Robotics Roundup

Robotics Program Looks at Some of Today's Most Pressing Environmental Problems

Imagine a desolate patch of ground, devoid of people but buzzing, whirring, and flashing with the activity of mechanical workers. Sound futuristic? It is, but then again, the year 2000 isn't that far off.

By the turn of the century, predicts Computer Sciences Dept. 1410 Manager Pat Eicker, a new family of mechanical workers will be solving many of today's most pressing environmental problems, including site remediation, waste reduction, and waste cask inspection. New robotics technologies are the key players in DOE's plans to clean up contaminated waste sites nationwide, he says.

And, according to Clyde Frank, Deputy Assistant Secretary of DOE's Office of Technology Development (OTD), Sandia is the "hub" of a multi-lab effort to develop these new robotics technologies for DOE, contributing advanced robotics technologies to a variety of DOE cleanup efforts.

"In the past, people often dreamt up 'whizzy' uses for robots without giving much thought to the ultimate customer or their practical applications," he says. "But new cleanup challenges have spurred renewed interest in robotics development. We're now delivering useful systems to DOE sites as well as some 'whizzy' ideas."

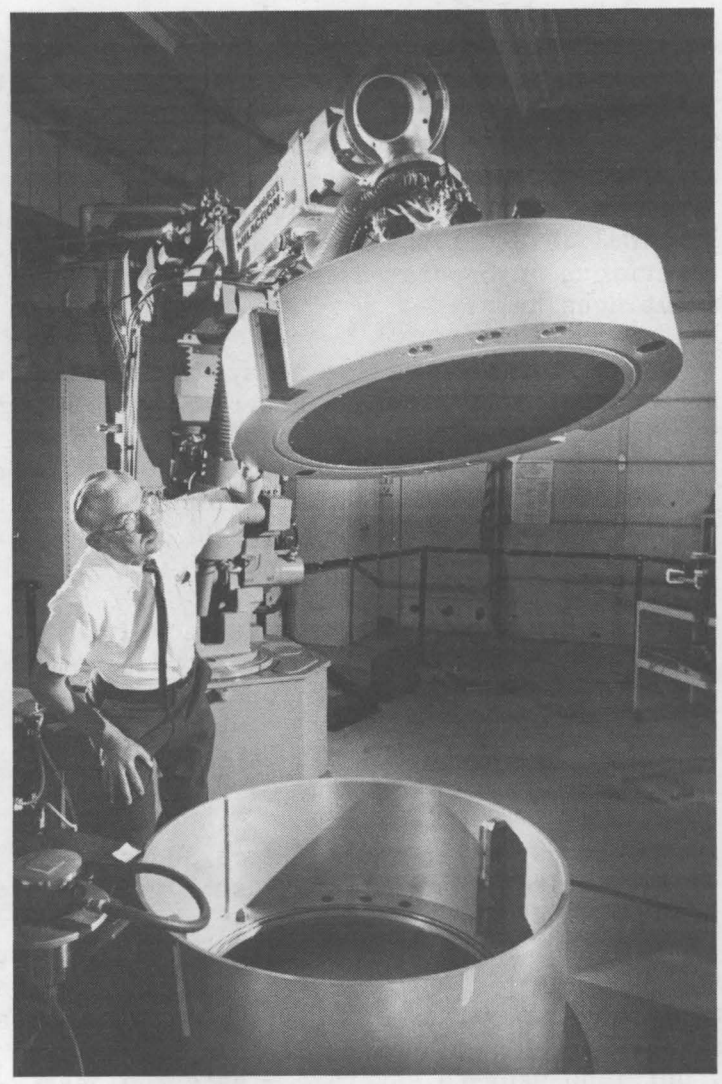
The 'Hub' of a Multi-Lab Effort

Earlier this year, Sandia was named the coordinating laboratory for OTD's "Crosscutting and Advanced Technologies Program" — a program that introduces new, widely applicable technologies for use with a variety of robotics systems. Pat says these new technologies are the building blocks for specific cleanup systems in OTD's other six robotic cleanup programs.

"Each of OTD's programs addresses a specific cleanup challenge within the DOE complex," says Pat. "Sandia is advancing the state-of-the-art in all six areas by introducing technologies that apply to a variety of new systems."

Programs include: facility decontamination and decommissioning, coordinated by Oak Ridge National Laboratory; waste storage tank

(Continued on Page Four)



EXTENDED FAMILY of "smart" robots is helping automate a variety of DOE operations. In Sandia's robot lab, researchers are developing a system that inspects lids on transport casks for high-level radioactive waste. Ben Petterson (1416) is seen checking the underside of a full-scale model of such a cask lid at Sandia's inspection station. (See "Automated Handling Techniques Reduce Waste, Hazards" on page five.) (Photo by Randy Montoya, 3162)

LAB NEWS

VOL. 43, NO. 25 SANDIA NATIONAL LABORATORIES DECEMBER 20, 1991

'Campaign 35' Wrap-Up

ECP Pledges Exceed '91 Campaign Goal

This year, as they've done for 35 years, Albuquerque Sandians pledged more to humanitarian agencies through United Way than they did the year before. The campaign goal for 1991 was $1.5 million. The total amount pledged is $1,528,293, an increase of more than $30,000 from last year.

THANKS, JOE! This year's Employee Contribution Plan (ECP) campaign is also a wrap-up for ECP Executive Secretary Joe Laval (left, 3163), who retires early next year. At the ECP wrap-up luncheon held at the Coronado Club Nov. 14, Executive VP Lee Bray (30) presented Joe with a plaque commemorating his 15 years of service to ECP.

The percentage of Sandians contributing this year is a record 90.2 percent — this is the second year in a row that more than 90 percent of employees have participated. The average annual contribution per participant is $230.

Some 46.1 percent of Sandians participate at the Fair Share level, contributing 0.6 percent of salary (equal to one hour's pay per month) or more; included in this group are the 5.8 percent of Albuquerque employees who participate at the Gold Share level, contributing 1 percent of salary or more.

The directorates with the greatest increase in ECP participation (percentage of employees participating) over last year are Orgs. 3400 and 6600, both up more than 8 percent.

"A highlight of the 1991 campaign was Albuquerque Mayor Louis Saavedra proclaiming Oct. 8 as Sandia Labs Employee Contribution Plan Day for 35 years of giving, totaling more than $20 million," says ECP Chairman Ted Schmidt (6450).

Retirees were invited to participate in ECP for the first time this year, and the initial response has been positive with 47 contributing, Ted says. •

Grass Roots Effort

New Program Helps Sandians Share Bright Ideas

Have you noticed processes affecting your job that could be improved? Have you had trouble with a supplier? Do you know of things your group could do to reduce costs and be more productive?

If so, the Quality Action Request (QAR) form is for you. Prototyped in organizations 7000 and 8000 in Albuquerque and Livermore, QAR is designed to give employees a voice in process improvement and will be implemented throughout Sandia Jan. 6.

Different from the Feedback program, which is a forum for handling specific questions, the QAR targets processes, says project coordinator Whitney Wolf (4311). In fact, a requester may even be invited to become part of the corrective action team formed to address the process in question.

All employees and contractors may use the QAR, says Harold Folley (210), the leader of the team that has been developing the QAR. Blank forms will be mailed to all employees in an upcoming special edition of the *Quality News*. Additional forms will be available in various buildings throughout Sandia, beneath posters that explain how to use them. Forms can also be obtained by

(Continued on Page Eight)

President Narath Thanks Sandians for 1991 Contributions — See Page Two

This & That

It's Barsis Time! – For some reason, we're getting into the habit of publishing feature stories about Computer Sciences and Mathematics Directorate 1400 (led by Ed Barsis) in our last issue of the year. Our final 1990 issue featured massively parallel computing developments at Sandia and how they are being applied. This year, we have a collection of articles by LAB NEWS Writer John German about 1400's work on robots designed for environmental cleanup and protection. I think you'll find these articles interesting and thought-provoking.

And I want to set the record straight. We don't publish articles about 1400 in the final issue of the year because it takes all year to get Ed's many suggestions incorporated and then rewrite stories to his satisfaction. But it does help.

* * *

Always Up – I'm not sure how we've always managed it, even in years that included recessions, economic uncertainty, or a smaller employee population, but Sandians have for 35 years straight given more money every year to the many causes supported by the Employee Contribution Plan. This year is no exception. Your record generosity exceeded $1.52 million, with more than 90 percent of Albuquerque employees contributing (see story on page one).

* * *

I Warned Him! – My boss didn't take me seriously when I told him he should come to the LAB NEWS studio to get his retirement photo made. Alas, I am forced to use the only photo I have of James E. Mitchell, taken on Vision Day last year. Would you buy a used car from this man? Would you buy anything from this man? Or take a piece of candy from him?

This is Jim's last day on the job after a 30-year stint as a writer, supervisor, and for the last 10 years Manager of Public Relations Dept. 3160. I'm not sure where he got it, but one of his standard sayings – slightly paraphrased – will stick with me forever: "There are two things that usually turn out OK, but aren't pretty to watch as they're being made – sausage and the news!" I won't embarrass him by prattling on about his accomplishments, but I do want to say this – he's the best PR man I've ever known, and I've known more than a few! We'll miss you, James.

* * *

See You in '92 – Our next issue will be published Friday, Jan. 10. Deadline for news and ads is noon, Friday, Jan. 3. Here's hoping your holiday break is a safe and happy one and that the weather gods are kinder to us Albuquerque folks during the break than they were during the 1990 break – a bitterly cold one.

* * *

Casual Reminder – It's been about a year since I promoted Informal Fridays. Although some snappier dressers around the Labs have accused me of leading the decline of Western Civilization by promoting this decadent practice, I remain unrepentant! The first Friday of every month is Informal Friday at the Labs, and you are free to wear your spiffy jeans or other casual duds (but clothes that "decent people" would wear, as dear old Mom might say) on all first Fridays. You're equally free to wear a business suit or other finery on Informal Fridays if you truly prefer. But don't be surprised if folks point and laugh! •LP

LAB NEWS

Published Fortnightly on Fridays

SANDIA NATIONAL LABORATORIES

An Equal Opportunity Employer

ALBUQUERQUE, NEW MEXICO 87185-5800
LIVERMORE, CALIFORNIA 94550
TONOPAH, NEVADA
NEVADA TEST SITE
AMARILLO, TEXAS

Sandia National Laboratories, a prime contractor to the US Department of Energy, is operated by Sandia Corporation, a subsidiary of American Telephone and Telegraph Co.

LARRY PERRINE, Editor (505/844-1053)
CHARLES SHIRLEY, Assistant Editor (844-5199)
LINDA DORAN, Writer (844-6210)
JOHN GERMAN, Writer (844-7842)
RANDY MONTOYA, Head Photographer (844-5605)
MARK POULSEN, Photographer and Production Coordinator (844-0421)
JANET CARPENTER, Editorial Assistant (844-7841)
JUANITA MARTINEZ, Assistant (844-7841)
LAB NEWS FAX, (505/844-0645)
BARRY SCHRADER, Livermore Reporter (510/294-2447; FTS 234-2447)

Recent Retirees

Laudente Montoya
7818 10

Jack Burkhardt
9122 33

Jim Winter
7813 43

Bob Kelly
3400 40

1991 — A Year of Change

President Thanks Sandians for Contributions and Dedication

Dear Fellow Sandians:

I want to thank all of you for your many contributions during 1991 — a year that has probably seen and required more changes than any other year in our history.

Reflecting on our changing world and on the many adjustments that we made at Sandia during 1991, I realize that the year has not been an easy one for us. In addition to our usual steady flow of technical accomplishments, we had some especially noteworthy accomplishments this year and initiated many changes that should serve us well in future years. We

- Reaffirmed our commitment to DOE's agenda and adopted the Baldrige National Quality Award criteria as a guide for improving the management of the Labs.
- Continued Strategic Planning and defined a set of core competencies around which we can concentrate future work.
- Achieved much progress in making Quality an integral part of our normal processes.
- Prepared for the ES&H Tiger Team visit and got generally high marks and praise for our efforts.
- In numerous ways, contributed to the success of military and government operations before, during, and after the Persian Gulf War.
- Started the Upward Feedback program to give employees the opportunity to evaluate Sandia management and offer suggestions for improvement.
- Reorganized management to reflect an increasing customer emphasis and began a restructuring effort to reduce the number of management positions.
- Completed a major employee survey (Sandians' Perspective) to better understand employee needs, concerns, and attitudes.
- Expanded our work with industry and entered into a number of CRADAs — cooperative research and development agreements — with US industry.
- Held well-attended Family Days at the Labs in Albuquerque and Livermore.
- Started the Science Advisors and School Partnership programs that — with other Sandia educational initiatives — are helping students and teachers better understand and appreciate science and math.
- Set records for employee participation in our Savings Bonds and employee-giving programs (ECP and LEAP programs).

I could list many others, but I think this list makes the point about a very busy and productive year — our progress is impressive. Again, thank you for your hard work and dedication. Your efforts are genuinely appreciated.

Al Narath
President

Help Us Recognize Sandians

The LAB NEWS wants to recognize Sandia employees and retirees for outstanding achievements — work-related and community-related.

Has your friend, colleague, boss, or employee been honored for good works in a community or professional group? Named a fellow or elected to an office in a professional society? Received a best-paper award at a meeting? Had a book published?

If so, keep the LAB NEWS in mind so we can give these folks a nod. Give us a call at 844-7841, or send a note with a few details to Division 3162.

