Stan has had either 16 or 21 managers in his 23 years at the Labs; it's 21 counting four acting managers and one person twice who was his manager at two different times. Can anyone top Stan, either way?

* * *

Name games — I enjoy unusual names and was thinking recently about two favorite businesses I've come across over the years: the "First National Bar" and a cheesy little motel I saw 10 years ago in Texas, the "It'll Do Inn" (now there's honesty, folks). Because Sandians hail from so many places and travel a lot, I hope you'll share with me similarly entertaining business names you've come across. If you'll send them to me, I'll share the best ones with readers.

— Larry Perrine (845-8511, MS 0165, lgperri@sandia.gov)

Sandia LabNews

Sandia National Laboratories

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LOCKHEED MARTIN

Kent Biringer elected ASME Fellow

Kent Biringer of Internal Security Initiatives Dept. 5324 has been elected to the grade of Fellow in the American Society of Mechanical Engineers (ASME).

The Fellow grade is the highest elected grade of membership within ASME, the attainment of which recognizes exceptional engineering achievements and contributions to the engineering profession.

Kent's career has involved research, analysis and project management, primarily at Sandia. His work includes photovoltaic system development, geotechnical analysis of Strategic Petroleum Reserve storage caverns, and systems studies of missile defense, US transportation infrastructure, manned space exploration, and conventional and nuclear arms control. Since 1993 he has helped establish and direct programs at Sandia's Cooperative Monitoring Center (CMC).

The CMC applies monitoring technologies to international security agreements in support of national nonproliferation and arms control objectives.

Kent is a Distinguished Member of the Technical Staff, has authored more than 30 papers, and is a registered professional engineer in New Mexico.

ASME is a 125,000-member worldwide engineering society focused on technical, educational, and research issues. It sets many industrial and manufacturing standards.

Labs' news conference attracts politicos and press in Washington

By Neal Singer

Fidgeting is not all bad. An audience at a Sandia-supported Washington, D.C., press conference, held June 13, learned it can save life and limb.

For the benefit of reporters, congressional staffers, and representatives of various US agencies that filled a cavernous Senate caucus room, a series of speakers that included US Sen. Pete Domenici, NNSA chief John Gordon, Sandia Executive VP Joan Woodard, quadriplegic former jockey Willie Shoemaker, and Joseph Alioto, founder of the Paralysis Project of America, celebrated the signing of an agreement that would ultimately use California dreaming, New York money, Russian materials, and Sandia electronics expertise, knit together by a Washington bureaucracy at its best.

The agreement should benefit humanity in the form of an affordable wheelchair seat that, by the motion of its internal pistons, generates motion in users and forces improved blood circulation. This new feature should allow many patients otherwise condemned to spend their lives isolated in hospital beds to become mobile, active, wide-ranging citizens. (See earlier story, *Lab News*, May 18.)

The limbs and lives of paralyzed patients or those who lack sensory input are threatened by ulcerous sores that grow when lack of motion – in effect, a lack of fidgeting — causes blood flow to diminish. The high pressure on bony prominences creates sores that typically require surgical skin grafts resulting in patients being confined in prone positions in bed for long periods of time and require intensive nursing care. The clinical application of the Total Contact Seat produced by Numotech — a California-based company, specializing in medical innovation, partnering with Sandia — heals patients without surgery. With Sandia miniaturizing components and incorporating electronics to assure safe seat operations, a fully mobile seat suitable for daily use has been prototyped that helps prevent sores from even forming.

Ordinarily, an agreement that hinges on signing an IPP CRADA — a cooperative research and development agreement under the aegis of the Initiatives for Proliferation Prevention program — to possibly produce a working, saleable device is not big news. However, because this is one of the first manufacturing challenges to be worked with Russian engineers and scientists coming out of Russian nuclear weapons laboratories, publications as varied as the *Washington Post*, *Design News*, *Inside Energy*, *Federal Technology Report*, and *Popular Science*, were either present, or expressed interest or a definite intent to write up the event.

Other attendees included staff members of congressional committees as well as representatives of a variety of Washington agencies.

Employee death

DAN FENSTERMACHER

Long-time Sandian Dan Fenstermacher of Hot Cells and Gamma Facilities Dept. 6432 died after a heart attack June 20.

He was 59 years old.

Dan was a member of the technical staff and had been at Sandia since 1967.

He is survived by his wife Joyce and daughters Lisa Fenstermacher and Rhonda Beltran.

Sympathy

To Fredrico Mora (9334) on the death of his brother, Manuel Mora, of Albuquerque, June 15.

Sandia interns begin to research wireless networks

Institute explores how devices might sense, talk, think, and act

By Nancy Garcia

Participants in the Embedded Reasoning Institute have seen the future, and that future is wireless.

Six upper-division students have begun a summer internship in the new institute to explore wireless networks of computers so small, they can be "worn" as easily as a cell phone or personal data assistant, or PDA, (such as a Palm Pilot). The students will investigate design and development of these small, computerized embedded systems connected by wireless networks.

People also talk about "smart" appliances, such as a refrigerator that knows when the milk is running low. . . .

The research includes work on the wireless hardware as well as development of software that uses artificial intelligence features to learn and reach decisions.

"The students are really excited about it," says Christine Yang (8920), who coordinates the institute. Fellow mentors are Rob Armstrong (8920), Nina Berry (8920), Carmen Pancerella (8920), and Ron Kyker (8411). "This is a growing field," Christine continues. For instance, there is a new publication dedicated to open source embedded solutions, the *Embedded Linux Journal*. Embedded systems are already offered in some cell phones, in which incorporation of global positioning systems allows the service provider to send emergency roadside assistance, even if the caller is lost.

Smart appliances, wearable computers

People also talk about "smart" appliances, such as a refrigerator that knows when the milk is running low, or a snack machine that recognizes it needs to stock up on corn chips. National security applications of these emerging technologies might include using wireless networks to gather information on sensors in flight tests.

In the interdisciplinary, upper-division summer institute, the students are working on very basic frameworks for computer-based situational understanding, Christine says. The Tiqit computer, developed at the Stanford Wearable Computing Laboratory, is being used as an example of a potential platform. Roughly as powerful as a desktop computer (although not as quick), it fits in the palm of a hand and can display to a monitor, provide access to the Internet, and support a World Wide Web server. The students' fields range from electrical engineering to computer science, so that as a group, they can address hardware and software or integration issues, Nina says.

Howard Hirano (16000) of the Advanced Concepts Group and Carmen have already briefed the students on a proposed device that will monitor a wearer's health-and-safety status. Dubbed "My Friend," this computerized device, integrating both hardware and software, could track physiological measures such as pulse and heart rate, recognizing when the wearer (or health provider) should be aware that the wearer's physiological condition warrants attention.

STUDENT ERIC BURNS (8920) shows the Tiqit computer platform and a "heads-up" monitor display that projects text onto the eye. Eric is a computer engineering student at Rutgers University. (Photo by Lynda Hadley)

Ron will be briefing the interns on Bluetooth, an emerging new wireless technology that permits creation of networks between different devices, say, between a cell phone, a PDA, and a computer. The group will be developing a wireless distributed sensor network for collecting health sensor data using this new hardware/software standard.

"Bluetooth, initially developed by the Swedish cell phone company Ericsson, is an exciting and enabling technology for many new applications." Ron says, "and we're going to play with it and find out what it can do."

Graduate students Katie Moor and Pippin Wolfe (both 8920), who are returning for their second summer at Sandia, along with graduate student Brian Lambert (8920), are looking at capturing and analyzing data from a fingertip oxygen sensor typically used in diagnostic monitoring. (Both sensors and a microprocessor could be wirelessly networked on the individual wearing them in a "personal area network.")

Three college-level students are also in the program this summer: Eric Burns, Stephen Elliott, and Chris Kershaw (all 8920). Working alongside them is Hillary Davis (8920), a student who is entering her senior year of high school and participated in the Sandia Go Figure math contest. She was also an outstanding achievement winner this year in the Sandia Women's Committee Math/Science Awards.

The interdisciplinary approach is intended to provide an R&D incubator so students can combine skills to produce solutions to a collection of innovative projects provided by their Sandia mentors.

For instance, Nina has a particular interest in artificial intelligence, software that learns and can function through the activity of programmed entities called agents.

"There's an exciting potential for software advancements using artificial intelligence techniques like neural networks and agent-based networks to recognize abnormalities and patterns for sensor interpretation," Nina says. "We want to ask, "What kind of intelligence can we add to this reasoning?"

The culmination of these summer activities will be the establishment of future projects in sensor and IT (information technology) research that will attract potential employees for Sandia's future.

Recent Retiree

Evelyn Chaney
15 2265

Sandia CaliforniaNews

Recent Patents

Gilbert Benavides and Lothar Bieg (both 14184): Double Slotted Socket Spherical Joint.

John Gieske (9122), Dennis Roach (6252), and Phillip Walkington (6252): Improved Ultrasonic Inspection Apparatus and Method Using a Focused Wave Device.

