

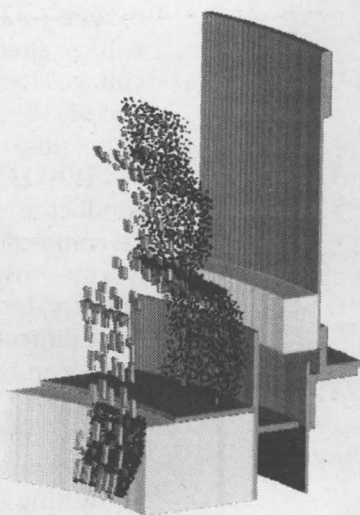
'Virtual testing' with Paragon supercomputer and Sandia codes helps ensure nuclear weapons integrity

Simulations playing greater role in weapons safety, reliability, effectiveness

As physical testing of US nuclear weapons becomes financially and politically more expensive, virtual testing that uses data from high-performance computing simulations plays a growing role in determining the effectiveness, safety, and reliability of the US nuclear stockpile.

Sandia is one of the leaders in finding answers to stockpile integrity questions. Sandia scientists are exploring a variety of issues.

With a truce declared in the Cold War, the need for nuclear weapons has diminished, and both the US and the former USSR, under the terms of the Nuclear Non-Proliferation Treaty, have eliminated thousands of their existing weapons. Still, policy analysts expect nuclear weapons to play an important role in deterring future national security threats. Thus, while



VIRTUAL TEST — Simulation sequence shows destruction of a shipping container caused by expanding debris from an assumed non-nuclear explosion of a weapon inside the container.

At left, time zero, initial conditions are shown; center, at 100 microseconds, most fragments have contacted the container; right, at 200 microseconds, the fragments have created a gaping hole in the container. These simulations were done by Fred Norwood and Marlin Kipp of Computational Physics & Mechanics Dept. 1432.

announcing in 1993 that the US would continue its moratorium on nuclear testing, President Clinton emphasized that the nation would explore "other means of maintaining our confidence in the safety, the reliability, and the performance of our weapons."

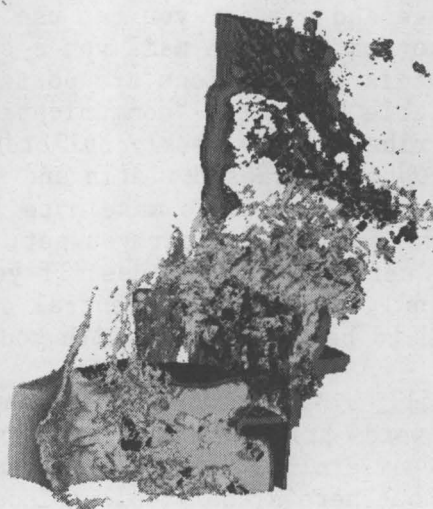
Virtual weapons testing

Enter high-performance computing — and a highly visible role for the emerging application of virtual weapons testing.

"The US commitment to ending underground testing, constraints on non-nuclear testing, and loss of production capability call for greatly increased reliance on computer simulation to verify the safety, reliability, and performance of the nuclear stockpile," says Ed Barsis, Director of Computational and Computer Sciences Center 1400.

"Computer simulations can help us assess the impacts of aging on existing weapons, and reduce the number of large-scale testing facilities," says Mike McGlaun, Manager of Computational Physics Research, Development, and Applications Dept. 1431.

Sandia is well known in both the conventional and nuclear weapons fields for its role in developing CTH, a family of codes for simulating complex phenomena in high-velocity shock physics (*Lab News*, Sept. 4, 1992).



Along with its parallel version, PCTH, the codes are used at more than 150 government and industrial sites to model complex, multi-dimensional, multimaterial problems characterized by large deformations or strong shocks. The range of applications stretches from modeling the collision between Jupiter and the Shoemaker-Levy comet last year (*Lab News*, April 15, 1994; Nov. 11, 1994) to predicting
(Continued on page 5)

Sandia National Laboratories

Sandia LabNews

Vol. 47, No. 12 June 9, 1995

Another Performance and Compensation Review — There's something new this year

A new link of 'value of contribution' added after 18-month study

This year, as before, Sandia will be engaging in a set of often exasperating activities referred to as the Performance and Compensation Review. While this is a recurring event at Sandia — and is commonplace throughout industry — employee satisfaction with the process seems to be an elusive goal.