Working Together

Sandians Reach Out to Help Fellow Employee, Residents in Aftermath of October Firestorm

On a nightmarish Sunday last October, a firestorm that destroyed more than 2,000 homes and apartments left Jay Keller (8364) and his family homeless, along with 5,000 other East Bay residents.

Jay, his wife Renee, and their two children, 10-year-old Julia and 6-year-old Daniel, were at home planning a bike ride when they first noticed smoke billowing skyward north of Route 24. Their home was on Wilding Lane, just south of Broadway Terrace and Route 24, a half-mile west of Route 13.

"We became concerned when the flames leaped Route 24," says Jay. "By noon, we began making plans for evacuation and collecting some personal belongings to take along. We had the kids go to their rooms and gather up personal effects of importance to them. Our son even stuffed a grocery bag full of his favorite clothes."

They worried about their pets — a cat and a bird, plus a turtle and some fish. All were eventually rescued except the fish. They went through the house collecting things they cherished that would fit into their two cars.

ALL THAT REMAINS of Jay Keller's home on Wilding Lane are a foundation and fireplace shell. Jay's home was the fourth of four destroyed on the north side of the street. The other homes on Wilding survived more or less intact, as evidenced by the one seen here in the background.

Friends and Employees Help Out

This month, Sandia employees presented Jay with a tabletop Christmas tree and ornaments in an effort to spread some holiday cheer in the aftermath of the Oct. 20 firestorm that devastated the Oakland and Berkeley hills.

"By noon, we began making plans for evacuation and collecting some personal belongings to take along."

Employees and friends have contributed in other ways as well. Many have lent the family furniture and household items to help them get by during the long, slow process of settling insurance claims and beginning to replace their belongings.

Jay says they were fortunate to find a rental house on Skyline Boulevard, where they plan to stay until they rebuild their home. Meanwhile, Jay's wife has relocated her landscape architectural business to an office in the home of a friend, Nina Bergan (5377).

A Race Against Time

"At some point when the flames got closer, we turned to watering down the house," Jay recalls. "The water pressure, normally quite high (150 psi) in our neighborhood, was down to 30 psi. As the fire grew, it dropped even further to about 15 psi. We couldn't even reach the roof with our garden hose. We had no firefighting tools and realized it was hopeless to keep that up." Their woodframe house was a tri-level with a shake roof.

A friend drove up at about 2 p.m. and took their two children and some belongings away. Jay and his wife made another sweep through the house looking for memorabilia. "Then the fireballs started dropping down all around our area, and houses were exploding on the street north of us. We knew we had to leave right away [just before 4 p.m.]."

The sky was raining embers and burning pine cones as they rushed down the hill to safety. When they were able to return to their neighborhood the following Tuesday, they found that the first four houses on the north side of Wilding Lane were gone. Theirs was the fourth — the rest of the block had been spared.

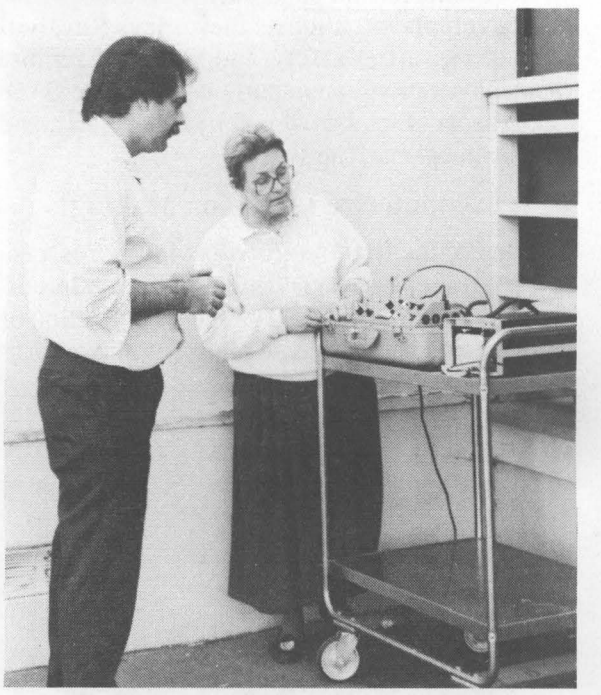
Sandia Helps Monitor Environment

Now Jay has turned his attention to helping deal with a potential threat to the neighborhood school attended by his daughter. The Hillcrest Elementary School, which survived the fire, is surrounded on three sides by gutted homes and charred trees. Recently a parents' group met to discuss safety concerns about hazardous materials left in the wake of the firestorm. Because many homes in the area were built with asbestos, they were concerned that asbestos fibers stirred up by winds or reconstruction may become airborne.

"There was absolutely no data on what kind of health threat this poses in the neighborhood," says Jay, "and I knew Sandia has the technology to help determine whether a danger exists."

At Jay's request, Sandia provided the school with a particulate monitoring device that collects fibers from the air for analysis. Don Patrician (8541) helped supply the equipment. Batch samples are now being taken by the Air Quality Management District to determine if asbestos is present. Jay also obtained a strip chart recorder that enables the device to record data.

Jay estimates it will be 18 to 24 months before he and his family are back in a new home on the same lot, but says they are determined to reclaim the "friendly neighborhood" street they have called home for the past 10 years. •BLS



EXAMINING PARTICULATE monitoring device provided to Hillcrest School by Sandia are Jay Keller (8364) and Principal Layton Dixon.

SANDIA LIVERMORE NEWS

Sympathy

To Al Elsea (8271) on the death of his brother in Reno, Oct. 23.

To Bob Pilkey (8275) on the death of his father in Yountville, Calif., Dec. 3.

To Nancy Zehnder (8526) on the death of her grandfather in Livermore, Nov. 19.

HOLIDAY SPIRIT — Some 200 Livermore area residents will receive gifts through the LEAP (Livermore Employee Assistance Program) Holiday Gift Campaign, intended to spread holiday cheer to those less fortunate. Sandians (from left) Renee Haynes (8531), Karen Simkins (5355), and Barbara Demo (5366) sort pledge cards from employees who signed up in November to be matched with needs. Mark Perra (8314) organized the campaign.

(Continued from Page One)

Robotics Program

characterization and cleanup (Hanford); buried waste characterization and cleanup (Idaho National Engineering Lab); waste facilities operations (Savannah River); chemical analysis automation (Los Alamos National Lab); and waste minimization technologies (Lawrence Livermore National Lab).

New Line of Capabilities

Ray Harrigan, Supervisor of Intelligent Machine Systems Div. 1414, says recent research at Sandia is providing the new DOE cleanup robots with capabilities never before available in commercial systems. For instance, automatic planning and programming software has been developed that allows a robot to program itself. In addition, sensor-and-model-based control systems are helping robots recognize and manipulate objects and perform other tasks without the aid of a human operator. (See "Recent Sandia Research Focuses on Robot Smarts" on page six.)

Developments such as these, says Ray, will help increase the safety and speed of remote cleanup operations, an important goal of the OTD. "The robots of tomorrow will be faster, safer, and cheaper to operate," he says.

Computerized Decision Making

One of the first outgrowths of the Crosscutting program, he says, is Sandia's Generic Intelligent System Controller (GISC) — a collection of software and hardware that allows a robot to program itself to work autonomously and make simple decisions without the help of a human operator. GISC software collects information supplied by a robot's sensors and keeps a three-dimensional computer model of its surroundings, which is constantly being updated. Using this model, the robot can survey its path ahead of time and avoid obstacles, maneuver, or perform other functions autonomously.

The GISC software package is arranged in small digestible chunks of computer code, each of which helps a robot perform a particular set of well-defined functions. For instance, general instructions (such as "move from here to there") are converted by GISC to specific, detailed commands that a robot "understands" (that is, "release brakes, accelerate to speed *x* for *y* seconds, apply brakes, etc."). Taken together, this combination of maneuvers appears fairly complicated, but broken down into individual tasks, the move is relatively simple.

General instructions are converted to specific, detailed commands that a robot "understands."

Another advantage of using a generic controller such as GISC is that a new robot can be adapted to a specific task in much less time. That's because GISC can translate a set of "generic" system commands into a robot's "native tongue," a computer programming code specific to each robotic system. "Because GISC can 'communicate' with almost any robot, commercial or otherwise," says Ray, "DOE can buy a new commercial robot and already have most of the control system in hand for using it."

GISC can also speed up certain tasks, he says. Each time a crane operator uses a crane or gantry to move a heavy object, for example, he or she must wait until the object stops swinging before setting it down again. Because an object at the end of the cable acts as a pendulum, this could last several minutes.

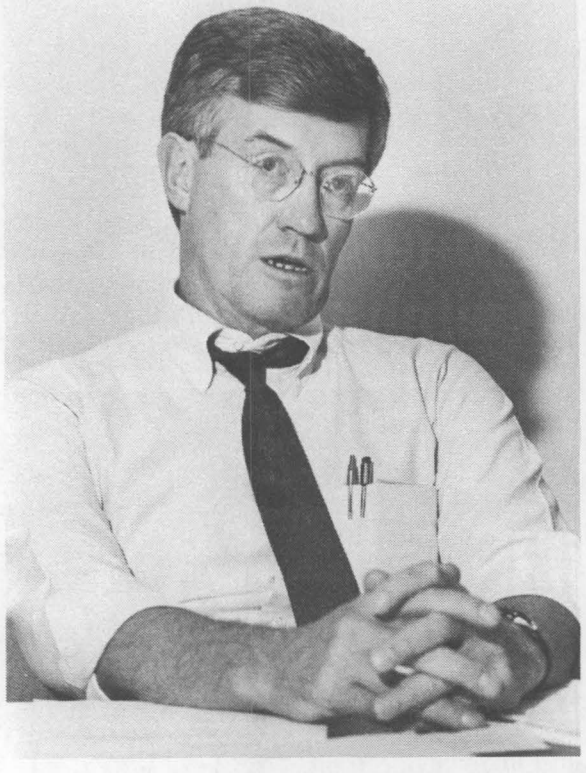
But "swing-free" software developed several years ago at Sandia can model the physics of an object and modify a crane's movements so that when the object arrives at its destination, it hangs virtually still. Such "swing-free" technology is useful at proposed nuclear waste handling facilities, such as the Waste Isolation Pilot Plant in southern New Mexico and the Yucca Mountain repository in Nevada, where the productivity of each crane or gantry can be increased by as much as 100 times and, therefore, the number of pieces of equipment reduced, says Ray.

Contrived Sixth Sense

"Using sensors and computer models, many robots make decisions in specific situations," says Ray, "but a human operator must help a robot perform functions that require complex decisions."

With this in mind, researchers in Dept. 1410 are developing techniques that allow a human

(Continued on Next Page)



PAT EICKER, Manager of Computer Sciences Dept. 1410: "New cleanup challenges have spurred renewed interest in robotics development."

Faster, Safer, Cheaper, and More Attractive

Successes Spark Commercial Interest

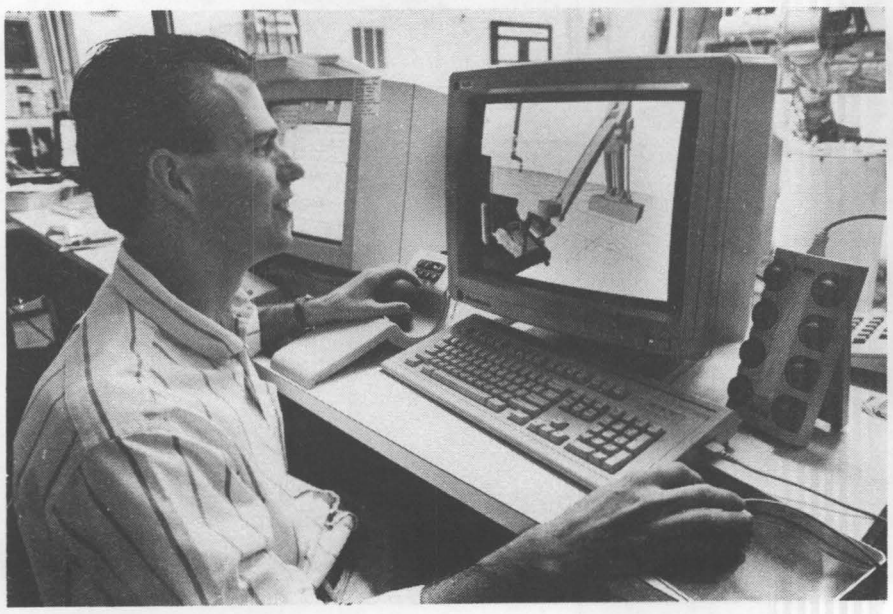
Faster, safer, cheaper — that's what's happening in robotics development right now, says Pat Eicker, Manager of Computer Sciences Dept. 1410. And recent DOE successes developing faster, safer, and cheaper robots to solve real-world problems are making robots look a lot more attractive to the private sector, he adds.