Nuclear power

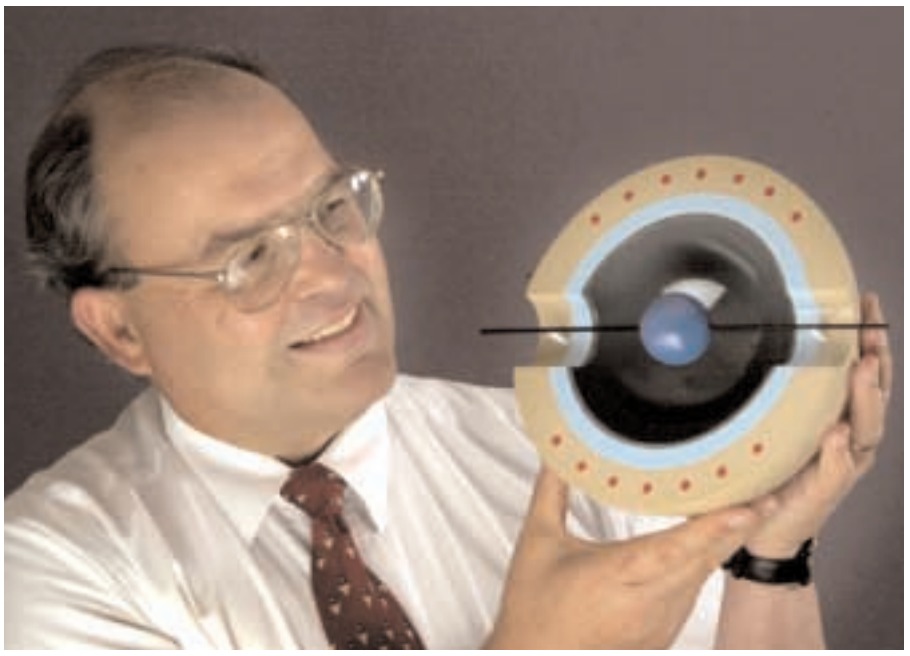
(Continued from page 1)

ment vessels as well as computer modeling tools such as the MELCOR software developed at Sandia now in use around the world. (For more information, see www.sandia.gov/media/NewsRel/NR2000/pccvtest.htm, www.sandia.gov/media/NewsRel/NR2000/vessel.htm, and www.sandia.gov/media/NewsRel/NR2000/melcor.htm.)

Such reactor safety research could become increasingly important as aging takes its toll on older recertified power plants originally licensed for 40 years, and as the nation explores alternative reactor designs, says Paul.

NERI-funded research at Sandia, for example, is seeking to create self-diagnosing plant equipment that helps operators, with the aid of sensors and software modeling tools, predict how and when components such as valves, cables, and concrete might fail. (Contact: Felicia Duran, 6410)

(Programs involving shipping container performance, spent fuel storage, seismic analysis, fire risk assessments, risk-informed regulatory processes, and other technology areas also have contributed to the Labs' continued nuclear energy programs. Many of these contributions will be covered in future *Lab News* articles.)



FISSION BATTERY — Gary Rochau holds a large-scale cutaway model of what a Magnetically Insulated Fission Electric Cell might look like. High-intensity magnetic fields near the fissioning cathode (center) trap electrons, allowing the more massive positively charged heavy atoms from the fission reaction to reach the anode and deposit their charges. Such a "fission battery" is among a handful of Direct Energy Conversion approaches being explored by Sandia. (Photo by Randy Montoya)

Reducing investment risk

Meanwhile, interest in the US for new nuclear power plants is growing. But potential investors are wary of the high level of uncertainty and investment risk associated with plant construction.

Sandia is part of a multi-agency team looking for ways to reduce the risk of building new plants. The three-year project is funded by NERI and led by Duke Engineering.

Each plant is different, so regulatory certifications are tedious and unpredictable and can cause costly labor standdowns and procurement delays, says Gary Rochau, Manager of Modeling & Analysis Dept. 6415.

Sandia's role in the NERI project is to identify the leading risk factors that cause uncertainties in new plant design, procurement, construction, installation, and evaluation, then develop software analysis tools that help plant designers reduce the uncertainties.

"A tool could tell investors whether to expect a capital cost of $1 billion plus or minus a few million rather than $1 billion plus $1 billion or minus $100,000," says Gary. "It's taking a systems-level look at project management and finding ways to reduce risk, reduce cost, and reduce the time it takes to get a new plant on line."

Designing by analysis

So far the Sandia team has identified some important risk factors and has defined a method to put those factors into a software tool that will model the complicated set of considerations that determine risk.

Such a tool may help plan a construction project so that the regulatory issues are resolved before construction workers arrive, says Gary, or set up the procurement schedule so that pre-certified parts are delivered from the factory to the site. It could lend credibility to the notion that plant designs be modularized or standardized so they're alike from a regulatory standpoint, or to help choose one design over another.

"Software tools could tell us whether and by how much these changes would reduce time, cost, and risk," he says.

Another NERI project team led by Vince Luk (6420) has begun to develop a software tool that will model the physics of reactor pressure vessel designs. It is the first step toward a "design by analysis" approach that could one day speed up regulatory certifications for new plant designs, says Gary.

Defining the future plant

But investors in the next generation of newly designed nuclear power plants, perhaps 30 to 50 years out, envision utopian plants that meet several general criteria: inherent or passive safety, proliferation resistance, high efficiencies, long fuel burn times, minimized waste streams, multiple uses, and fuel sustainability. (See "High ideals for future nuclear power plants" at left.)

High efficiency metal- or gas-cooled reactors, pebble bed reactors, and breeder reactors — such as those demonstrated or in use in other countries — may meet many of the criteria, says Paul.

Sandia has studied safety and engineering issues associated with each of these reactor types, and some of that research continues in support of the DOE "Generation IV" program to evaluate options for next-generation, advanced nuclear power plants.

For example, Sandia is conducting an LDRD-funded study on the feasibility of highly efficient, passively safe, high-temperature gas reactors, says Paul. Such systems take advantage of the inherent design characteristics of the reactor to achieve safety and efficiency, minimizing the need for additional complex safety systems. (See "The expandable fuel resource" on page 5.)

"You can't keep adding layers of engineered systems and have the plants remain cost competitive," he says. "Next-generation plant designers should ask 'what's the most robust and simplest way to do this and how can we get the cost down without compromising safety?'"

Fission batteries

Labs researchers also are developing new, futuristic concepts for generating nuclear power that represent major departures from current nuclear energy technology and that would meet many of the criteria.

One concept, called Direct Energy Conversion, seeks to generate electricity from fission without first boiling water. (In a boiling water reactor common in the US today, heat from fission reactions in the reactor core converts water to steam, the pressurized steam drives a turbine, and the turbine's rotational energy drives a generator. See illustration at left.)

As part of a NERI-funded project, a Sandia-led team has developed three concepts for direct energy conversion "fission batteries" that produce electrical current directly from fission. Essentially, positively charged heavy atoms and electrons released during fission reactions in the fuel are separated and collected by electrodes, creating a usable voltage.

This separation, a big technical challenge, says Gary, might be accomplished either by directing differently charged particles in opposite directions using magnetic fields (borrowed from Sandia's pulsed power research) or by separating differently charged fragments using charged mesh filters.

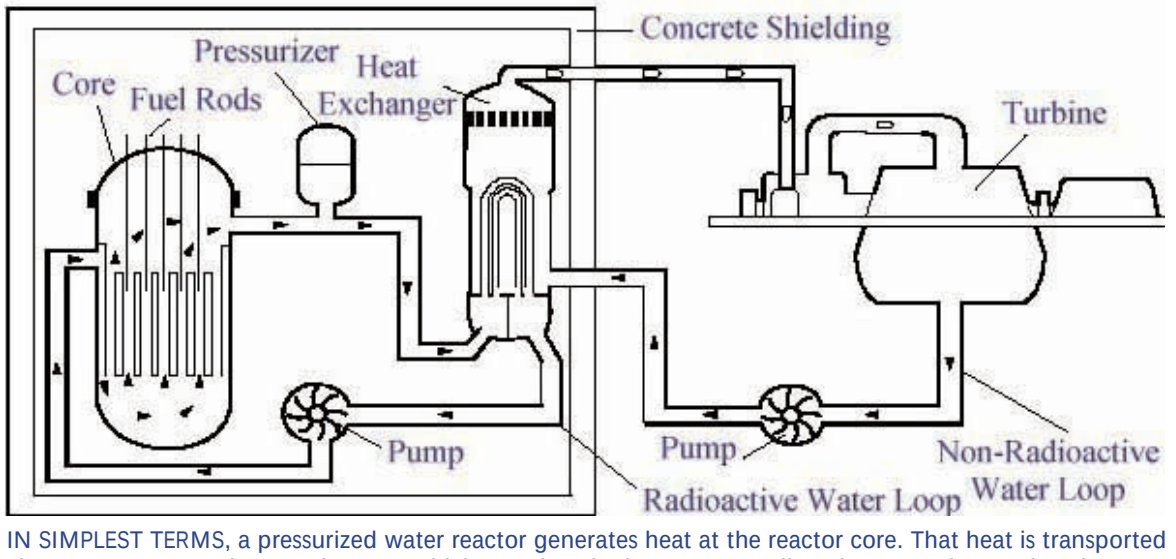
(Continued on next page)

High ideals for future nuclear power plants

Designers of tomorrow's nuclear power plants envision plants that meet several general criteria. They include:

- inherent safety (they rely on passive, or self-regulating, safety features rather than engineered safety systems, such that meltdowns or other catastrophic failures are not physically possible);
- proliferation resistance (fuel cannot be readily diverted to weapons use);
- high efficiencies (plant designs get the most out of each fission);
- long run times (minimized fuel-handling requirements and waste outputs);
- minimized waste streams (fuel is recycled, reprocessed, or transmutated such that the amount of waste generated is minimal and/or it is of low toxicity);
- multiple uses (plants are capable of generating process heat, hydrogen, or other useful products in addition to electricity);
- fuel sustainability (reactor designs make the best use of nuclear fuel resources).

A pressurized water reactor



IN SIMPLEST TERMS, a pressurized water reactor generates heat at the reactor core. That heat is transported via water vapor to a heat exchanger, which transfers the heat to nonradioactive water (water that does not come in contact with the fuel rods). The heated nonradioactive water is then used to create steam that drives a turbine, which produces electricity.

Nuclear power

(Continued from preceding page)

The result is a self-contained, current-producing ball, tube, or chamber with an anode and a cathode. Some of the concepts, such as the grapefruit-size ball called a Magnetically Insulated Fission Electric Cell, are potentially mass manufacturable, can be stacked together into arrays that could produce perhaps 60 megawatts of electricity, and theoretically are capable of 60-percent conversion efficiencies. A cell the size of a golf ball might produce six times the energy of a D-cell battery.

"The basic physics behind these ideas was demonstrated in the 1950s and 60s, but recent advances in technology could make them practical," says Gary.

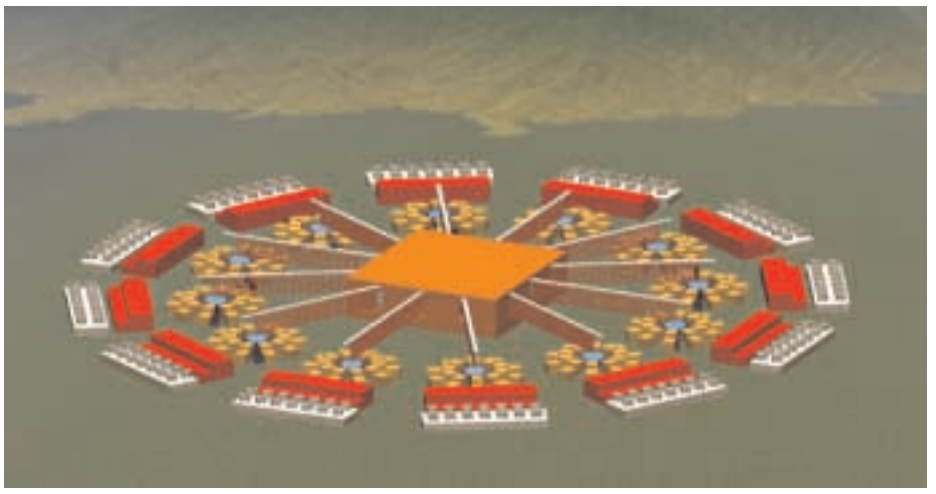
"We're now building engineering models to see how much power we can get out of each one," he says. "By August we are to down-select one concept for NERI. But none of these ideas is bad, so we'll look at using them each in different applications."

Seeking a limitless energy source

Although uranium potentially represents a larger energy resource than fossil fuel reserves, ultimately, even uranium is a finite resource, reminds Paul. In part because of the abundance of fuel, fusion has long been considered the ultimate nuclear energy source.

A 30-year international R&D program in fusion energy has explored magnetic confinement fusion and inertial confinement fusion approaches, but each candidate technology has presented researchers with formidable technical challenges.

Sandia's favored approach to fusion energy, based on a scaled-up version of the Labs' Z machine, likewise has its challenges, but many of the challenges are in the engineering, rather than the physics, arena.



Z-PINCH POWER PLANT — Artist's rendition of what a pulsed fusion power plant based on Sandia's Z-pinch technology might look like. A distribution center at the hub of the plant provides mass-produced fuel target inserts needed every few seconds to keep the 12 Z-style accelerators around the rim of the plant "popping." Each accelerator might produce one pulse every 10 seconds to generate as much as six gigawatts of total electricity at the plant.

"We've shown with our Z accelerator that the physics is on course for demonstration of fusion," says Gary.

"We believe we can contain the explosion. We believe we can get the energy densities that are needed. So it's an engineering problem, but a big one."

An accelerator that could rapidly repeat high-yield pulsed fusion of deuterium and tritium would represent an essentially limitless supply of energy for mankind, he says. (Deuterium and tritium are heavy isotopes of hydrogen. Deuterium is abundant in nature and tritium can be manufactured by the power plant.)

Palo Verde times two

One LDRD-funded partnership among Centers 6400, 1600, and 14100, the University of Wisconsin, UC Davis, UC Berkeley, the University of New Mexico, and General Atomics seeks ways to feasibly accomplish cheap, repetitive pulsed power quickly enough to provide uninterrupted electricity, including the need for mass-manufactured target assemblies. (Gary Rochau, 6415)

Another LDRD project seeks to develop a recyclable transmission line, which along with the target assemblies would be destroyed with each shot. (Steve Slutz, 1674)

Labs researchers envision a ring of 12 scaled-up Z-style accelerators each popping off one pulse every 10 seconds to generate the electricity, with a target distribution area in the center to rapidly deliver mass-produced target inserts. The entire plant might take up an area the size of the Palo Verde nuclear plant near Phoenix and would produce as much as six gigawatts of electricity (twice the Palo Verde output). Its primary byproduct would be tritium, a short-lived radioisotope and a primary fuel component for the plant.

"If this worked, it would be clean, there would be no long-lived radioactive waste, and you can't make bombs out of tritium alone," says Gary. "We would have more fuel than we could ever use."

"That's the ultimate nuclear power plant," adds Paul. "A fusion power plant is a long way out on the horizon, and there are of course major hurdles, but this approach provides a promising alternative path to achieving the fusion energy goal."

The expandable fuel resource

Current light-water reactor nuclear power plants common in the US today use a once-through fuel cycle that utilizes a relatively small fraction of the energy available in the nuclear fuel. At the current rate of consumption, the world might use up its available nuclear fuel resource in several decades.

But advanced reactor systems could significantly extend the available fuel resource by more efficiently burning the fuel and by conversion of unspent fuel into reusable fuel forms during fission. Breeder reactors, for instance, which generate more fissile fuel than they consume, might extend the current fuel supply to centuries.

Although many technical hurdles have to be overcome before a sustainable power source using fusion rather than fission is possible, the energy available via fusion is essentially limitless.

Tiny Pac-Man

(Continued from page 1)

A market in the billions?

A microfluidic device typically consists of thousands of channels conducting tiny amounts of fluids for analysis. The channels' widths are measured in microns. One-thousandth of an inch is 25 microns. An integrated device of this type, operated by a technician, can displace a laboratory's worth of chemists formerly needed to perform multiple tests. The device also greatly reduces the amount of material and time needed for testing. The market for such devices is currently in the billions of dollars.

cell walls for drug insertion; either of the latter methods kills large numbers of cells.

Also, microelectromechanical insertion is less expensive than these other methods. The devices — powered by electrostatic actuators — and the microchannels in which they function are so cheap to fabricate that, when mass-produced, a device could be thrown away after it is used once.

The depth and precise position of molecular insertion would be controlled by researchers who have located the cell's "sweet spot" by observing effects of the insertions.

Hundreds or thousands of units assembled in parallel, puncturing cells at the rate of 10 a second, could create a sizeable supply of enhanced material.

Why the device could be built

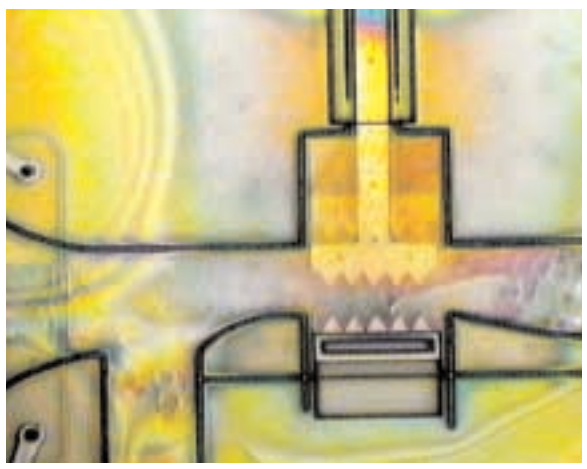
Inexpensive fabrication of the device became possible for two reasons: the capabilities of the Sandia MEMS SUMMiT V fabrication process — a sequence of deposition, patterning, and etching — to create complicated micromachines, and the use of silicon nitride to build insulated microchannels in that process.

An effective insulator is needed because microchannels of silicon, an electrical conductor, would short out electrodes that create electrical and magnetic fields used to analyze or manipulate the contents of the channel. By fabricating channels instead out of a version of silicon nitride, the researchers were able to avoid these problems.