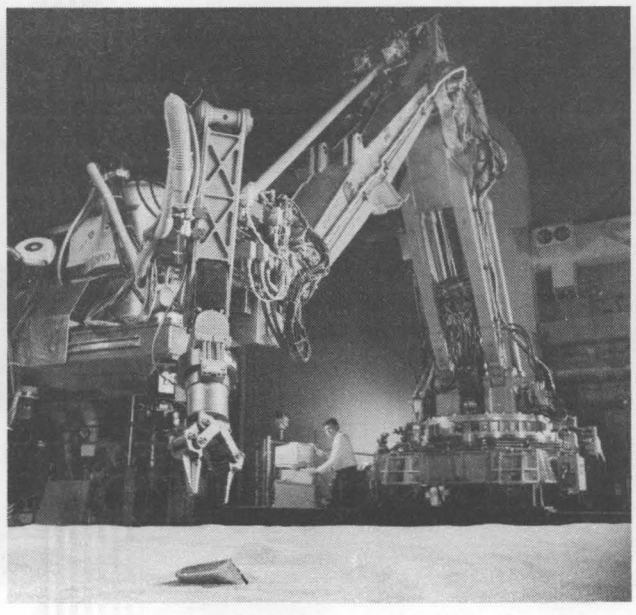
Industries are now considering using some of DOE's time- and cost-saving automation technologies to improve their day-to-day operations. Sensor-and-model-based control technologies can increase the speed and safety of commercial manufacturing processes, for example, and automatic planning and programming will allow robots to be used in new ways (see main article).

In addition, says Pat, system control software recently developed at Sandia allows complex intelligent robotics systems to be built much faster than was previously possible. "Because this software can communicate with almost any robot," he says, "a complex multi-arm system was integrated at the Hanford site into a single, working system in only eight weeks [see "Cleanup Robots," page six]. Such time-saving technology will be particularly valuable to industry."

Some software components developed at Sandia are creating commercial interest, he says. These include the Intelligent System Operating Environment, which allows a variety of robots, sensors, computers, and other devices to communicate reliably with each other; the Robot Independent Programming Environment and Language, which permits a single programming language and model to be used regardless of a robot's application or combination of components; and Graphical Programming and Control software, which provides a graphics-based user interface for site remediation technicians.

In addition, some Labs robotics technologies are already proving useful to industry. For instance, Sandia's "swing-free" controller technology has been adapted for use in commercially available gantry robots by CIMCORP, a manufacturer of commercial robots. Also, GISC-based graphics control software called the TeleRobotic Interface is being marketed by Deneb, a graphics software company, to enhance graphical control of industrial robots.





LIKE BEING THERE — Sandia researchers are developing "virtual reality" techniques that deliver an "almost real" representation of a robot's surroundings to a human operator's control panel. On Brian Christensen's (1414) computer screen (left), for example, robot sensor data is converted to information that is more readily understandable to an operator, in this case a three-dimensional representation of a double-arm robot (right) under development at the Hanford site (see "Cleanup Robots," page six).

Waste Booties, Gloves, and Smocks

Automated Handling Techniques Reduce Waste, Hazards

Helping clean up the nation's outdated production plants and reactors is an important mission for robotics technologies. But DOE envisions using robots to stop contamination at the source as well, thus minimizing the amount of waste generated in DOE work and avoiding the necessity of future cleanups.

"Studies at certain DOE sites attribute 70 to 80 percent of contaminated waste to human handling of hazardous and radioactive materials," says Ray Harrigan, Supervisor of Intelligent Machine Systems Div. 1414. "By automating tasks that once required human handling of these materials, we could significantly reduce this source of waste."

And taking humans out of the handling loop not only eliminates a significant source of waste — including protective clothing such as booties, gloves, and smocks — it also reduces unnecessary human exposures to radiation and other hazardous materials, he says.

"DOE mandates keeping human exposures 'As Low As Reasonably Achievable,' " says Ray. "Automating tasks that result in unnecessary handling by workers virtually eliminates these exposures."

Handling Potentially 'Hot' Items

Two new DOE development programs — the waste facilities operations program and the waste minimization technologies program — are now looking at ways to reduce waste generation by automating some DOE operations. Successful automation of these operations, says Ray, will require Sandia's automatic planning and programming and sensor-and-model-based control technologies (see article beginning on page one).

At waste handling facilities, for instance, the labeling, storing, shipping, unloading, and disposing of waste could be automated, significantly reducing waste output and taking humans out of the handling loop. One such operation is cask and drum handling at the Waste Isolation Pilot Plant (WIPP) in southern New Mexico, says Ray.

"Studies at certain DOE sites attribute 70 to 80 percent of contaminated waste to human handling."

When waste arrives at WIPP, it will be contained in large transport casks called TRUPACTs, each containing many barrels of waste. Aboveground automated handling stations are needed at these sites to inspect transport casks for leaks and surface radiation and then unload their contents.

Proposed stations will employ sensor-and-model-based control software to make inspection possible and to increase the safety of the operation. A small-scale model of such a handling station for unloading TRUPACT containers is now being built in Sandia's robot lab.

Labs robotics researchers also had a hand in designing transport casks for high-level waste from commercial nuclear reactors, notes Ray. Using a half-scale model of a high-level cask and a small "smart" gantry, they studied the dynamics of handling such casks. In addition, a full-scale system that inspects cask heads, or lids, on high-level casks is now being studied at Sandia. The concepts developed here are expected be used at the proposed Yucca Mountain facility in Nevada, where high-level waste may be stored.

Gloveboxes and Mechanical Hands

Also using Sandia "smart" robot technologies, Sandia and Lawrence Livermore National Laboratory are designing gloveboxes that use robotic arms rather than lead-lined gloves and human hands to manipulate materials inside.

Other automation technologies developed at Sandia include "Robo Op," a mobile robot that inspects underground waste storage rooms at the WIPP site, and a new system for use at the Pantex plant that will help disassemble decommissioned nuclear weapons (see "Disassembly Robot Helps Scale Up US Weapons 'Build-Down' ").

"Automated systems such as these will help cut down on waste in a number of DOE operations," says Ray. "Once developed, many are adaptable to commercial operations outside the weapon complex." •JG

On the Road to Pantex

Disassembly Robot Helps Scale Up US Weapons 'Build-Down'

Workers at DOE's Pantex plant in Amarillo have a pretty strict dress code when it comes to weapon disassembly: lead-lined apron, gloves, and a dosimeter on the body and another on one hand, for starters.

That's because disassembling the explosive portion of a nuclear weapon — the part containing high explosives and weapon-grade uranium or plutonium — requires a lot of physical protection.

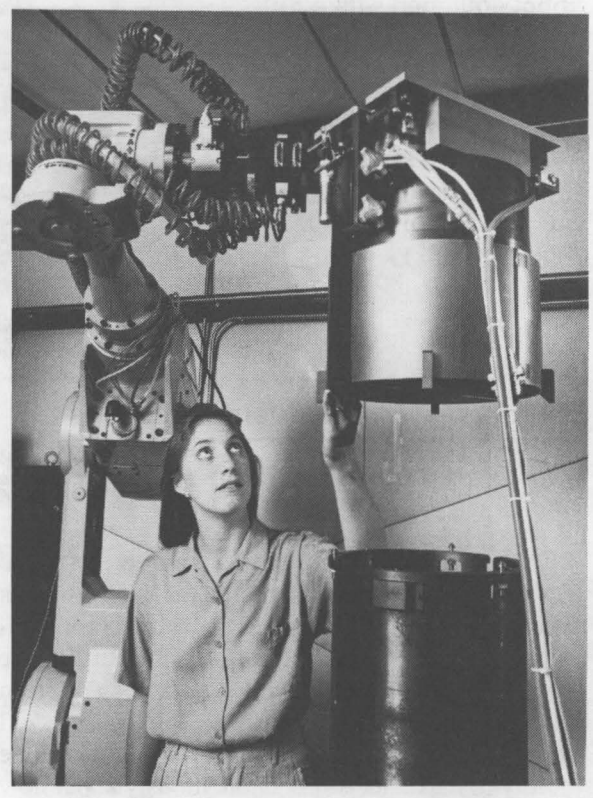
During disassembly, the radioactive "pit" of the weapon must be removed, physically separated from the high explosive portion, locked into a special handling fixture, and then placed inside a drum for storage or transport. Workers now do this work by hand, moving quickly to avoid unnecessary exposure. The procedure also generates some low-level radioactive waste in the form of contaminated protective clothing, notes Pat Eicker (1410).

But a new, automated disassembly system currently under development at Sandia may soon do this work, eliminating any direct human handling of radioactive materials. This system, says Jill Fahrenholtz of Intelligent Machine Technologies Div. 1416, employs sensor-and-model-based control software to manipulate bomb parts. This includes separating the two explosive portions of a weapon using water pressure and then placing them in their appropriate containers.

Robot movements are planned using Sandia's automatic planning and programming software. This pre-programming of the robot's actions allows movement only in specified areas of the workspace, an important safety feature of the system.

Al Jones, Supervisor of Div. 1416, says a prototype of the disassembly system will be tested at the Pantex plant starting this fiscal year, and plans are under way to build several similar devices.

"There will be a lot more weapon disassembly to do in the future as a result of stockpile build-down," says Al. "This system is just one way robotics technologies can help meet this increasing demand while minimizing worker exposure and minimizing waste output from DOE operations."



JILL FAHRENHOLTZ of Intelligent Machine Technologies Div. 1416 examines a robotic system under development at Sandia that will help disassemble decommissioned nuclear weapons. Disassembly work is expected to increase as the US reduces its nuclear weapons arsenal. (See "Disassembly Robot Helps Scale Up US Weapons 'Build-Down.' ")

(Continued from Preceding Page)

Robotics Program

operator to see and feel from far away what a robot "sees and feels" with its eyes and ears — its sensor array. These techniques — called "virtual reality" — use GISC's graphical computer model to deliver an "almost real" representation of a robot's surroundings to a human operator's control panel. "Virtual reality lets an operator know what's going on in terms that he or she can understand," says Ray.

A remote computer screen, for example, can display a moving picture of a robot's surroundings — such as the inside wall of an underground storage tank or a rocky terrain. Or, by introducing a signal to an operator's control joystick, such as a resistant force or warning sound whenever a robot gets too close to an object, an operator eventually develops a contrived "sixth sense" of the robot's surroundings.

In addition to coordinating robotics cleanup work at other DOE labs, Sandia is also working closely with DOE facilities slated for major cleanup, says Pat. Demonstrations of fully integrated cleanup systems will take place at the underground waste storage tanks at the Hanford site (see page six), buried radioactive waste sites at the Idaho National Engineering Lab (INEL), aboveground waste silos at the Fernald Environmental Management Site in Ohio, and at a mixed-waste landfill at Sandia.

Other projects include establishing cooperative R&D projects with several universities and transferring new Labs robotics technologies to industry. "DOE's successes at finding practical, cost-saving applications for robotics technologies are encouraging others, including the private sector, to do the same," he says. (See "Successes Spark Commercial Interest" on page four.) •JG

Scraping, Scooping, and Carting Away

Cleanup Robots Help Decontaminate Old Reactors & Plants

Black and yellow signs caution: "No Admittance" and "Danger: Radiation Area," but the warnings go unheeded by at least one worker whose job it is to find and remove buried hazardous and radioactive materials so that someday the warning signs might be removed.

Named RETRVIR (for Remote TeleRobotic Vehicle for Intelligent Retrieval) by its Sandia developers, the fearless worker is, of course, a mobile robot, cousin to several new robots developed to help clean up DOE waste storage sites.

This new "extended family" of robots under development at Sandia and other laboratories is expected to play a major role in DOE's Buried Waste Program, a program devoted to cleaning up buried radioactive and hazardous waste at sites such as Sandia and Idaho National Engineering Laboratory (INEL), where waste from nearly 50 years of radioactive materials processing is stored in underground trenches.

"Sandia's role will be to help demonstrate to DOE a team of working robots that together can perform the gamut of standard operations expected in any cleanup operation," says Pat Eicker, Manager of Computer Sciences Dept. 1410. "Robots such as RETRVIR are among the most practical, efficient, and safe ways to clean up sites where it's hazardous for people to go."

Autonomous ATV

RETRVIR is a Honda all-terrain vehicle equipped with a 6-ft. robotic arm for digging and picking up pieces of contaminated material and placing them in storage containers. RETRVIR drives itself, using automatic planning software and sensor data to avoid obstacles and make other decisions autonomously (see article beginning on page one).

Currently, RETRVIR's manipulator arm is controlled manually by a human operator who uses a trackball or joystick to grab and manipulate objects that appear on a remote video screen. Unfortunately, says Pat, this process is slow and sometimes dangerous because a remotely controlled arm has minimal dexterity. Momentary clumsiness could cause RETRVIR to rupture or spill a container of contaminated material.

Sandia researchers are now developing smart robot technology that will make RETRVIR's arm self-guided as well. Using automatic planning and programming software in conjunction with sensor-and-model-based control software (see "Recent Sandia Research Focuses on Robot Smarts," below), RETRVIR may soon be able to recognize familiar objects, such as half-buried waste drums, and understand how to grasp and remove them.

Then, if a human operator wants an object removed, he or she must simply point to the object on the video screen using a mouse, and RETRVIR will plan its own maneuvers and remove the object autonomously. "Such automatic maneuvering can speed up and improve many remotely controlled operations that are tedious and potentially dangerous," says Pat.

At places such as INEL, where waste is buried underground, mobile robots such as RETRVIR are needed to transport sensors and tools to remote sites for mapping and cleaning up "hot spots" before a major cleanup takes place so site operators can decide when and how to remove the waste safely.

"The main objective is to detect and remove any particularly 'hot' items before a major retrieval takes place," says Peter Boissiere (1414), RETRVIR project leader. (RETRVIR is a joint project of Dept. 1410 and Advanced Technology Div. 9567.)

FEARLESS WORKER — Sandia's Remote TeleRobotic Vehicle for Intelligent Retrieval, better known as RETRVIR, is a mobile robot equipped with a 6-ft. robotic arm for digging and picking up pieces of contaminated material and placing them in storage containers. RETRVIR goes where it's unsafe for people to go. (Photo by Mark Poulsen, 3162)

Other, Less Mobile Robots

Sandia is currently applying the same robot "smart" technology to several other robotics systems, enabling them to perform a wide variety of cleanup functions, says Ray Harrigan, Supervisor of Intelligent Machine Systems Div. 1414.