Silicon nitride's other advantages are that it is transparent, allowing researchers optical examination of the experiments, and that it is a material commonly used in microelectronic device fabrication — an important consideration.

Although the microdevices are fabricated step by step with lithographic processes well known to the semiconductor industry, the ability to easily make this complicated device is credited to the Sandia SUMMiT V fabrication process, which allows five-level micromachine construction to be quickly designed and implemented. The SUMMiT V process is the only one available worldwide that can construct five-level micromachine devices.

Another invisible ingredient in the mix was the expert MESA (Microsystems and Engineering Sciences Applications complex) fabrication teams that physically created the device.



LOOKS DANGEROUS, but red blood cells love it — Sandia's Pac-Man-like macerator guards a microchannel, buffeting red blood cells passing through its fearsome teeth without damaging the cells.

Problems with electroporation

Current methods of cell implantation use electric fields to open cell walls for chemical absorption. A problem with this method, called electroporation, is that it causes the overwhelming proportion of cell populations to die. Other manual methods also exist in which genetic material is delivered into cells one by one through a very fine pipette — a very labor-intensive and specialized process. Sandia's Pac-Man device has the possibility of overcoming both of these problems.

Sandia's 52-year-old Bldg. 800 to take a leap into 21st century with major renovation

Renovation of Labs' 'front door' to be completed and ready for move-in by July 2002

By Chris Burroughs

THIS ARCHITECTURAL RENDERING shows what the interior of Bldg. 800 will look like when renovation is completed. The new occupants will be Corporate Business Development and Partnership Center 1300.

Over the next year, Sandians may notice a lot of construction activity around the Labs' "front door," Bldg. 800.

The building, which includes the original 52-year-old north wing and its 32-year old east side addition, is being completely renovated. Interior demolition and seismic upgrades are now underway with renovation completion scheduled for July 2002.

"People will see construction crews and equipment working in and around the building on a regular basis," says Scott Rowland (7824), project manager. "But what they won't see are permanent exterior changes to the north wing."

That's because while the building is being gutted and completely renovated, special attempts will be made to keep the exterior looking the same.

While the building is not on the state's official historic building list, Sandia and DOE are dedicated to keeping the appearance of the exterior of the brick building like it was when it was constructed in 1949.

"In terms of history of the Labs, Bldg. 800 represents Sandia's first push for permanent buildings to house both administrative and mission-related activities in the early years of the Cold War," Scott says. "It plays a significant role within Sandia's cultural memory as a link to the Labs' origins and original mission."

The brick veneer of the building will be retained, as will the look of the guard tower. However, the top of the tower will be completely renovated. The brick pillars and the 37,000-pound concrete cap that they currently hold up will be removed. The old pillars will be replaced with new steel reinforced brick pillars. The cap will be replaced with a steel structure that will look identical to the original concrete cap, yet weigh far less.

In addition to the normal electrical and mechanical renovations, which include replacement of all the 50-year-old heating and cooling systems, the building and its addition will be seismically upgraded to meet current code requirements set by the International Building Code 2000.

Darrick Jones (7823), Sandia lead structural engineer for the project, says that when Bldg. 800 was designed and constructed, code requirements for seismic durability were very minimal. And although Sandia is in an area of moderate seismic activity (2 on a scale of 0-4), the building will be renovated to meet current seismic codes, as will other older Labs buildings as their turn for renovation comes around. The seismic upgrade will involve pouring several concrete shear walls and tie beams between selective building columns to strengthen the overall lateral resistance of the building.

The second floor of Bldg. 800, which has been vacant since last fall, has already been gutted, and preliminary work for the upcoming seismic upgrade has commenced. The first floor, occupied by Oracle staff members, will be vacated by July 27. Following that, the remaining interior walls, heating and cooling ducts, and electrical equipment will be torn out.

Seismic upgrades are expected to be completed by November 2001. The building will be ready for its new occupants, Corporate Business Development and Partnership Center 1300, in about a year.

Center 1300 Director David Goldheim says he is "very excited by this opportunity to consolidate our organization into one location and thereby improve our internal communications and efficiencies and our support to our Sandia partners, DOE, and Sandia's external customers."

"I believe the design, which includes modern meeting facilities and work areas, will present a welcoming, professional, and business atmosphere," David says. "Occupying Bldg. 800 represents the best of all worlds. We will be close to the tech area and the executive offices and yet able to meet with community and industrial partners in a facility that does not require clearances."

The architects for the project are Dekker/Perich/Sabatini. Chavez Grieves Consulting Engineers is providing the structural engineering, and Bridgers and Paxton Consulting Engineers, Inc. is providing the electrical and mechanical design. Big J Enterprises and its primary subcontractor, G & H Construction Co., are performing the work on this stage of the overall renovation project. All contractors are from Albuquerque.

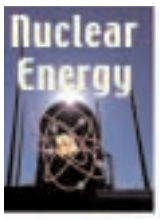
Bldg. 800 is one of seven Sandia buildings located in the northwestern portion of Technical Area 1 that were designed by the architectural firm of W.C. Kruger and Associates. They were all built between 1949 and 1951. The other buildings are 801, 802, 808, 835, 840, and 860. Bldgs. 800 and 801 have been remodeled several times to update both office and security facilities.

Most recently, in 1996 Sandia completed a renovation of Bldg. 800's lobby and the connecting corridor between Bldgs. 800, 801, and 802. The project modernized the entrance and passage sequence and provided controls and access to an expanded Badge Office and organized security requirements for access to Tech Area I.

BLDG. 800 WHEN IT WAS NEW — This photograph shows Bldg. 800, Sandia's "front door," as it looked when it was completed 52 years ago.

Take Note

The June 15 issue of *Lab News* featured an incomplete list of the Sandians working on the DisCom^2 project. The complete team included Art Hale (9220), Pete Dean (8903), Len Stans (9336), Jim Ang (9220), Martha Ernest (9336), John Naegle (9336), Tom Pratt (9336), Kathie Hiebert-Dodd (6353), Steven Humphreys (6353), John Noe (9338), Bill Rahe (9332), Mike Vahle (9300), Marty Barnaby (9338), Sue Goudy (9223), Thomas Otahal (9343), Manoj Bhardwaj (9142), Judy Sturtevant (9338), Harvey Ogden (6536), Lilia Martinez (9220), Diana Eichert (9334), Fred Mora (9334), Dal Jensen (9334), Jonathan Kreisle (9329), Esther Baldonado (6535), Judy Beiriger (6531), Hugh Bivens (6535), Dwight Coles (6535), Clark Haskins (6535), Wilbur Johnson (6535), Lois Lauer (6535), Ellen Lemen (6534), Ron Rhea (5902), Ruthe Vandewart (6535), Larry Claussen (6536), Ann Hodges (6536), Chuck Keller (6523), Don Moore (6536), Bryan Spicer (6536), Mark Hamilton (9143), Luis Martinez (9336), T.C. (Richard) Hu (9336), Steve Simonds (9338), Bill Collins (9338), Paula McAllister (9338), Dan Sandoval (6535), Geoffrey McGirt (9338), Joe Brenkosh (9336), Tim Picchione (9352), Ron Moody (9334), George Rivera (9334), Bob Mason (9334), Vicki Williams (9334), Doug Brown (9332), Dick Hawkins (9327), Glen Machin (9332), Pat Moore (6535), Melissa Myerly (9332), Len Stans (9336), Larry Tolendino (9336), Bill Swartz (9329), and Don Gould (7826).



Sen. Bingaman takes helm of Energy committee at critical juncture in national energy debate

Nuclear energy deployment a business decision, but government can help, Bingaman says

By Bill Murphy

Sen. Jeff Bingaman is noted in Washington and in his home state of New Mexico for his reasoned and balanced approach to public policy issues. So when he says he thinks nuclear power should remain a vital element in the nation's energy mix, it's a good bet he's looked at the issue thoroughly and weighed the merits dispassionately.

Now, with the Democrats regaining control of the Senate for the first time since 1994, Bingaman has more opportunity to express and advance his energy ideas: he's been named chairman of the Senate's Energy and Natural Resources Committee. He assumes his new leadership role at a time when the nation is focusing its attention on energy issues with an intensity unmatched since the late 1970s. Indeed, colleagues on both sides of the aisle have quietly expressed appreciation that his fair-minded and even-tempered approach will help keep the present highly volatile energy environment from becoming overly politicized.

In an exclusive *Lab News* interview, Bingaman discussed his views on a number of nuclear energy-related issues. The June 15 *Lab News* featured an interview with Sen. Pete Domenici on the same subject.

Bingaman bill supports nuclear R&D

Bingaman in March introduced the Comprehensive and Balanced Energy Act of 2001, which, among its features, calls for investment of $433 million in nuclear energy R&D for FY 2002, increasing to $557 million for FY 2006. The multi-part bill features measures to increase energy supply, decrease demand, address global climate change concerns, and support energy R&D (in nuclear and other technologies). The bill extends the provisions of the Price-Anderson Amendments Act for 10 years. That act is important to the nuclear industry because it limits financial liability in the event of an accident.

The bill, co-sponsored by 17 senators, is being considered by Bingaman's committee.

"We'll have more hearings next week [the week of June 18] and the following week and in July on other portions of it. We hope that sometime later this summer we would be able to put together a bill which contains parts of the bill and parts of other bills and report it out of the Energy and Natural Resources Committee."

Bingaman says the fact that he is now chairman of the committee "won't necessarily determine how the votes [on the bill] go. It will certainly help to get it considered."

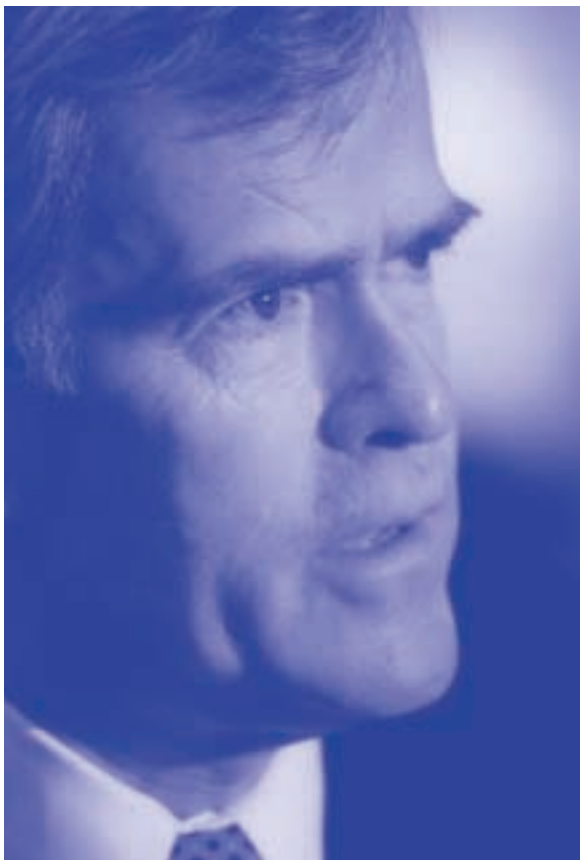
Nuclear energy fate a 'business decision'

Regarding nuclear energy's prospects in the US, Bingaman says, "Well, it is a substantial part of our energy mix today — it accounts for about 20 percent of the electricity we use —and that's expected to continue into the future. The question of whether we build additional nuclear generating capacity in the future I think is primarily a business decision.

"As you know, it costs more to construct a nuclear plant than it does virtually any other kind of plant. It takes longer. Those nuclear plants are subject to tougher safety standards. Those are factors that need to be taken into account. Once constructed, a nuclear plant produces relatively cheap energy.

"I don't think the government should be making the judgment for business as to whether to pursue additional nuclear capacity or some other type of capacity. I think we should make that option available and we should do all that we can to make it a viable option."

Bingaman acknowledges that much of the cost to industry of bringing a nuclear plant online is related to the cost of meeting regulatory requirements. "There are a lot of requirements put on by the Nuclear Regulatory Commission in particular," he says, "and the licensing process is pretty formidable. But I do think the NRC has streamlined its processes for licensing. They testified to our committee a few weeks ago that they are ready and willing to consider applications for new licenses if they receive them."



NEW MEXICO SENATOR Jeff Bingaman, who recently assumed the chairmanship of the Senate's Energy and Natural Resources Committee. (Photo by Randy Montoya)

"I don't think the government should be making the judgment for business as to whether to pursue additional nuclear capacity or some other type of capacity. I think we should make that option available and we should do all that we can to make it a viable option."

Bipartisan support for nuclear energy

While the Bush administration has a national energy plan and Democrats have an energy plan, there is much common ground, Bingaman says.

"I think there is bipartisan support for continued use of nuclear energy and expansion of it to the extent that the economics justify," he says.

In addition to the nuclear energy-related sections of the comprehensive energy bill, Bingaman earlier this year also introduced the University Nuclear Science and Engineering Education Act of 2001. That bill, Bingaman says, emerged as a response to a Nuclear Research Advisory Committee report that indicated there is a substantial decrease in the number of people going into nuclear science and engineering.

"That caused a concern on my part," he says. "I think there's no question that for the foreseeable future we're going to need scientists and engineers in this field. I thought it was appropriate to concentrate some federal resources on bringing people in and keeping them in the field." The senator says he expects the provisions of the earlier bill to be included in the comprehensive energy bill. In any event, he says, "One way or another I would like very much to see it enacted as part of something this year if we can."

Defer to experts on Yucca Mountain

Some nuclear energy experts — proponents as well as opponents — believe that the disposal of nuclear wastes could be the Achilles heel of any increased use of the technology. The Department of Energy has spent several billion dollars and some 20 years studying the feasibility of building a deep waste repository at Yucca Mountain, Nevada. If approved, it would solve the waste disposal issue, but approval is by no means certain.

"My understanding of where things are with the Yucca Mountain project," Bingaman says, "is that the Department of Energy is continuing to analyze that site and attempting to characterize it [scientifically] so that it can make a recommendation to the president on whether to proceed. Once that recommendation is made to the president, then I believe he'll make a decision. [At that point] The governor of Nevada is given an opportunity to wade in and disagree with the president if the president says to go ahead and the governor is of the other view. If in fact the governor of Nevada were to state his opposition, it would come to Congress and we'd have an up or down vote. Presumably that would happen sometime early next year — that would be my understanding of the timetable. I don't know how the votes would come out in Congress at that point. I personally would be inclined to defer to the experts. If the experts said it was an appropriate site and could be safely used, I would tend to support that."

Over-reliance on natural gas 'a cause for concern'; Sandia's prospects look bright

Sen. Jeff Bingaman, D-N.M., said the apparent fact that most new electricity generation capacity for the immediate future will be based on natural gas technology "is some cause for concern."

"We need to have a diverse group of sources from which we're drawing our energy, just as a matter of prudence," he says. "I would like to see us produce power from a variety of different sources. I would hope we can see additional generation from alternative fuels. I hope we can see additional generation from some of the other sources in addition to natural gas. But again, these are decisions that the industry makes on the basis of their perception of the economic viability of these different options."

As chairman of the Senate Energy Committee, Bingaman will be intimately involved with a lot of legislation that affects Sandia and DOE. From that perspective, he sees Sandia's future as being bright.

"I think Sandia's prospects are very good over the next few years," he says. "I think there's a strong recognition in the Congress that our national laboratories, and particularly our weapons-related laboratories, are fulfilling a vital function. I believe that view is also shared in the administration. So I would think that Sandia would do well. I do believe strongly that Sandia and the other weapons-related labs need to be able to participate in nonweapons-related research to a substantial extent and I hope that can continue as well." — *Bill Murphy*

Mileposts

New Mexico photos by Iris Aboytes
California photos by Lynda Hadley


Ben Sedlack
45 2954


Thomas Cutchen
35 2501


Robert Edgar
35 6215


Francisco Gonzalez
35 6432


Donald Keener
35 2992


Larry McConahy
35 6525


David Renninger
35 1735


Robert Bickes
25 2523


David Carlson
25 12300


Sharon Chapa
25 6543


Meliton Gonzales
25 14112


Kenneth Reil
25 6423


Pandora Apodaca
20 9412


David Fordham
20 9813


Lucille Forster
20 9511


Carmela Gallegos
20 5941

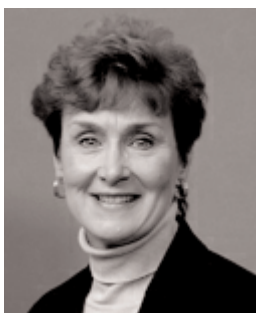

Karen Higgins
20 1905


Laura Loudermilk
20 10005


Frederick Mitchell
20 2995


Bruce Tuttle
20 1846


Linda McNiel
20 1321


Judy Moore
20 16000


Jeffrey West
15 9329

Recent Retiree


Sharla Bertram
32 6851

Milepost photos now archived on CQuest

Milepost photos, starting with those that ran in the *Lab News* in January 2000, are now on the corporate image database CQuest. People who already have access to CQuest can locate an image in the Creative Arts Picture Volume by entering their last name in a "Proper Name" field.

People who don't have CQuest on their computers can download the software at http://www-irn.sandia.gov/organization/div12000/ctr1260012620.html. The URL can also be located by performing a search for "12620" from the Sandia home page. On the resulting page, scroll down, select the CQuest Image Archiving button on the left side and follow the directions.

Please allow one month from publication date for the photos to be posted.

Recent Patents

Barry Spletzer (15211): Method and Apparatus for Extracting Water from Air.

Carol Ashley (1841), Paul Clem (1846), Mark Rodriguez (1822), and James Voight: Process for Forming Epitaxial Perovskite Thin Film Layers Using Halide Precursors.

Stephen Casalnuovo (1763) and Gregory Frye-Mason (1764): Method of Making Suspended Thin-Film Semiconductor Piezoelectric Devices.

Douglas Loy (6245) and Kamyar Rahimian (1811): Non-Shrinking Siloxane Polymers.