At the Hanford plant in Hanford, Wash., for instance, DOE is testing a three-arm system that will one day map the insides of underground storage

(Continued on Next Page)

Increasingly Intelligent Machines

Recent Sandia Research Focuses on Robot Smarts

In industry, "dumb" robots are often effective for turning out hundreds of thousands of products in a highly structured, repetitive manufacturing environment, says Pat Eicker (1410). But in site cleanup operations, where workspaces are often unstructured and where a robot might be expected to perform any number of tasks, a robot needs the ability to make decisions autonomously about how to perform its job.

Research conducted at Sandia during the last few years is providing DOE's new line of cleanup robots with greater "thinking" ability than ever before, says Ed Barsis, Director of Computer Sciences and Mathematics 1400. For example, automatic planning and programming software has been developed that allows a robot to program itself to do specific jobs in a variety of workspaces.

Traditionally, robots have been "taught" the geometry of a room or workspace by a human operator, who uses a calculator-looking device called a teach pendant to program "*x*, *y* coordinates" into the robot's memory point by point. After coordinates are stored, a program is written that allows the robot to do a single, repetitive job within its confines.

Sandia researchers have now developed generic programs that, when fed the geometry of a room and the location of obstacles, will automatically train a robot to perform its job within the confines of any workspace. Combined with new sensor-and-model-based control systems also developed at Sandia, robots can now measure their own workspaces and make decisions autonomously about how to perform their jobs.

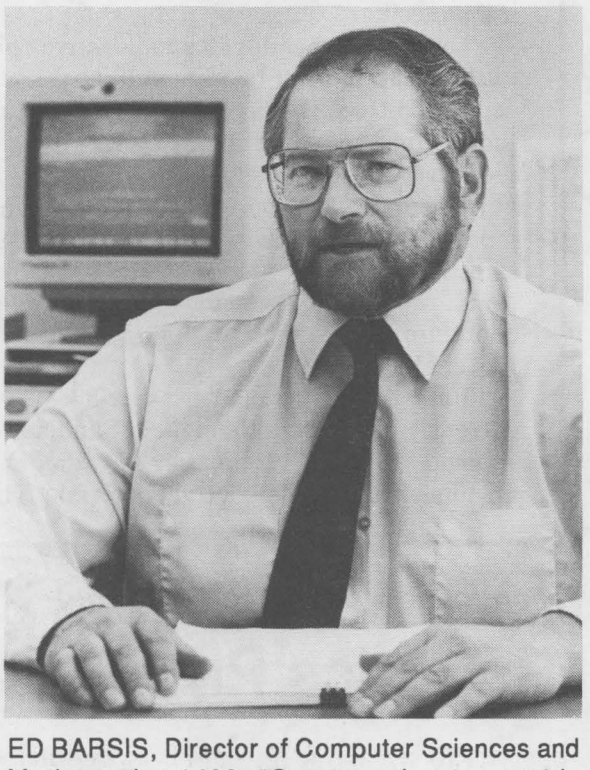
Sensor Smarts

These new sensor-and-model systems, says Pat, allow a robot to build a three-dimensional computer model of its surroundings or of objects based on sensor information. Then, using this model, the robot can react to and avoid unexpected obstacles and plan its own actions. In addition, a robot can be taught to recognize certain objects within its workspace based on a memory library of three-dimensional computer models.

For example, says Ed, if a mobile robot locates a 55-gal. drum during a cleanup operation, a human operator could decide to remove it by pointing to the drum on his or her computer screen using a mouse. The robot then moves toward the drum, uses sensors to build a three-dimensional model of the drum, decides how best to manipulate it, and then automatically removes it, all the while updating its computer model.

In addition, sensors and models are being used to mimic the actions of humans, he says. For example, in removing a fastening nut from a shipping container, a robot will align a wrench by "feeling" the nut using force sensors in conjunction with a Sandia-developed grasping algorithm (see "Robots: Much More than Mechanics" on page seven).

"Greater robot 'smarts' is Sandia's most significant contribution to DOE's robotics programs," says Ed. "Sandia will continue to call upon its technical base in robotics as DOE expands the role of robotics in its operations." •JG



ED BARSIS, Director of Computer Sciences and Mathematics 1400: "Greater robot 'smarts' is Sandia's most significant contribution to DOE's robotics programs."

(Continued from Preceding Page)

Cleanup Robots

tanks and then remove radioactive and hazardous "sludge." The system consists of a single arm that inpects the insides of tanks and a double-arm system that maps the tanks' contents and removes waste. (See "Underground Challenge: Peanut-Buttery Sludge" below.)

One of Sandia's contributions to the Hanford system is the control software, which controls the robotic arms and integrates them for use with various sensors and tools (see article beginning on page one). Sandians worked with researchers from Hanford, Pacific Northwest Laboratories, Oak Ridge National Laboratory, and INEL to get the system fully integrated for a successful Aug. 22 demonstration for DOE officials.

"Using tools and sensors in conjunction with intelligence software really expands a robot's range of capabilities."

Similar integrated systems have been developed to help clean up other DOE sites such as the Fernald Environmental Management Center in Ohio, where radioactive and hazardous wastes are stored in aboveground silos.

Sandia and Oak Ridge have developed a laser mapping sensor system that measures the thickness of clay caps covering the waste inside silos. This sensor has already been used to map the original waste surfaces in the silos, helping Fernald complete a key milestone mandated by the Environmental Protection Agency. A similar system will probably be used to map waste at the Hanford site as well, says Pat.

Other robots under DOE's new Decontamination and Decommissioning program ("D&D" for short) will incorporate Sandia's new smart robot software to clean up outdated production plants and reactors within the weapon complex. One of these new robots will find contaminated pipes in DOE chemical plants and then decide how best to remove them using a giant "chomper" tool. Another will be able to locate a contaminated surface, such as a wall, and decontaminate it by scraping away and removing a portion of its surface.

Gamut of Required Operations

One way to meet the wide range of requirements expected in any cleanup operation, says Ray, is to use robot smart software in conjunction with a set of specialized tools and sensors, each with a specific function and adaptable to a number of robots.

The software — including automatic planning and programming and sensor-and-model-based control systems developed at Sandia — allows a robot to "think" and plan its actions in an unstructured work environment, characteristic in any remote cleanup operation. During cleanup, then, a robot is able to choose and then grasp from its "tool box" the best tool for the job.

Tools include scalers that break hardened waste into chunks, pipe cutters, welding torches, and grabbers for picking up and manipulating objects. Sensor packages include ground-penetrating radars for looking at geological features, chemical sensors for detecting vapors, radiation sensors for finding "hot spots," and seismic sensors that create three-dimensional maps by examining shock waves.

"Using a variety of tools and sensors in conjunction with intelligence software really expands a robot's range of capabilities and increases its value to DOE," says Ray. "Demonstrating these functions is just one more way Sandia can help get things rolling for DOE's site cleanup efforts." •JG

The Mathematics of the Matter

Robots: Much More Than Mechanics

Say "robot" and most people think of a complex piece of machinery made of metal and wire that moves around in a certain way to accomplish a specific task.

But Pat Eicker, Manager of Computer Sciences Dept. 1410, says today's robots are much more than just mechanics. "Smart" robot technologies, such as Sandia's automatic planning and programming and sensor-and-model-based control technologies, are made possible through an understanding of advanced computer science and mathematics.

For instance, says Pat, today's intelligent robots know how to avoid unexpected obstacles in their paths — a giant step forward in robot safety. Using sensors and sophisticated "search" algorithms, a robot can recognize an obstacle and choose a new path from hundreds of possible paths. The trick is to put mathematical limits on the amount of searching the robot does, says Pat. "It's how you mathematically structure the search that allows a robot to choose from a very large number of possibilities," he says.

In addition, he says, Sandia has developed algorithms that allow robots to mimic the actions of humans in performing certain tasks, such as part insertion. These alogrithms result in a robot's capability to "feel" for a proper fit rather than requiring very precise alignment and position locations, a costly and time-consuming requirement.

Sandia also has demonstrated leadership in developing computer programming languages specific to the special needs of robotics applications, says Pat. These languages carry with them a set of instructions specific to the programming of robots.

"People who program computers for scientific calculations use programming languages specific to their discipline," says Pat. "Similarly, languages have been developed specifically for robot programming that provide a way to communicate with the mechanical portion of a robot through a computer."

Sandia's research in programming languages for intelligent machines has led to development of the Robot Independent Programming Language and Environment, which has been adopted by robot programmers DOE-wide. RIPL provides the language by which complex real-time robotics systems — consisting of robots, computers, and sensors — can be programmed, says Pat.

Don't Know, Can't Go

Underground Challenge: Peanut-Buttery Sludge

Some of the sludge at the bottom of underground storage tanks (USTs) at DOE's Hanford site is completely solid, and some has the consistency of peanut butter.

During the past 40 years, waste chemicals from uranium and plutonium processing at the plant have been dumped into these tanks, evaporating at different rates. Some of the single-shelled tanks may have leaks, making the site one of DOE's top cleanup priorities.

"There are 149 single-shell USTs at Hanford, each containing a number of different hazardous materials," says Ray Harrigan (1414). "Under current Environmental Protection Agency guidelines, unknown materials must be identified before being disturbed, so the first task for cleanup robots at Hanford will be to characterize what's down there."

In Situ Sensing

But taking hundreds of samples from each of 149 tanks is costly and time consuming. A single core sample can cost half-a-million dollars and take six months to analyze. Each core sample involves hundreds of individual chemical analyses, and sample material cannot be handled directly by a worker.

That's why researchers in Intelligent Machine Principles Div. 1411 are developing miniaturized sensor packages, called minilabs, that can accompany a robot underground and analyze the sludge remotely. This *in situ* sensing capability, says John Feddema (1411), significantly speeds up sample analysis.

Each sensor package, integrated by Sandia's sensor-and-model-based control software, may include temperature, humidity, pressure, oxygen, or hydrogen sensors, broad-band gamma sensors, gamma spectrometers, and gas chromatographs, as well as physical sensors capable of mapping the inside surfaces of a tank and its contents.

On-Site Analysis Labs

In some cases, says Mike Griesmeyer (1414), analysis cannot be carried out *in situ*. Automated chemical analysis laboratories are being developed for use in aboveground hot cells at sites such as Hanford, where many samples need to be analyzed quickly and accurately. Sandia is now developing analysis modules — individual labs consisting of the equipment and associated software needed to perform a single chemical analysis function — for these on-site laboratories. A combination of modules can be strung together, using Sandia's Generic Intelligent System Controller, to perform a complete analysis of a sample.

Says Mike: "These automated 'plug & play' labs will turn out analyses quickly and with a high degree of repeatability, which will allow us to compare our results accurately with environmental standards." Development of the automated chemical analysis labs is a collaborative effort of Sandia, Los Alamos National Laboratory, Idaho National Engineering Laboratory, and Pacific Northwest Laboratories.

Sandia is also working with the Consortium for Automated Analysis Laboratories Systems (CAALS), sponsored by the National Institute of Standards and Technology, whose purpose is to establish standard interfaces to connect analysis modules manufactured by different companies.

" 'Plug & play' will not work unless there's a way to join individual chemical analysis modules," Mike says. "Sandia will help establish a standard set of commands and develop software so that these labs will provide consistent, verifiable results regardless of the combination of modules used." CAALS-member companies will be the first to use Sandia 'smart' software commercially, says Mike.

(Continued from Page One)

Bright Ideas

calling the Quality Hotline on 5-9497.

Albuquerque employees may submit their completed forms to Quality Support Div. 4311, Livermore employees to Component Development Div. 8441. These two organizations will also provide assistance to corrective action teams and publicize success stories.

While it is not essential to submit your name, organization, and phone number in order to use the QAR, this information does enable the corrective action team to ask questions, provide information on the status of the request, or ask the requestor to participate.

What Happens to Requests?

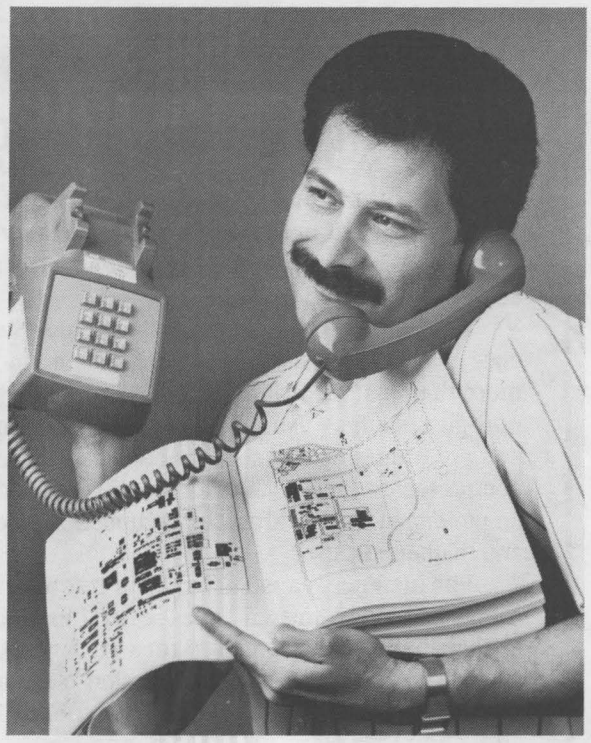
Once a QAR is received, it will be entered into the QAR data base. The requestor, if identified, will receive an acknowledgment.