Guard tower takes tumble

THE 1940s-VINTAGE GUARD TOWER in Area 2 came tumbling down early Friday, June 22. The demolition work, done by Coronado Salvage, involved attaching two cables near the top of the tower and using a cutting torch to cut the bolts holding the tower to its foundation on the north side. Execution varied slightly from the plan, however. As soon as the slack was out, the tower toppled faster than expected. This picture captures the tower just as it hits the ground. (Photo by Mike Pacheco, 7864)

Sandia Classified Ads

How to submit classified ads

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

- **E-MAIL: Janet Carpenter (jacarpenter@sandia. gov)**
- **FAX: 844-0645**
- **MAIL: MS 0165 (Dept. 12640)**
- **DELIVER: Bldg. 811 Lobby**
- **INTERNAL WEB: On Internal Web homepage, click on News Center, then on Lab News frame, and then on the very top of Lab News homepage "Submit a Classified Ad." If you have questions, call Janet at 844-7841.**

Because of space constraints, ads will be printed on a first-come basis.

Ad rules

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

MISCELLANEOUS

TWIN BED, mattress, & box spring, metal frame, good condition. Leach, 821-9124.

NEW UMBRELLA STROLLER, never been used, $12. Mayberry, 293-4025.

LAB MIX DOG, loves people, to good home. Foiles, 220-6130.

CUSTOM IGUANA CAGE, on wheels, 6 x 6 x 2, all lights required for reptiles included, $1,400. Bordlemay, 275-0405.

RESORT STUDIO ACCOMODATIONS, 1 or 2 weeks in Puerto Vallarta, $800/week, 5-star luxury, on the beach. Hasan, 836-0354.

CHILDREN'S BED, w/built-in drawers & nightstand, matching dresser; infant bouncer, stroller, walker, toys, clothes, shoes, etc. Heath, 440-1402, ask for Leila.

HEADACHE RACK, fits full-size pickup, very good condition, black, $75. Ritchey, 299-7082.

BOOK/DISPLAY CASE, oak, light finish, excellent condition, $50. Bessette, 798-9067.

BROYHILL SOFA & LOVE SEAT, plus 2 chairs, excellent condition, $475 OBO for everything. Brito, 266-1018, ask for Mary Lou.

IBM SELECTRIC II TYPEWRITER, newly reconditioned, $40. Bear, 881-7128.

XEROX PERSONAL LASER PRINTER, Docu Print P8, never out of box, new, $150 OBO. Curzi, 296-5386.

COMPAQ COMPUTER, 486DX, 66MHz, 2.0GB HD, CD16X, 33.6KB modem, MS Windows 95, 14-in. monitor, $210; dot-matrix printer, $10. Gonzales, 823-9511.

CELL PHONE, Sprint PCS dual-band Samsung flip-face, w/desktop charger, car cigarette lighter adapter, & new $70 extended lithium battery, all for $70. Dybwad, 296-9047.

EIGHT REDWOOD PLANKS, used, 2 x 8, 7-1/2-ft. long, all for $9. Stamm, 255-2640.

COMPLETE COIN SETS, Albuquerque Balloon Fiesta, Commemorative, Balloon Glow, Special Shapes, Gas Race, total of 38 coins, sell at or near appraisal value, $5,700. Heerdt, 323-5706.

WASHER & DRYER, Whirlpool Imperial, clean, good working order, $260 for both. Tate, 293-0654, ask for Alan or Karen.

COMPUTER, Macintosh Performa 6200CD, 24MB RAM, 15-in. screen, Style Writer 1200, $500; new walker, $30. Simon, 299-8468.

FILL DIRT, adequate for compaction but not ideal for growing plants in, approximately 15 cu. yds., free, I'll load. Pohl 271-1328.

WEDDING SET, .25-carat round diamond, 14K gold, dazzling & unique, cost $455 new at Kruger's, asking $200 firm. Haines, 296-7354.

TWO SOUTHWEST ROUNDTRIP TICKETS, 1 expires Sept. 12, 2001, & the other expires Nov. 13, 2001, good anywhere Southwest flies, $290 each, cash only. Lujan, 822-0205.

TIRES & RIMS, 200 miles, tires are 31x10.50 15, rims are 15x10, comes with warranty, $1,000. Bryan, 844-9586.

GOLF CLUBS, men's, left-handed, graphite, 1, 3, 4, 5 and S-3 irons, with bag. Spray, 821-5877.

PLAYHOUSE, Fisher-Price Little Tykes, retails at $170, will sell for $50. Hammond, 821-0284.

DINING ROOM TABLE & 6 chairs, $250; queen-size sofa-bed, $100. Marder, 291-8140.

COMPUTER, Pentium 75MHz, 16MB RAM, 1.0GB HD, 56K modem, CDROM/3.5-in. disks, monitor, speakers, Win3.1, MS Office, $200. Giunta, 338-5277.

AQUARIUM FLUVAL 303, underground filtration system, electric heater, salt, water-testing kit, & more, $85; red, white, & blue coral, worth $400, asking $200. Moreno, 550-3764, ask for Gary.

EXERCISE CYCLE, dual action; band saw, 1/3-hp, blades, moulding, dado heads. Pitti, 256-1629.

LA-Z-BOY SOFA SLEEPER, queen-size bed, brown & tan, excellent condition, $200. Schamaun, 298-5192.

USED RAILROAD TIES, $2; used cinder blocks, free; small amount of cottonwood firewood, free; various baby gear. Maxam, 343-9409.

THREE SETS OF DRAPES, 60 x 90, 48 x 84 windows, tan/blue, gold weave, & light blue, Spring Crest rods, $50 all. McClellan, 828-1881.

PENTAX K1000 CAMERA, 28-80 & 70-210 zoom lenses, filters, new bag, very light use, $250. Kercheval, 864-6549.

SOUTHWEST AIRLINES TICKET VOUCHER, anywhere Southwest flies, round trip, expires 04/27/02, $300. Perrine, 293-1429.

HEARING-AID BATTERIES, #13, 42 for $15. Barbier, 856-9391.

QUEEN MATTRESS SET, Sealy Posturepedic, including frame, guest-room use only, top condition. Harrison 821-9099.

ROOM AIR CONDITIONER, 1-year-old Amana, 5,000-Btu, available because of moving, $150. Thompson, 823-4567.

POWER RACK, 255# Olympic weights, lat/leg attachments, 200# weight stack, Olympic bar, incline/decline bench, $600. Flores, 291-8649, ask for Jay.

STEAM CLEANER, Hoover Steam-Vac, deluxe carpet/upholstery deep-cleaner, like-new condition, paid $200, asking $95 OBO. Hollister, 323-1657.

DRESSER, $75; changing table, $50; twin box spring, $20; sandbox, $5. Tharp, 792-0790.

CHILDREN'S PRODUCTS: twin bunk bed, bed, mattress, desk; toys: Little Tykes/Fisher-Price cars, kitchen, etc. Meyer, 856-9649.

JEWELRY-MAKING TOOLS & SUPPLIES, hundreds of wax patterns & hot-waxing tools. Luther, 822-1187.

FLAT-SCREEN TV, Sony Wega, 20-in., new, $350; Magnaplanar flat-ribbon-type speakers; $400. Petersen, 856-3499.

CSF TEXTBOOKS: *Organization Theory and Design*, 7th edition, Daft, $50; *Economy Today*, 8th Edition, Schiller, $50. Maestas, 883-7617.

TIMESHARE: attending the COMDEX conference in Las Vegas this Nov.? Timeshare available Nov 10-17 at the new Fairfield Grand Desert, near convention center & strip, 1-bdr. suite, sleeps 4, make offer. Owens, 839-4286.

COLOR TV, 19-in., needs cable to work, works well, $50. Gallegos, 363-7589.

LOVESEAT, very nice Victorian floral tapestry material, 70" long, excellent condition, approximately 3-1/2 years old, $125. Buteau, 856-7705.

WHEELCHAIR, Invacare Tracer LX, w/leg supports, like new, $150 cash. Abbott, 298-2039.

FAN MOTOR, 2-spd., 115-volt, 2.6-amp, 60-Hz, 1/15-hp, $25. Durkee, 255-4211.

ROLLBAR, double/single, $150; pre-run bar; AR Outlaw II rims, w/31x10.5 tires, $500; truck/hatchback speakers; all currently on '85 Toyota. Yazzie, 281-2223.

TRADE OR SELL, new Cool Shade canopy; 11'6"W x 13'6"L x 9'H, too big for us, still in the box, trade for a smaller canopy or sell for $60 (1/2 price). Stude, 897-4352.

UPRIGHT VACUUM CLEANER, Simplicity Sentry III, includes onboard tools for furniture, $449 new, asking $100. Kaiser, 828-1660.

PROFESSIONAL AIRLESS SPRAYER, Binks Super Bee, 1/2-gmp, 1/4-hp, w/rapid-clean gun, 2 25-ft. hoses, $500. Williams, 344-9276.

COLLECTIONS: decorative birdhouses, large, small, tall, and heart-shaped; angels & other heart-shaped items. Bronkema, 286-0423.

EXERCISE BIKE, "Edge" dual-action, w/computer program settings, brand new, assembled, $150 OBO. Dubbs 299-8350.

HOME-SCHOOL CURRICULUM: *Bob Jones Heritage Studies 4; ABeka 4th Grade Science, Health, Language; Saxon Math 2*. Lott, 281-0702.

TOP-OF-LINE CHILDCRAFT CRIB, dark oak, like new, $200; white changing table, $40. Hendrickson, 275-3119.

BABY STROLLER/CAR SEAT, Cosco Eddie Bauer, 4-in-1 combination, all terrain, new condition, $100. Errett, 858-1013.

CHILD'S TWIN LOFT BEDFRAME, w/slide & clubhouse, used 9 months, great condition, $250. Laub, 299-3321.

BICYCLE ENGINE, 1-hp, $40. Guttmann, 888-5114.

DINING ROOM TABLE, w/6 chairs, entertainment center, & more, moving & must sell. Evans, 238-6282.

STEREO SURROUND-SOUND RECEIVER & 2 speakers, Pioneer 100W, $125 OBO. Thomas, 284-2083.

MOUNTAINEERING BOOTS, Lowa "Denali," gray plastic, 11.5, normal shell liner, w/successes on McKinley & Rainier. Aas, 856-6674.

THREE KITTENS, to good home(s), 2 have Siamese markings and 1 is solid black, approximately 4 weeks old, house trained, loving & ready to be adopted. Healy, 256-3268, after 5 p.m.

TEXAS TECH EX-STUDENTS ASSOCIATION, dinner/auction at the Cooperage, Sat., July 14, football coach Sonny Dykes speaking. Caldwell, 858-0190.

OFFICE DESK, 47"L, 30"D, 26"H, regular drawer & file drawer, $50 OBO. Long, 294-4591.

TRANSPORTATION

'72 PONTIAC GRAND PRIX, 2-dr., AT, AC, PS, PB, good condition, 125K miles, $1,500. Kobs, 281-1102.

'98 CHEVY 4x4, 1/2-ton, Z-71, ext. cab, short bed, 5.7-liter, AT, CD/cassette, trailer towing pkg., 3rd door, 18,200 miles, $21,000. Vigil, 271-1328.

'57 CHEVY PICKUP, 3100 series, 4-spd., 327 V8, AM/FM/cassette, full wrap-around rear window, 84K miles, excellent condition, $13,500. Grasser, 828-9051.

'99 FORD F550, 2-ton, 6-spd., Power Stroke diesel, Xcel trim, AM/FM, white/gray, $18,000, Chelette, 275-0955.

'80 OLDS CUTLASS, 73K original miles, very clean, great transportation, new tires, $2,000 OBO. Thorpe, 332-8162, evenings.

'96 HONDA CIVIC EX, great condition, fully loaded, $9,000 OBO. Martinez, 833-5670.

'95 FORD WINDSTAR, 67K miles, bronze, AT, PW, PL, 6-cyl., large AC, runs great, $7,450. Kral, 298-6699.

'72 VW SUPER BEETLE BUG, convertible, classic, runs excellent, must see, $5,900 OBO. Sanchez, 238-5363.

'99 FORD F150 XLT, Supercab, AT, 205-hp V6, excellent condition, low miles, $18,500. Easterling, 298-7083, ask for Paul.

'00 Volvo V70, 20K miles, 5-cyl., silver leather, excellent condition, $1,000 below blue book. Hayden, 323-5344.

'89 CHEVY PICKUP, 4x4, regular cab, Silverado & extras, good condition, 131K miles, 1 owner. $5,900. Rodriguez, 994-8546, ask for Manny.

'70 BUICK RIVIERA (2), '68 Cadillac convertible, 14-ft fishing boat, other old cars, in Belen. Barnette, 864-1881, ask for Leo.

'97 SATURN SC2, 5-spd., red, 31K miles, AM/FM/CD, loaded, power sunroof, leather seats, extended warranty, excellent condition, $10,500. Opalka, 298-0779.

'97 MAZDA 626, 4-dr., 5-spd., AC, all power, cassette/CD, $7,500. Brown, 259-5173.

'65 VW BUG, blue, new interior, new tires, runs great, excellent condition, must see, $3,950 OBO. Thomas, 294-2960.

'94 SATURN, 4-dr., 70K miles, 5-spd., AC, Alpine CD, Fosgate speakers, snazzy rims/tires, halogen lights, paint, good teenager car, $5,400. Walker, 294-4087.

'87 FORD F250, 4x4, 460 V8, 4-spd., new tires, $4,500. Martin, 377-1461.

'55 OLDS 88 (2): hardtop (body only), $500; sedan, runs, $2,500; 2 refrigerators: 25-cu.-ft., $300; 20-cu.-ft., $75. Rowe, 286-5432.

'91 HONDA CIVIC DX, hatchback, 5-spd., AC, 80K miles, excellent condition, $4,500 OBO. Lunt, 898-9501.

'96 TOYOTA 4RUNNER SR-5, V6, 4x4, excellent condition, AM/FM cassette, CD, 49K miles, dash/cargo covers, allow wheels, new tires, $17,500 OBO. Basil, 822-9544.

'67 PONTIAC FIREBIRD, 400-cu.-in, Muncie M22 4-spd. manual, straight body, runs/drives well, red w/black interior, $5,900. Bradley, 293-9586.

'98 TOYOTA 4-RUNNER SR5, V6, AT, AC, AM/FM/CD, excellent condition, tow pkg, warranty, 47K miles, $23,000. Romero, 299-6283.

'98 SUBARU FORESTER-S, AWD, Limited trim, loaded, Yakima bike rack, 61,500 miles, $17,500 OBO. Skogmo, 250-0522.

'90 TOYOTA 4-RUNNER, SR-5 V6, lots of extras, 112K miles, good condition, $7,800 OBO. Schueler, 296-8279.

'98 OLDSMOBILE AURORA, 4-dr., FWD, power sunroof, anti-theft system, premium stereo, aluminum wheels, leather, 26K miles, excellent condition, $19,500. Hart, 292-5110.

'90 SUBURBAN, 4x4, AC, PB, PS, new engine, clutch, water pump, distributor, recent fuel system overhaul. Byers, 298-8592.

'84 SUBURBAN, 2WD, AC, 3-spd. AT, new shocks & tires, tailgate, $4,000. Bauer, 266-8480.

'93 FORD THUNDERBIRD LX, 3.8 V6, 78K miles, AT, AC, anti-theft, $6,300; '72 Ford Ranchero, 302 V8, PS, PB, 164K miles, $5,900; in Carlsbad, willing to deliver. Guerin, (505) 887-2384.

'95 CHEVY G20 CONVERSION VAN, low mileage, alarm, 110V hookup, sofa bed, captain's chairs, loaded, $12,000. Halbleib, 797-4979.

'98 TOYOTA TACOMA, X-cab, AC, cruise, tilt, 53K miles (12K tow), $13,400. Tucker, 821-5448.

'98 FORD RANGER, Splash option, V6, 5-spd., matching camper shell, low miles, like new, $10,500. Prevender, 296-8586.

RECREATIONAL

MOUNTAIN BIKE, Diamondback Racing, Vertex model, aluminum 17-in. frame, Ti spokes, XT components, Grip-Shift shifters, White Bros hubs, $350. Padilla, 271-1328.

EDDIE MERCKX RACING BIKE, full Dura-Ace components, 60cm frame, dark blue/orange, white frame, ridden approximately 1,500 miles, very nice condition, $725. Lindgren, 271-1328.

RALEIGH TOURING BICYCLES, 10-spd., 26-inch frames, 1 man's (good condition), $65; 1 woman's (excellent condition), $85. Gossler, 822-9151.

'98 SUZUKI MARAUDER 800 CUSTOM, C/A red, w/fairing, extra chrome, 4,700 miles, $6,000 firm. Lippert, 299-6594.

'85 BAYLINER CUTTY BOAT, 19-1/2-ft., V8, I/O, V-hull, looks/runs great, always garaged, second owner, $4,900 OBO. Leeto, 299-5649.

'00 HARLEY-DAVIDSON, Heritage Classic, fully loaded, extras, including new trailer, $30,000. Eberhart, 296-8154.

TWO GIRL'S MOUNTAIN BIKES, both Raleighs: red M20, 12-in. frame, 26-in. wheels; purple Mountain Scout, 12-in. frame, 24-in. wheels; $85 ea. Griego, 265-2130.

CAMPING TRAVEL TRAILER, short, 14-ft., rear door, great road clearance, good storage space, sleeps 3 adults plus 2 children, $1,300. McConkey, 275-6636.

AVON INFLATABLE BOAT, 8-ft., oars, foot pump, storage bag, good condition, $300. Stephens, 265-5341.

'97 HARLEY-DAVIDSON ROAD KING, 8K miles, showroom condition, thousands of dollars in chrome accessories, $19,000. Gonzales, 292-6308.

'99 SHADOW CRUISER TRAILER, 19 ft., lightweight, self-contained, inside/outside shower, awning, dual axles, $7,800. DePoy, 281-4536.

'86 SUZUKI GSXR 750, nice paint, new slip-on pipe, w/leathers & boots, runs great. Thatcher, 730-3005.

'00 GEORGIE BOY MOTORHOME, 33-ft., fully equipped, 454 Chevy Vortec engine, 11K miles, paid $70,000, asking $52,000. Tennant, 275-8014.