As a rule, QARs will then be assigned to the appropriate center (directorate) for action. Corporatewide issues will be sent to a QAR screening board, which will include a union representative and people involved in ES&H processes and the Feedback program. This screening board will also review Feedback and ES&H issues for opportunities for improvement.

The QAR system replaces Barrier Busters, a panel of employees that until earlier this year reviewed and improved inefficient practices. Like Barrier Busters, QARs allow people involved in Sandia operations to share their concerns and recommendations. Similar employee input programs have led to significant improvements at other companies, such as Florida Power and Light, the first US-based company to win the Deming Prize for quality.

The development of the QAR process has been a team effort involving many Sandians. In Albuquerque, team members include Art Trujillo (4313), Ken Ronquillo (4313), Larry Claussen (2818), Irene Thurston (2816), Yvonne Vallejos (4311), and Mike Patton (3435). In Livermore, team members include Cliff Yokomizo (5301) and Sheila Akins (8441).

"This is a first for Sandia, using all levels of our population to make up a process for our people," says Mike. "Sandia is asking its own people to help improve quality. I think we're started in the right direction."



WITH THE HELP of a map, Nash Chavez (7841) demonstrates what it would take for a person unfamiliar with a particular area or building to explain to a dispatcher where an emergency is located. Nash submitted a Quality Action Request recommending that Sandia place stickers on all telephones detailing the phone's location. Soon to be in use throughout the Labs, the stickers could save a person from frantically trying to figure out his or her location during an emergency.

A cross-section of employees at Albuquerque and Livermore participated in pilot runs of the QAR, addressing processes in a variety of organizational settings. Many of the lessons learned during those experiences have been incorporated into the QAR process.

Of course, the ultimate success of the QAR depends on employee involvement and use of the process, says Whitney.

"The Quality Action Request is designed for all levels of employees," says former ES&H and Quality Coordinator Shirleen Perez (3154), a member of Local 251 of the Office & Professional Employees International Union (OPEIU). "It is a way for both represented and non-represented employees to voice their concerns without fear of reprisal and feel that they are making a difference in their jobs." •

AL LUNA (3435) is congratulated by his wife, Becky, at an award ceremony during which he was named Sandia Security Inspector of the Year. This is the first year Sandia has presented the award, which honors Al for his professionalism on the job and leadership among his peers, says Capt. Dave Stout (3435). Al received a jacket and an Individual Performance Award, and his name will be posted on a permanent plaque. Al has worked at Sandia for 25 years. (Photo by Mark Poulsen, 3162)

Fun & Games

Bowling — Winners of the SANDOE Bowling Association Four-Game, No-Tap Tournament held at Holiday Bowl on Oct. 26 and 27 were Fernando Dominguez (7712) and Rena Yellowrobe (6423) with a 1538 combined handicap series. Second place went to Lyle (281) and Alice Davis with a combined handicap series of 1460.

Winners of the SANDOE Bowling Association Best Ball Tournament held at Fiesta Lanes on Nov. 16 and 17 were Barbie Haralson and Brett Day with a composite 780 three-game handicap series. Placing second were Jim and Sharon Foreman with a composite 777 three-game handicap series.

SANDOE Bowling Association August-September Bowlers-of-the-Month included: Scratch — Reggie Tibbetts (7813), 712, and Trinie Chavez, 558; Handicap — Melissa Silversmith, 478 and 649.

October Bowlers-of-the-Month included: Scratch — Gary Cochrell (5024), 651, and Sharon Voccio (1151), 568; Handicap — Glenn Folkins (5154), 640 and 712, and June Brunner (152), 514 and 655.

* * *

Audubon Society Bird Count — Every year from mid-December to early January, the National Audubon Society sponsors its unique Christmas Bird Count, inviting novice and experienced birders for one day to list the birds they see. Counters travel together in designated areas recording numbers and species; society membership is not necessary. Amateur birders are welcome; expert birders will lead the groups. The next count in the Sandia Mountains is scheduled for Dec. 28. Counters will meet at Pete's Mexican Restaurant (North Hwy. 14, one-half mile north of the Sandia Crest turnoff) at 7 a.m. For information, contact group leader Kay Anderson on 821-1606.

Holiday Advice from Sandia Security

Getting Your Holiday Packages Out the Gate — Sandia policy is that both personal and official packages hand-carried through perimeter gates are subject to inspection. You won't have to unwrap a gift-wrapped present if you show the security inspector a Property and Material Gate Pass (Form SF-6951-AF) with the package. The pass must accurately describe the package and be signed by your supervisor.

Keep a Workplace Thief from Ruining Your Holidays — By following these security tips, you may keep a thief from having a happy holiday season at your expense.

- Secure all classified documents and material before leaving for the holidays. It's easy to get distracted this time of year, so be extra careful.
- Remember to secure small items of company property that may mysteriously disappear — calculators, cameras, tools, etc.
- Don't leave personal property unsecured at your work area over the holidays — take it home.
- Never leave cash in your desk, even if the desk is locked.

Sandia News Briefs

Recycle Old Telephone Books — A 'Monumental Effort'

If all Albuquerque Sandians stacked their old city telephone directories at a Tech Area gate, together they could build a stack about 700 feet tall, taller than the Washington Monument.

New city telephone directories will soon be distributed to Sandia, Albuquerque employees, says recycling coordinator Louise Bland (3422), and US West has agreed to recycle the old city directories. Collecting cages and boxes will be located near Tech Area gates.

Louise asks that employees not place old directories in the halls or in office trash or recycling containers. For more information, contact her on 4-2540.

Brockmann Elected to Aerosol Research Board of Directors

John Brockmann of Severe Accident Phenomenology Div. 6422 has been elected to serve on the board of directors of the American Association of Aerosol Research (AAAR). Board members serve for three years.

John already serves on the editorial board of the AAAR's technical journal, *Aerosol Science and Technology*. AAAR is an international society with approximately 700 members.

Computer Codes Predict How Parts Respond to Manufacturing

Computer codes for analyzing structures are helping Sandia researchers predict a part's response to manufacturing processes. These codes may significantly reduce the time it takes to develop prototypes and manufacturing processes for certain components, without using costly and time-consuming trial-and-error techniques.

Manufacturing processes such as welding, forging, sheet forming, brazing, casting, and injection molding subject materials to a wide variety of stresses and strains that can weaken or deform a finished part. Microscopic cracks, shrinkage, and residual stresses — loads left inside a material after processing — can reduce a part's lifetime or performance.

The codes, some developed at Sandia, use mathematical descriptions of material response to predict these problems, which can lead to more optimum production processes and higher-quality parts, says John Biffle, Supervisor of Computational Mechanics and Visualization Div. 1425. "A manufactured part often undergoes more severe conditions during its production than it ever sees in service," he says. "The goal is to eliminate process-induced problems before they happen."

Sandia Retiree Appointed to State Investment Committee

John Anaya, a Purchasing buyer who retired last February after 40 years at the Labs, was recently appointed by State Treasurer David King to serve on the New Mexico State Treasurer's Investment Committee. The seven-member committee supports the state treasurer by reviewing incoming state revenue from various state agencies.

In October, John accompanied Gov. Bruce King and 30 New Mexico business people to the New Mexico/Chihuahua Trade Mission in Chihuahua, Mex. The purpose of the mission was to promote economic relations between business people on both sides of the border.

Send potential Sandia News Briefs to LAB NEWS, Div. 3162.

Community Focus

UNM Regent to Speak Jan. 8

Albuquerque attorney Roberta Ramo, president of the UNM Board of Regents, will discuss her view of leadership in New Mexico at a Community Focus presentation Wednesday, Jan. 8, at noon in the Technology Transfer Center (Bldg. 825).

ROBERTA RAMO

Her talk, titled "Leadership in New Mexico: Are We Ready for the Future?," is sponsored jointly by the Sandia Women's Program Committee and Community Relations Div. 3163. Seating is on a first-come basis.

Ramo is director of an Albuquerque law firm. She was appointed to the UNM Board of Regents in 1989. In 1990, she chaired UNM's presidential search committee and in 1991 became president of the board.

Ramo is also a member of the boards of New Mexico First, which conducts town hall meetings on statewide issues; New Mexico Amigos, a goodwill ambassador team that promotes New Mexico in other states and nations; the Greater Albuquerque Chamber of Commerce; and the Albuquerque Community Foundation. She is also a member of the New Mexico Performing Arts Center advisory board.

For more information, call her Sandia host, Ann Riley (3726), on 4-7139.

South 14 Village Project

Sandia Mug, Cap, T-shirt Proceeds Help Rural New Mexico Families

Employee purchases of Sandia souvenir caps, T-shirts, and coffee mugs this year are providing a record amount of help to needy families in the villages of Escabosa, Chilili, Tajique, Torreon, Manzano, and Punta south of I-40 along State Highway 337 (formerly Highway 14).

Sandia retirees John Shunny and Julian Sanchez run the charity project, with most sales made by the LAB NEWS staff in Bldg. 814. All labor is voluntary, and all profits from the sale of the souvenir items go to charity. Most of the profit is used to help needy families in the villages, but donations are made to other groups when funds allow.

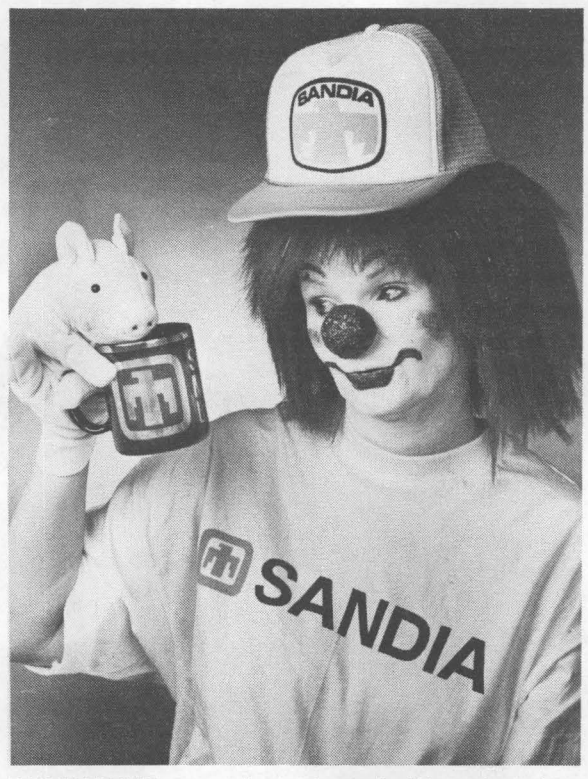
As of Dec. 10, a total of $2,100 had been provided to 21 families this year, and $2,010 had been given to other charities, reports John.

Started in 1966 by Sandians in what was then the Technical Information Department, the fundraising project originally provided food baskets during the Christmas season to the village families, but cash is now donated at various times during the year to families who are having financial difficulties.

"Several years ago, we decided that cash was often needed and more welcome than food baskets," John explains. "We have some good contacts in the villages who alert us when families in their areas are in need."

He says the record year for Sandia souvenir sales is due primarily to the "whopping success" of the sale of the new Sandia coffee mugs and the healthy business that he and Julian did at Family Day in October.

Other charities receiving help from the project this year include the Albuquerque Rescue Mission, New Mexico Museum of Natural History, Roadrunner Food Bank, Salvation Army, Amnesty International, and others. •



PONDERING some last-minute holiday shopping, Pixie the Clown and friend check out the Sandia souvenirs available at the LAB NEWS offices in Bldg. 814. Profits from this year's sales have enabled record donations to charities and to needy families in villages south of I-40 along State Highway 337. Pixie's alter ego is Cindy Gregory (3524).

Take Note

The Phillips Laboratory Video Teleconferencing Center (VTC), Bldg. 419 on the west side of the base, is offering free video-circuit time to military, federal, and Sandia employees who wish to visit with family via live television during the holidays. Hours of operation are from Dec. 23 through Jan. 3, 7:30 a.m. to 5 p.m., Monday through Friday, for 30-minute visitations. Calls may be made between KAFB and the following sites: Andrews AFB, Md.; Brooks AFB, Tex.; Eglin AFB, Fla.; the Pentagon; Falcon AFB, Colo.; Griffiss AFB, N.Y.; Hanscom AFB, Mass.; Norton AFB, Calif.; Los Angeles AFB; Offutt AFB, Nebr.; Patrick AFB, Fla.; Vandenberg AFB, Calif.; Wright-Patterson AFB, Ohio; and some Army installations. To schedule visits and for more information about other sites not listed, contact Steve Gonzales or Jerry Halpern on 6-4837. The VTC now has its own visitor badges. Visitors no longer have to go to the Visitor Control Center.

* * *

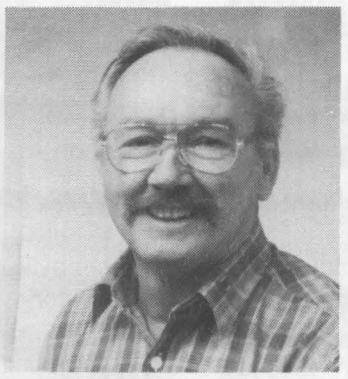
Retiring and not pictured in LAB NEWS photos: Tom Green (1151).