BOY'S BIKE, 20-in., 5-spd., Huffy, great condition, $50 OBO. Kelly, 293-2475.

'99 BAYLINER CAPRI, 24-ft., 250-hp Mercruiser, 35 hrs., better than new, $19,900 OBO. Krein, 899-8312.

'82 GOLDWING ASPENCADE, new tires, brakes, battery, rebuilt carbs & steering, best offer over $2,000. Hebron, 281-2901.

MOUNTAIN BIKE, '98 18-in. GT Avalanche, smooth Marzocchi Bomber shocks, Shimano components, excellent condition, $540 OBO. Blaich, 822-1605.

REAL ESTATE

3-BDR. MOUNTAIN DREAM HOME, 1,500 sq. ft., 2 baths, private 1/2-acre, views, decks, garage, carport, shed, Cedar Crest, $149,000. Mitchell, 281-4348.

4-BDR. MOBILE HOME, '96 T&C Town Manor, 2,100+ sq. ft., 2 full baths, large laundry, island kitchen, fireplace, 3.59 acres, Moriarty Heights, motivated seller, $69,900. Vokes, 884-4697.

MOBILE HOME, 14' x 62', near base, excellent condition, washer/dryer, refrigerator, oven/range included, recently renovated, lot w/pool, $10,500. Sensi, 299-3958.

3+-BDR. HOUSE, 2 levels, 2,730 sq. ft., excellent schools, large rooms, $229,900. Martinez, 298-7382.

LOT IN FOREST LAKES SUBDIVISION near Vallecito Lake & Durango, Colo., $4,800. Patterson, (307) 455-2010.

2-BDR. MOBILE HOME, Belen, 2 baths, built-in addition, 1/4-acre lot, 1-1/2-car garage & carport, fenced, landscaped, trees. Santistevan, 864-6198.

3-BDR. LUXURY TOWNHOME, 1,628 sq. ft., clean, bright, spacious, low maint. and util., 2-1/2 baths, NE Heights. Elder, 828-2608.

5 ACRES, wooded north side of Heron Lake in northern New Mexico, within gated community, $38,500. Dell, 291-0274.

3-BDR. HOME, 1-3/4 baths, tile floors, new carpet, carport, fenced 1/2-acre on Raymac Rd. SW, $95,000. Knoff, 877-8077.

3-BDR. HOME, 2,137 sq. ft., 2-car garage, 1-3/4 baths, hardwood floors, great room, office, LR, 2920 Tennessee, $154,900. Quintana, 296-9155.

WANTED

RADIO FLYER WAGON, in good condition. Veltkamp, 271-0325.

MOTORCYCLE for beginner, road bike or dual-purpose, 125-500cc, street-legal, good mechanical condition, reasonable. Kureczko, 286-4426.

GRADUATE STUDENT HOUSEMATE, nonsmoker, share 3-bdr. house, NE of Montgomery & Tramway, $300/mo., utilities included. Butler, 292-8823.

'90-'95 FORD BRONCO, want 5-spd. manual transmission with 4WD, not interested in automatic transmission. Zender, 294-8210.

SOMEONE TO SHARE MY NANNY, starting in August, my home or yours, prefer Montgomery/Tramway area but negotiable. Wampler, 299-4910.

SOLAR PANEL, 30 watts minimum, for mounting on roof of RV. Horton, 883-7504.

REFRIGERATOR, dorm-size. Spears, 266-9782.

HAMMERED DULCIMER; giraffe unicycle. Korbin, 299-9088.

WORK WANTED

BEGINNING FLUTE LESSONS, advanced flute student will teach beginning flute to K-4 ages, $5 per lesson. Bencoe, 294-3768.

LOST & FOUND

SKEIN OF YARN, found in parking lot south of Thunderbird cafeteria. Perea, 842-9521.

J.B. Rivard: From nuclear safety engineer to mystery novelist

"Apartment manager Morton Kingsley knows the Asian woman he's discovered dead in one of his locked apartments isn't a tenant. Although the cause of her death isn't obvious, the police quickly label the death suspicious because the body was moved after death. The apartment's tenant, a sexy young woman, is unavailable for questioning . . . ."

J.B. RIVARD

This isn't the scenario for a Sandia security exercise. Or a grabber for some Sandia ethics training. But there *is* a Sandia connection. It's part of the back-cover blurb about a new mystery novel.

The author? Sandia retiree Joseph Rivard. Joseph, a member of the Mystery Writers of America, spent the better part of 25 years in nuclear reactor safety research at Sandia, in Albuquerque. He retired in 1985 and took up fiction writing in 1990. (His short story "Where's Del" will appear in a forthcoming issue of *Blue Murder* magazine.) He now lives in Spokane, Wash.

Joseph has just published a novel, *Handful of Air* (1stBooks Library, Bloomington, Ind., www.1stbooks.com), under his pen name of J.B.Rivard.

He tells the *Lab News* that although *Handful* is a mystery, the protagonist is not the familiar amateur sleuth who brilliantly solves the mystery while everyone around remains baffled.

His protagonist "is instead an everyday sort, an apartment manger," who makes a discovery and soon finds himself in peril. "With jeopardy comes suspense," Joseph says, "although, quite properly for a mystery, 'whodunit' remains a question right to the end."

Joseph says he is available by e-mail for discussions or questions at jbrivard@cet.com.

— Ken Frazier

Coronado Club

June 28 — Bingo: 6 p.m., early bird; 6:15 p.m., regular game. Buffet line and card sales begin at 5 p.m

June 29 — Sunday brunch, 11 a.m.-1 p.m. Dancing with Roger Burns Trio, 1-5 p.m.

July 4 — Barbecue chicken & ribs, baked beans, corn on the cob. Buffet starts at noon. Pool open from 11 a.m.-8 p.m.

Splash down — Every Thursday and Friday evening all summer long, the pool is open until 9 p.m. Buffet line, too.

Fair highlights home, workplace safety

FIT TO BE TIED — Kimberley Craft, a tennis instructor at the Coronado Club, gets a demonstration of an Evac-u-splint during the Safety Fair held June 20 at the club. Information on home and workplace safety was handed out to hundreds of Sandians and their families. After her "rescue" by paramedics, Kimberley was able to continue with tennis lessons. Her dad is Charles Craft (5941). (Photo by Randy Montoya)

KAFB arts and crafts programs available to Sandia employees, families

Clarence Cruz, a Native American storyteller and potter from San Juan Pueblo, on June 29 will help re-launch the Kirtland Air Force Base Skills Development Center, which reopened this month after a brief hiatus. Cruz will tell classic Native American animal stories and provide instruction for youngsters in making and painting modeled clay animals.

The presentations and arts and crafts instructions offered at Kirtland Air Force Base's Skills Development Center are open to all base personnel and related individuals, including Sandia employees and their families.

The Center is located kitty-cornered to Bldg 800, right across the street from the fire station at F and Wyoming streets. It is a service activity in the 377th Services Squadron Community Services Flight.

Storyteller Cruz's presentation is part of the Center's Zoo-to-You Animal Creations workshop for children ages 3 to 11 (with a participating adult family member). It's scheduled for Friday, June 29, 9 a.m. to noon.

The modeled clay animals painted by attendees to the workshop will be fired and available for pickup the next day.

Cost of the program is $27.50 for two family members, with any additional family sign-up covered for $5 each additional person.

The Skills Development Center also has numerous workshops and crafts classes coming up later in the summer and fall, including some workshop trips about local folk arts and free brown bag lunch seminars. Contact Laurie Lange for more information at 846-0588.

Critical dates announced for Sandia President's Quality Award 2001 application process

Sandia developed the President's Quality Award (PQA) criteria in 1992 in an effort to make the Malcolm Baldrige National Award criteria more meaningful to Sandia employees. Project managers and teams are the focus of the PQA Award criteria because they are often the primary interface between Sandia and its customers. Based on feedback by PQA applicants, the PQA process is continually improved in the effort to reward activities that are both high impact and well managed, better serving Sandia customers.

The purpose of the PQA is to:

• Develop awareness of quality as a critical element of Sandia's success,

• Provide an introduction to the use of measurements, processes, and tools to better serve Sandia customers, and

• Recognize jobs well done, as Sandia strives to be better, faster, and more economical on behalf of customers.

Critical dates in 2001 process

July 1, 2001	Release of criteria
Aug. 16, 2001	Applicant Training, CA, Mobile 22
Aug. 20, 2001	Applicant Training, NM Bldg. 811
Aug. 22, 2001	Applicant Training, NM Bldg. 811
Aug. 28, 2001	Applicant Training, NM Bldg. 811
Aug. 30, 2001	Applicant Training, NM Bldg. 811
Sept. 10, 2001	Examiner Training, NM Bldg. 811
Sept. 12, 2001	Examiner Training, NM, Bldg. 811
Sept. 18, 2001	Examiner Training, NM Bldg. 811
Sept. 20, 2001	Examiner Training, NM Bldg. 811
Sept. 25, 2001	Examiner Training, CA, Mobile 22
Oct. 1, 2001	Application deadline, NM and CA (5 p.m.)
Nov. 15, 2001	Examination completed
Nov. 19, 2001	Announcement of winners each VP
Jan. 15, 2002	Awards Ceremony