Holiday Reminder: Cover Your Computer

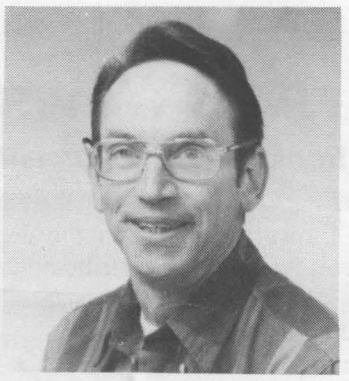
Communications and Computing Services Dept. 1930 reminds employees to protect their computers and workstations during the holiday vacation from damage that could be caused by water, chemicals, dust, or smoke in case of fire. Plastic covers or garbage bags may be used to cover computers and workstations. Please place storage media (floppy disks, cartridges, etc.) into their appropriate containers.

MILEPOSTS
LAB NEWS

December 1991

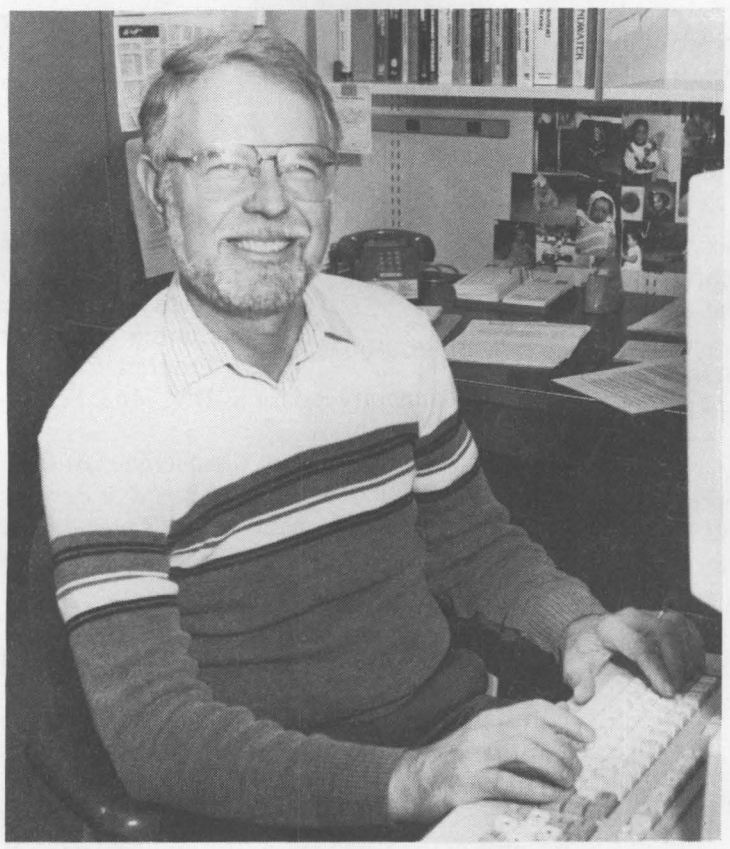


Lloyd Faucett
9127 35

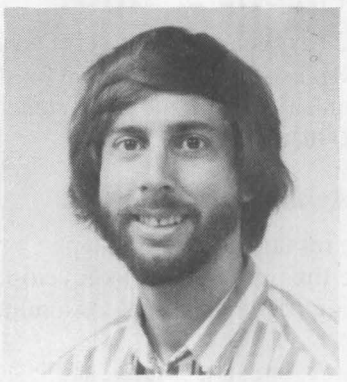


David Tallant
1821 15

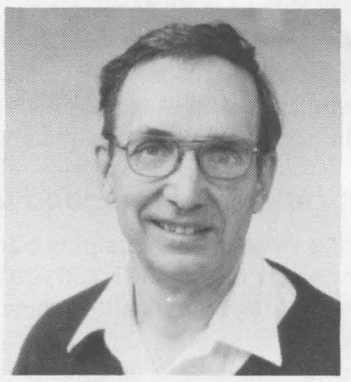
Larry Johnson
5147 35



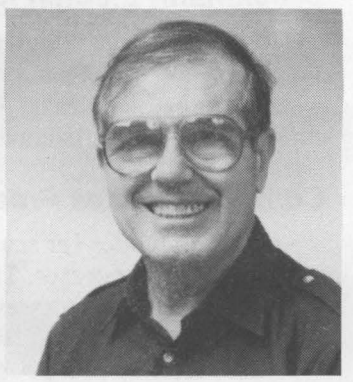
Warren Miller
6316 35



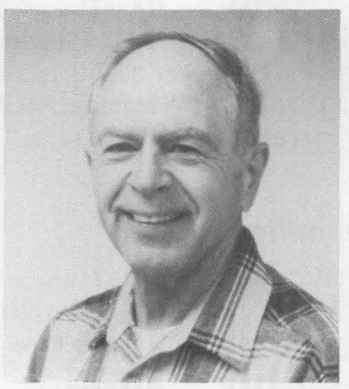
John Mareda
1425 15



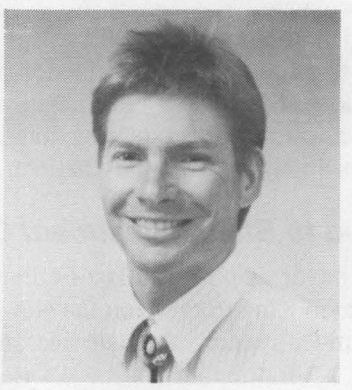
Jim Plimpton
9310 30



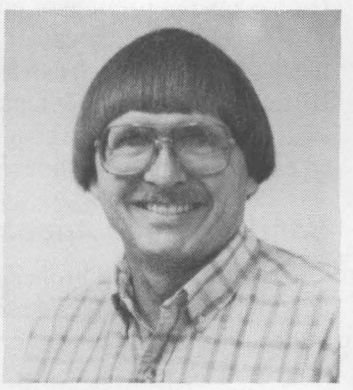
Sanders Dolce
9313 25



Don MacKenzie
1554 35

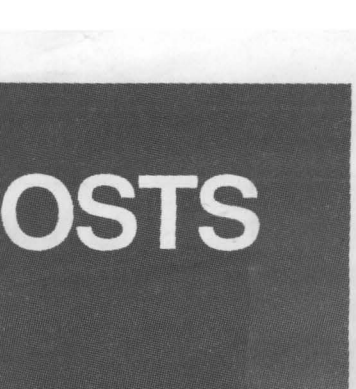


Daniel Pritchard
9538 15



Don Stuart
1841 25

Bernard Kenna
9548 30



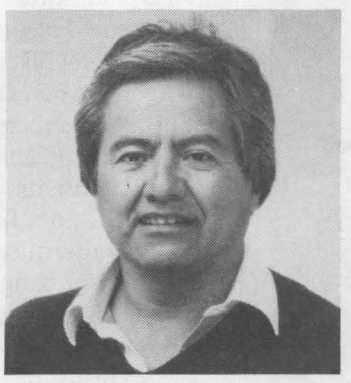
Clifford Sharp
2754 15

Richard Anderson
6342 30

Earl Rush
6215 25

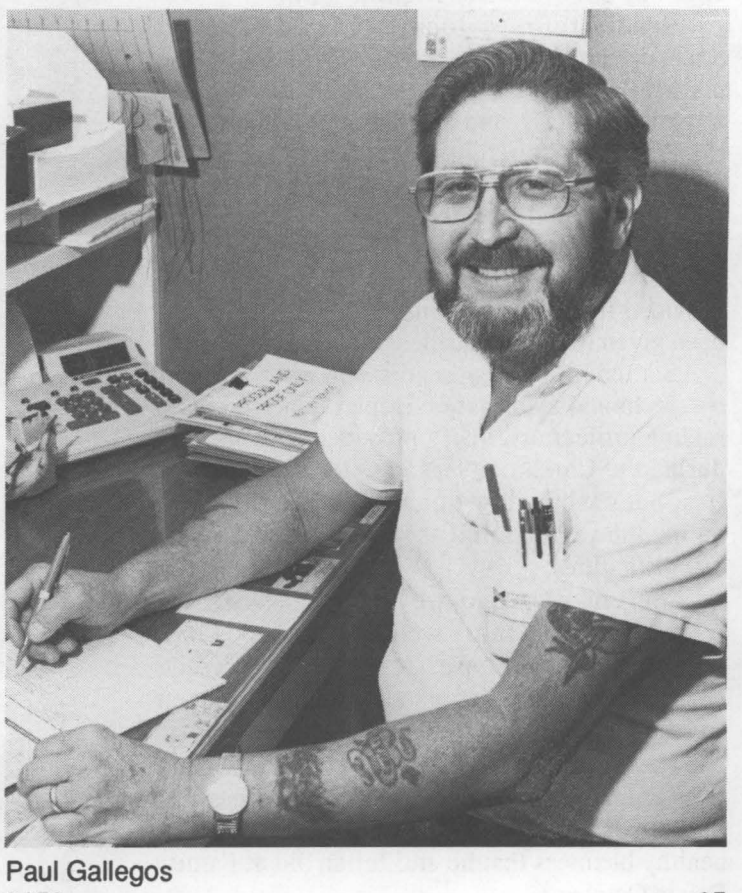
Clifton Kinabrew
9313 35

David McCloskey
6400 25

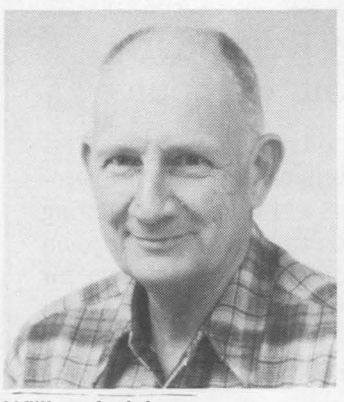


Emery Chavez
153 25

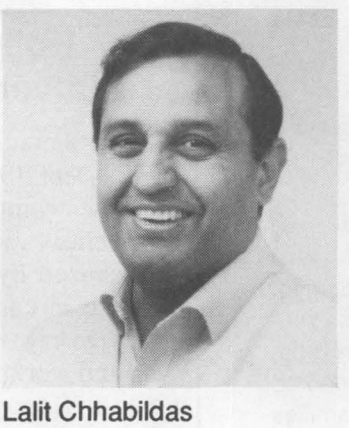
Cecil Sonnier
9249 35



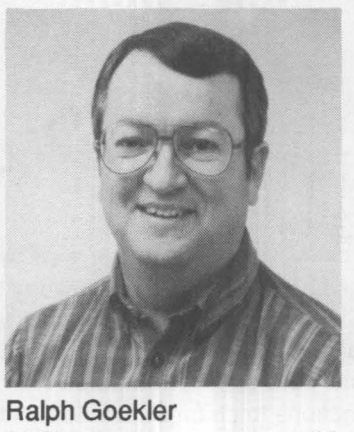
Paul Gallegos
3153 25



William Leisher
2414 25



Lalit Chhabildas
1433 15



Ralph Goekler
9222 20

feedback

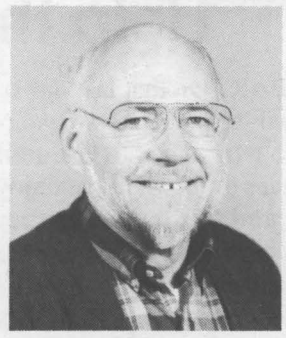
Q: Consider installing state-of-the-art solar panels on rooftops for testing purposes and for generating supplemental power. Use all possible excess building rooftop areas. Also, use excess land area and share power with KAFB.

A: When new buildings and facilities are designed at Sandia, DOE procedures require energy-conserving features to be considered, including various solar energy applications. The costs of these features are weighed against expected savings by performing Life Cycle Cost Analyses, and justified features are incorporated into system designs. All of our newer buildings are designed to be energy-efficient and the results show favorable energy usage.

Sandia has been active in research and development of both thermal solar and photovoltaic electric power systems. To date, we have not been able to justify the power generated from solar energy, especially when sufficient power is available at commercial rates. As the cost of these developing technologies becomes more competitive, you can be sure that Sandia will promote their use by including them in building and utility system designs.

Jake Jacobs (7800)

Employee Death



JACK PUARIEA

Jack Puariea of Discrete Semiconductors and SSICS Div. 2555 died Dec. 5 after a long illness. He was 60 years old.

Jack had been at the Labs since 1959. He was a senior member of the technical staff.

He is survived by his wife, three sons, and two daughters.

UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS

Deadline: Friday noon before week of publication unless changed by holiday. Mail to Div. 3162.

Ad Rules

1. Limit 20 words, including last name and home phone.
2. Include organization and full name with each ad submission.
3. Submit each ad in writing. No phone-ins.
4. Use 8½ by 11-inch paper.
5. Use separate sheet for each ad category.
6. Type or print ads legibly; use only accepted abbreviations.
7. One ad per category per issue.
8. No more than two insertions of same "for sale" or "wanted" item.
9. No "For Rent" ads except for employees on temporary assignment.
10. No commercial ads.
11. For active and retired Sandians and DOE employees.
12. Housing listed for sale is available for occupancy without regard to race, creed, color, or national origin.
13. "Work Wanted" ads limited to student-aged children of employees.

MISCELLANEOUS

SEARS ELECTRIC CLOTHES DRYER, excellent condition, white, $60. Boozer, 293-1348.

FIVE-YEAR-OLD MARE, 13H, gentle, $500 OBO. Baker, 294-3334.

BUCKET SEATS for '74 Volkswagen Super Beetle, 1 pr., $20 ea. OBO; Franklin stove, complete, $200 OBO. Bland, 265-6286.

CALIFORNIA KING WATERBED, soft foam sides, liner, heater, mattress, 1-1/2 yrs. old, plus fitted cover, $95 OBO. Hoselton, 294-6109.

IBM AT COMPUTER, 8MHz, 2.5M RAM, 43 MEG hard disk, 1.2 MFD, 360KFD, 1S1P, new case, pwr. sup. & kybd., math coproc., $500. Scott, 281-4332.

TWO MATCHING TWIN BEDS, complete w/sheets, mattress pads, bedspreads, & pillow shams, $125/ea. Tucker, 888-9786 after 7 p.m.

FREESTANDING FIREPLACE, w/chimney, Preway make, den- or cabin-type, $150. Rainhart, 268-1148.

SOFA, good condition, clean, earth-tones, $125 OBO. Sanchez, 292-1982.

STERLING SILVER FLATWARE, service for 12, plus serving pieces, excellent condition, $1,400. Hills, 888-5149.

COLOR TELEVISION, 13-in., works well, inputs for video or RGB (CGA card included), $100 OBO; dot-matrix printer, make offer. Hueller, 296-0976.

BISTRO TABLES, w/4 chairs, $125; steel bakery shelves, $100; paper towel dispensers, $24. Schultz, 275-9349.

BLUE TOPAZ & DIAMOND RING, appraised value $300; yours for $200; 1 Southwest Airlines travel voucher, completely transferable, $100. Owens, 836-7802.

ACOUSTIC GUITAR, Washburn, w/case, capo, some music, $190 OBO. Slutz, 898-9462.

KONICA VIDEO CAMERA; Emerson 700 VCR, tuner, 2 rechargeable batteries, AC/DC connections, remote, $400. Schofield, 292-7220.

MINIATURE DACHSHUND, black/tan, AKC-registered, ready for your home Christmas week, parents on premises, $200. Simmons, 293-9294.

SCHWINN AIRDYNE EXERCISE BIKE, $500; custom-made doghouse, removable roof, insulated, holds up to 3 dogs, $150. Esch, 298-8914.

EPSON COMPUTER, 80286, 40MB hard drive, 5.25-in. floppy, 2 yrs. old, lots of software, all manuals, boxes, paperwork, $800 OBO. Lium, 299-4287.

SOFA BED, double, striped brown/white, good condition, $50. Witek, 296-5198.

GREAT PYRENEES PUPPIES, AKC-registered, born Oct. 27, $250. Wrobel, 891-8409.

APPLE IMAGEWRITER I PRINTER, good condition, cable & paper included, $175 OBO. Bohnhoff, 899-2605.

WATERBED MATTRESS, king-size, semi-firm, good condition, $60 OBO. Sikora, 881-4741.

AUTHENTIC INDIAN JEWELRY, Zuni inlay, several pieces; baby walker, $25; high chair, $20. Little, 883-9329.

PANASONIC VCR, VHS, Model PV1340, cleaned & checked July 1991, $125; VCR Plus+ automatic VCR controller, $40. Dippold, 821-5750.

SOFA SLEEPER, 8-ft., love seat, recliner, big wood shelves, all in good condition, $275. Jojola, 242-8459 after 5 p.m.

TABLE, 42-in. round, white steel, Formica top, 4 chairs, vinyl w/casters, $100. Roberts, 255-9527.

NORWOOD LOOM, 8-harness, many extras, including sectional beam, warping board, tensioner box, yardage counter & shuttles, $2,300. Mulligan, 294-7320.

BARBIE DOLLS & CLOTHES, w/accessories, extensive collection in excellent condition; Babysitter Club books, $1/ea. Wagner, 823-9323.

TRUMPET, Reynolds, 2 mouthpieces, case, $175 OBO; Yamaha tenor sax, semi-pro model, $675 OBO. Aragon, 888-3473.

CRAFTSMAN SNOW-THROWER, 24-in., self-propelled, 3-spd., 4-cycle, 6-hp engine, $300. Devaney, 281-3961 before 10:30 p.m.

SPEAKERS, Martin Logan Sequels, $1,750; ski rack, $15; skis, Pre 1200S, 180cm, w/bindings, $90; glass-blowing lathe. Hsing, 293-5670.

POOL TABLE, $800 OBO; 20.1-cu.-ft. refrigerator, $300 OBO; freezer, $175; microwave, $45; darkroom equipment; furniture. Berman, 296-5640.

DYNASTAR SKIS, never used, 190cm length. Seager, 281-5045.

PIONEER SX-535 STEREO RECEIVER, $35; Technics SLBD20 turntable, $65; 2 AR speakers, $135; turntable/speakers hardly used. Lauriano, 867-5165.

STEEL SHELVING ASSEMBLIES (6), industrial-grade, 36" x 12" x 72", $35/ea. OBO. Silverman, 298-1308.

MICROWAVE OVEN, 1200W, Magic Chef, w/turntable, like new, $100; Smith-Corona portable electric typewriter, $50; large couch, good condition, $100. Lehrer, 898-2581.

ROTTWEILERS, AKC-registered, just in time for Christmas, 2 females, 9 wks. old, $400/ea. Brooks, 298-3294.

BALDWIN ORGAN, w/bench, dual keyboard, including music, excellent condition, good deal, moved & no room. Wheeler, 892-6404.

DOWNHILL SKIS, 190cm, Dynastar Axioms, still in box, $100. Bender, 281-1989.

MACINTOSH 512K w/printer, $800; 286 PC color monitor, $1,150; Recaro driving seats, $300. Salazar, 296-5671.

SEARS PORTABLE DISHWASHER, $120; single roll-away bed, $50. Roherty-Osmun, 293-8127.

WALL UNIT, 3-piece (each piece 30"W x 76"H), w/built-in desk, lights, & cabinet, in excellent condition, $400. Jenkins, 293-9714.

QUEEN-SIZE BED, kitchen table, both only 2 yrs. old. Tuminaro, 296-0523.

WASHER & DRYER, heavy-duty Maytag washer & electric Kenmore dryer, $200/set. Watkins, 265-5625.

MOVING SALE, entire home's contents: appliances, TVs, wall unit, stereo equipment, furniture, clothing, lawn mower, yard goods, etc. Trump, 831-5621.

CHINA HUTCH, $225; double headboard, $12; oak dresser, $225; chest of drawers, $175; Rival food slicer, $25. Ramel, 821-0475.

Deadline Change

The next LAB NEWS will be published Jan. 10. Deadline for ads and other submissions is noon, Friday, Jan. 3.

CHEST-HIGH WADERS, new, never used, size 9, made in the USA, suspenders included, cost more than $50, sell for $30. Freyermuth, 299-2053.

EPSON LX-800 DOT-MATRIX PRINTER, 4 type styles, plus NLQ & draft modes, $75. Casper, 268-4464 leave message.

IBM-COMPATIBLE, 386, 25MHz, 44MB IDE drive, VGA grayscale, mouse, 3-1/2-in. floppy, printer. Senglaub, 281-8002.

NINTENDO VIDEO GAMES & magazines, games are $8 to $20/ea. & magazines are $2. Kolb, 299-3403.

MAPLE KITCHEN TABLE, w/Formica top, $30; antique maple rocker, $60; wooden dressing vanity, $35; brass lamp, $25. Levan, 293-0079.

AKITA PUPPIES, AKC-registered, males & females, champion bloodlines, ready for Christmas, pedigrees, parents on premises, $500. Fitzgerald, 275-0521.

THOMASVILLE HI-BOY, walnut, excellent condition, $300; queen-size headboard, w/bookshelves, $100. Kozlowski, 822-0117.

'78 LONG-BED MINI-PICKUP CAP, for Datsun/Toyota trucks, Spirit brand, good condition, $30. Collier, 299-0182.

SLIDING STORM DOOR, $20; exterior door & frame, $15; Hoover vacuum cleaner, $35; wrought-iron coffee table, $15. Garcia, 293-3937.

GUITAR, Les Paul copy, w/distortion pickups, $80; Alamo bass guitar, $40. Gonzales, 344-4933.

WOMAN'S STRETCH BIB SKI PANTS, small, navy, matching parka, $25/ea.; trunk bike rack, $10; Barrecrafter ski rack, $45. Sackett, 292-1048.

COMPUTER HARD DISK, 330MB/control card, $800; Everex 3000/RAM, $200; Intel 80387DX-25 coprocessor, $125. Miller, 892-3262.

REMINGTON 1100 SHOTGUN, 12-gauge, new, $275. Roth, 344-7060.

SAPPHIRE/DIAMOND NECKLACE, new, valued at $270 (certificate included), great Christmas present, $100. Gregory, 275-3855.

SMITH-CORONA TYPEWRITER, $50; man's leather jacket, brown, Londontown, w/lining, size 38, $60 OBO. Frietze, 299-8744.

ELECTRONIC KEYBOARD, Yamaha PSS470, w/49 mid-size keys, voices, preset rhythms, drummer, base chord system, w/carrying case, adapter, $135. Oishi, 293-9478.

PENTAX K100 SLR, w/50mm f2.0, case, $100. Kraynik, 294-1043.

MATERNITY CLOTHES, size 8 & 10. Sullivan, 298-4880.

SNOW TIRES (2), 185/70SR13 Sempirit, studded, mounted, balanced, $140. Hinkebein, 299-2481.

COPILOT II CAR SEAT, $15; Tomy Powerride electric 3-wheel ATC w/battery & charger, $40; 12-in. bicycle & tricycle. Shrouf, 821-0765.

TRANSPORTATION

BOY'S MOTOBECANE BICYCLE, 21-in. frame, 10-spd., blue, like new, $100. Boozer, 293-1348.

'77 CADILLAC SEVILLE, $2,950, $350 paint allowance = $2,600; '78 Ford conversion van, 15K miles on rebuilt engine/trans., $2,300 firm. Green, 275-7375.

'89 TOYOTA TERCEL, 49K miles, white, 2-dr., AC, PS, 5-spd., AM/FM cassette. Misak, 892-3033.

'83 THUNDERBIRD, white body, red interior, excellent condition inside & out, new tires, brakes, more, well-maintained. Everts, 822-1767.

'84 JAMBOREE CLASS C, 26-ft., gen., microwave, awning, sleeps 6, 460 Ford, 37K miles, many extras, immaculate condition, $18,000 OBO. Cook, 869-6921.

'67 MUSTANG FASTBACK, fully restored, new paint, many performance extras, $5,500 OBO. Slutz, 898-9462.

REPOS: '85 Toyota MR2, 4-cyl., 5-spd., AM/FM stereo tape deck, AC, 107,855 miles; '86 Merkur XR4TI, 4-cyl., AT, AC, PW, PL, 41,447 miles; '88 Isuzu Trooper, 4-cyl., 5-spd., AM/FM stereo tape deck, AC, 84,613 miles; bids accepted through Dec. 24; we reserve the right to refuse all bids; subject to prior sale. Sandia Lab FCU, 293-0500.

WOMAN'S 10-SPD. BICYCLE, blue, Schwinn Varsity, excellent condition, $100. Little, 883-9329.

'89 HARLEY-DAVIDSON FXR SUPER-GLIDE, 5K miles, warranty, $8,200. Ross, 281-2477.

'66 HONDA DREAM, 305cc engine, blue flash chrome, new tires & battery, excellent condition, 10,623 miles, $700. Tyhurst, 281-1417.

'71 OLDS. CUTLASS, slightly old, missing door handle, acceleration? it takes off like a rocket, $600. Devaney, 281-3961 before 10:30 p.m.

SCHWINN BIKE, ages 8-13. Berman, 296-5640.

'83 FORD F-150, 4x4, Supercab, 6-cyl., 4-spd., AC, tilt, cruise, captain's chairs, fiberglass shell, 69K miles, original owner, $5,700. Stone, 821-5070.

BMX BIKE, Redline Freestyle, like new condition, sold for $350 new, will take $175 OBO. Schaub, 865-8807.

MOUNTAIN BIKE, GT Karakoram K2, 18-in., excellent condition, very low mileage, paid $600. Stibick, 1-384-5307.

FIRENZE MOUNTAIN BIKE, 15-spd., like new, $150 OBO; Schwinn Sprint, 10-spd., man's 27-in., $70 OBO. Baker, 294-3334.

'85 MAZDA RX-7 GSL/SE, 13B engine, w/fuel injection, 5-spd., 2 tops, cover, 35K miles, $7,500 OBO. Smith, 298-9588.

'78 TOYOTA CORONA BODY, in good condition, no engine, $150. Sanchez, 865-5973.

'86 MAZDA RX7 GXL, white, burgundy interior, excellent condition, $6,500 OBO. Umstead, 294-5299 after 4 p.m.

'83 HONDA ACCORD LX, hatchback, only 70K miles, very clean, AC, AT, $3,000. Tuminaro, 296-0523.

TWO BICYCLES: boy's 10-spd., 27-in. Raleigh Record, good condition, $90; girl's 3-spd., Montgomery Ward, includes exercycle attachment, $50. Freyermuth, 299-2053.

'85 NISSAN KC PICKUP, 5-spd., AC, cruise, bed liner, camper shell, jump seats, 67K miles, $3,650. Lackey, 869-9333.

YAMAHA DIRT BIKES: '91 YZ250, '90 YZ125, '86 YZ250. Pryor, 294-6980.

'80 CORVETTE L48, PW, PB, AC, T-tops, tilt & tele., AM/FM cassette, new paint, tires, muffler & catalyst, $7,800 OBO. Voccio, 255-1847 or 292-6001.

REAL ESTATE

3-BDR. HOME, spotless, 2 baths, double garage w/workshop, fireplace, walk-in closets, sprinklers, lawn front & back, Eldorado district, $89,500. Blewer, 268-9019.

3-BDR. HOUSE, southeast, near KAFB, 1-3/4 baths, 1-car garage w/opener, security wrought-iron, new thermal windows & stucco, $53,500. Trump, 831-5621.

3 WOODED ACRES ON ANIMAS RIVER, north of Aztec, has well & electricity, $28,000. Childers, 344-9281.

WANTED

TURNTABLE for RCA stereo vintage 1955-1965, plays 78, 45, 33. Dollahon, 294-4256.

SAT & ACT EXAMPLE TESTS for Macintosh computer. Harrigan, 266-4143.

NINTENDO MILLIPEDE CARTRIDGE. Everts, 822-1767.

GOOD COPY OF THE BOOK *House Divided* by Ben Ames Williams, published 1947. Foster, 299-2778.

YOUTH ENGLISH RIDING APPAREL & headgear, hunt seat or saddle seat attire. Shrouf, 821-0765.

LOST AND FOUND

LOST: Pearle prescription glasses in brown case on Dec. 2 in or near Bldg. 887 parking lot. Rosten, 292-6341.

SHARE-A-RIDE

ACADEMY CARPOOL: from Academy between Eubank & Ventura, non-smoking. Gido, 823-6697.

Coronado Club Activities

Help the Club Close Down on the 24th

READY FOR A BREAK? On that last day of work, Dec. 24, the Club will help you e-a-s-e yourself into a spirit of leisure guaranteed to last until the new year. Come on over to the Cantina, enjoy the free casual buffet, and let Santa's helper Marlon serve you some cheering beverages.

NEW YEAR'S EVE is coming soon, and so is the Club's Big Band Bash on Dec. 31. Call for reservations now (265-6791).

MAKE SOME RESOLUTIONS — Plan now to give yourself a treat early next year. On Friday, Jan. 3, the Club's great kitchen crew and the Isleta Poor Boys will team up to help you do just that, with two-for specials (roast prime rib or grilled halibut) as well as other choices. Dinner is 6 to 9 p.m., and the Poor Boys will keep your toes tapping from 7 to 11. Make your reservations and mark your calendar.

TOP OFF BRUNCH WITH A TEA DANCE — Get in on the first Tea Dance of the year Sunday, Jan. 5, when the Best Shot Band plays from 1 to 4 p.m., just after the regular Champagne Brunch (10 a.m. to 1 p.m.). All Thunderbirds showing proof of membership will get $1 off the normal members' all-you-can-eat brunch price of $6.95. Reservations are required.

TIPTOP NEW SERVICES — The Club keeps thinking of new ways to serve you. Starting Jan. 6, members can purchase Sandia Peak Tram tickets. The Club will be able sell up to four passes a day for $5 a person; reserving or purchasing in advance would be a wise idea. On a more down-to-earth topic, did you know there's now free notary service at the Club? Carol Nigrey, in the main office, is the person to see. For more information about either service, call 265-6791.

STILL STUCK for a gift idea? Remember, C-Club members can buy discount movie tickets for General Cinema and United Artist theaters, at $4.25 each. Come on over to the Club, grab a few tickets, and you or your "giftee" can catch a new release over the holidays.

Events Calendar

Events Calendar items are gathered from various sources. Readers should confirm times and dates of interest whenever possible.

Dec. 20-22 — "Christmas Joy," collection of dances celebrating the true meaning of Christmas, staged by the Performers Ballet and Jazz Company; 7:30 p.m. Fri. & Sat., 3:30 p.m. Sun.; Rodey Theatre, 293-9432 or 275-3308.

Dec. 20-21 — "Burn This," New Mexico Repertory Theatre presentation of a love story by Lanford Wilson about contemporary New Yorkers (adult theme and language); 8 p.m. Fri., 2 p.m. & 8 p.m. Sat.; KiMo Theatre, 243-4500.

Dec. 20-21 — "A Christmas Carol," by Charles Dickens, adapted by Richard Jones; 8 p.m., Albuquerque Little Theatre, 242-4750.

Dec. 20-21 — "The Flying Twins," contemporary dance, works in progress by Molly Prewitt and Amy Schactman; 8 p.m., UNM Carlisle Gym.

Dec. 20-22 — "A Chicano Christmas Carol," La Compañia Teatro de Alburquerque presentation of a bilingual adaptation of Charles Dickens' story set in Albuquerque in 1991; 8 p.m. Fri. & Sat., 2 p.m. Sat. & Sun.; KiMo Theatre, 242-7929.

Dec. 20-22 — "The Gifts of the Magi," musical adaptation of O. Henry short story; 7:30 p.m. Fri. & Sat., 2 p.m. Sat. & Sun.; Vortex Theatre, 247-8600.

Dec. 20-21 & 26-29 — "Miracle on 34th Street," stage version of the famous screenplay performed by the Albuquerque Civic Light Opera; 8:15 p.m. Sat. & Sun., 2:15 p.m.; Popejoy Hall, 345-6577.

Dec. 20-Jan. 5 — Exhibit, "Photographs by Karsh," work by the well-known photographer Yousuf Karsh who for more than 50 years has documented the likenesses and personalities of many important statesmen, artists, and literary and scientific figures; 9 a.m.-5 p.m. Tues.-Sun.; Albuquerque Museum of Art, History, and Science, 243-7255.

Dec. 20-Jan. 9 — Exhibit, "The Sagebrush Ocean," more than 60 Cibachrome color and black-&-white prints by author and photographer Stephen Trimble, based on his book *The Sagebrush Ocean: A Natural History of the Great Basin*; shows wide range of desert ecosystems from salt-encrusted dry lake beds to 13,000-ft. alpine peaks; 9 a.m.-5 p.m., New Mexico Museum of Natural History and Science, 841-8837.

Dec. 20-Jan. 10 — Exhibit, "Abstract Art: A Manifesto of Liberation," presentation of art from the '30s that emphasizes spiritual liberation through color and non-objective form; 9 a.m.-4 p.m. Tues.-Fri., 5-9 p.m. Tues.; UNM Jonson Gallery, 277-4967.

Dec. 20-Jan. 19 — Miniature Exhibition and Sale, benefit for the Albuquerque Museum, exhibit includes more than 300 works by 130 artists whose styles range from traditional to abstract with equally diverse techniques and media; 9 a.m.-5 p.m. Tues.-Sun.; Albuquerque Museum of Art, History, and Science, 243-7255.

Dec. 20-Feb. 3 — Exhibit, "Gustaf Nordenskiold: Pioneer Archaeologist of Mesa Verde," details work of Swedish scientist who 100 years ago visited the Anasazi cliff dwellings at Mesa Verde and undertook the first major excavation and documentation of the ruins there; 9 a.m.-4 p.m. Mon.-Fri., 10 a.m.-4 p.m. Sat., noon-4 p.m. Sun.; Maxwell Museum of Anthropology, 277-4404.

Dec. 20-Feb. 9 — Exhibit, "USS New Mexico Battleship," in commemoration of the 50th anniversary of World War II to honor veterans from all branches of the service, sponsored by the Navy League of the United States and the Albuquerque Museum; 9 a.m.-5 p.m. Tues.-Sun.; Albuquerque Museum of Art, History, and Science, 243-7255.

Dec. 20-Feb. 9 — Exhibit, "Horse Tales: An Evolutionary Odyssey," produced by the Natural History Museum with the Hubbard Museum of the Horse in Ruidoso Downs, tells about the horse from its first appearance in North America; 9 a.m.-5 p.m., New Mexico Museum of Natural History and Science, 841-8837.

Dec. 21 — "Christmas in Mexico," Baila! Baila! International Dance Studios interpretation of Mexico's "Las Posadas" in dance and drama performed by adult and youth ballet folklorico dance teams and adult Latin dance group, Christmas music performed by the St. Mary's Boy's Choir; 7 p.m., UNM Continuing Education Conference Center (University & Indian School Rd. NE), 265-1858 or 277-4624.

Dec. 21 — Demonstration: Norwegian Rosemaling, another in a series of monthly craft demonstrations; 11 a.m.-3 p.m., free, Maxwell Museum of Anthropology, 277-4404.

Dec. 22 — Annual Children's Christmas Party, sponsored by the Old Town Optimist's Club; 11 a.m. - 12:30 p.m., free, Albuquerque Convention Center, 764-1660.

Dec. 22-24 & 26-31 — Indian Dances, traditional dances presented by various groups from the 19 pueblos of New Mexico; 2 p.m., free, Indian Pueblo Cultural Center, 843-7270.

Dec. 22-31 — Exhibit, "E.I. Couse — An Imagemaker for America," famous western artist is the subject of this major retrospective, with many paintings and artifacts from his studio used as props; 9 a.m.-5 p.m. Tues.-Sun. (closed Mondays & holidays), Albuquerque Museum of Art, History, and Science, 242-4600.

Dec. 28 — Vaudeville Nouveau: The best of the new vaudevillians, for the whole family; 2 p.m. children's show, 8 p.m. adult & family show; KiMo Theatre, 764-1700.

Dec. 31 — Sandia Mountain Magic: Spectacular countdown to the new year, sponsored by KGGM-TV 13 and Sandia Peak Tramway; 11:30 p.m., free, Sandia Peak Tramway, 243-2285.

Jan. 5 — "Kiss Me Kate," Cole Porter masterpiece, Popejoy Hall celebrates its 26th season with "The Best of Broadway"; 8:15 p.m., Popejoy Hall, 277-3121.

Jan. 6 — Monday Monthly Lecture, "Pueblo Pots and Paintings," by J. J. Broday, UNM Professor Emeritus of Art History; 10 a.m., free, Indian Pueblo Cultural Center, 843-7270.

Jan. 8-19 — "The Mystery of Irma Vep," Charles Ludlum's parody of Victorian melodrama and Hollywood horror films, presented by the New Mexico Repertory Theatre; 8 p.m. Tues.-Sat., 2 p.m. Sat. & Sun.; KiMo Theatre, 243-4500.

Jan. 10 — "A Night in Vienna," the Chamber Orchestra of Albuquerque performs the music of Beethoven, Strauss, and Haydn; 8:15 p.m., St. John's Methodist Church (2626 Arizona NE), 881-0844.

Welcome

Albuquerque — Bonnie Buck (21-1), Renee Bustamante (21-1), Sandra Culler (21-1), Carol Eubanks (21-1), Holly French (21-1), Janet Helt (21-1), Clara Jackson (21-1), Leigh Kelly (21-1), Cesar Lombana (4212), Joan Maes (21-1), Carol Marquez (21-1), Linda Ristvet (21-1), Donna Roth (21-1), Kasumi Silva (21-1), Mary Tapia (21-1), Bess Wade (21-1), Sandra Wagner (21-1).

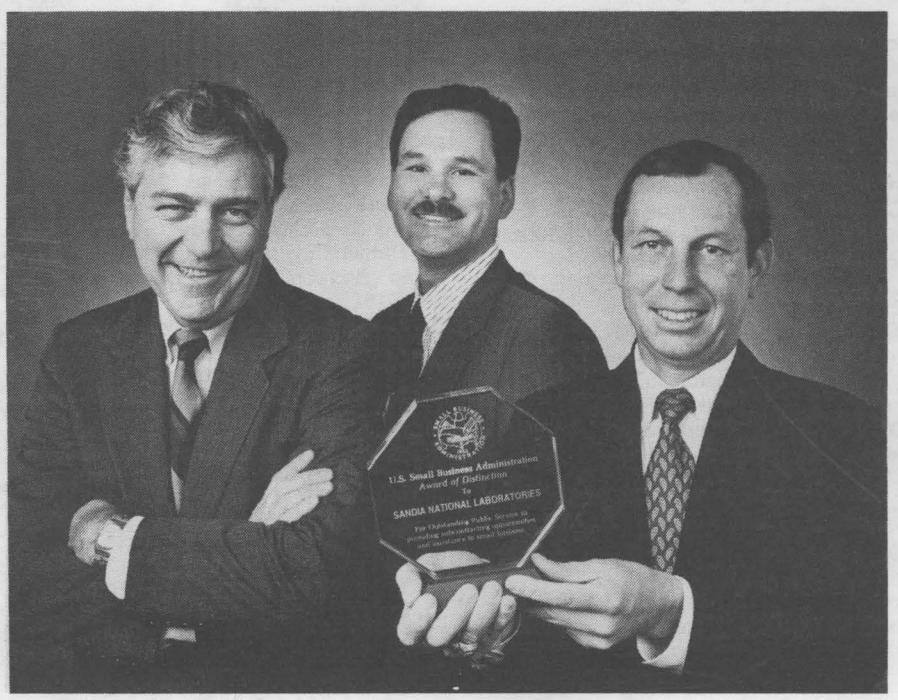
Retiree Deaths

John Peterson (87) ..... Nov. 6
Willard Rippleyea (72) ..... Nov. 17
Robert Quinlan (89) ..... Nov. 17
John Erni (75) ..... Nov. 24

Sympathy

To Mary Nation (4302) on the death of her father-in-law in Albuquerque, Dec. 4.

To Harvey Brewster (5000) on the death of his father in Muskegon, Mich., Dec. 10.



FOR SUPPORTING small and small disadvantaged businesses by providing subcontracting opportunities with Sandia, the US Small Business Administration (SBA) has awarded the Labs its highest honor: Award of Distinction. Seen here with the award, presented to Sandia Dec. 10, are (from left) Jon Bedingfield, Dan Naru (both Supplier Relations Div. 3703), and Purchasing Director Bob Zaeh (3700).