For several years, the people involved with these matters at Sandia have been addressing issues identified by employees in their responses to several opinion surveys. These surveys range from the Rewards & Recognition Survey of 1990, the Sandians' Perspective Surveys of 1991 and 1993, and employee focus groups conducted in the last few years.

The 1993 Sandians' Perspective Survey produced a 43 percent approval rating for the Performance Appraisal process and a 38 percent

approval rating for Rewards & Recognition at Sandia, says Ed Cassidy, Manager of Compensation & Job Evaluation Dept. 3545. He says these ratings were either *at* (for Performance Appraisal) or significantly *below* (for Rewards & Recognition) the norm for R&D companies participating in the survey. As further comparison, in a recent William H. Mercer Inc. survey of 218 companies that conduct formal employee performance evaluations, 47 percent characterized their process as being of "fair to poor value to employees, or to the overall organization (51 percent)."

New process last year

The question for Sandians now is "What should we expect to see in the performance and compensation review this year, and why?"

About a year ago, Sandia's employee-designed Performance Management Process was introduced and implemented for managers and all nonrepresented staff. "This introduction followed implementation of performance management for both represented employees and at the VP and director levels," says Margaret Harvey, Performance Management Project Manager in Dept. 3545. "As a result, for the first time this year, all nonrepresented employees will participate in a process that uses a uniform set of performance ratings." (See "Performance ratings defined" on page 4.)

Ed says the annual performance and compensation reviews support "our philosophy to reward both individuals and teams for the value of their contributions to fulfilling San-

(Continued on page 4)

In-engine video helps probe unburned fuel mysteries

3

Emergency exercise with 'victims' involves multiple agencies

6



8

'Horizon' lets Sandians access library resources from desktop

9

Questions about compressed workweek? Here're answers.

This & That

Weird name and address time - It's time again to review some of the strange foul-ups and misspellings of our lab, city, etc. You folks send me so many that I can't publish them all, but here are some of the best of the worst:

Robert Kelley (7809) received a package addressed to Sam Dog Nat'l Lab. Don Hente (6513) got junk mail addressed to Don Hect in Albert, NM. Ben Blackwell (1514) got mail addressed to Sandia Batuibak Labs (I figured that one out; "Batuibak" would be "National" if the typist's right hand weren't one set of keys too far left.) Margaret Carroll's (7732) hotel bill had her as a resident of Alberqurqr. A former employee got a package addressed to her in Albequirkie. Stan Kawka (5122) received a package from London that took almost 5 months to arrive, addressed to Sandia Nail Lab. Bill Jacklin (5913) received a letter addressed to Sandia National Brands. Keep those weird names and addresses coming, and we'll do this again. Mail 'em to me at MS 0129.

* * *

Free cybersubscriptions - Most of you bona fide computer jockeys probably already know this, but I only recently learned about an extremely handy feature on Sandia's internal web homepage. If you have access to the homepage and e-mail, you can use a special "subscription service" that will automatically e-mail you a short notice when new issues of several Sandia publications are posted on the internal web. The service is available under the "communications" icon.

You can "subscribe" to the *Weekly Bulletin*, *Labor Relations Bulletin*, the (Job) *Opportunities Bulletin* and many more publications. This all ties into Sandia's plans to make more information available on the web and reduce the amount of paper you get. Check it out if you have access. It's a great service, easy to use. If you can't get the hang of it, though, the friendly folks at the central computing help desk on 845-2243 will be glad to help, or check with your local computer commando.

* * *

Who ya gonna call? - "Provided by the management for your protection." Those are the words printed on the boxes of paper toilet-seat covers mounted in our rest room stalls. Sometimes I think Sandia management is just too good to us, but here's the problem: Those words don't provide enough detail. They don't indicate what level of management provides these things. When the box is empty, should I call a manager, director, or maybe a VP? Maybe they take turns restocking those things between meetings!

* * *

New publication day? - Several folks have asked whether we intend to change the day on which the *Lab News* is delivered (alternate Fridays) when the "9/80" compressed workweek option (see page 9 for related info) becomes available to many Sandians at the end of this month. Beginning then, a substantial number of employees will be gone on Fridays.

Our answer is a firm, "We don't know yet." We're considering changing our publication day, but we have a firm *Lab News* printing contract with a commercial printer, and it specifies delivery to our mail room on Thursday, with distribution to employees the following day. We'll think about it, talk to our printer and our mail room folks, and see what's possible. Stay tuned. - Larry Perrine (845-8511, MS 0129)

Sandia-developed imaging techniques push microelectronics

Sandia has developed two imaging techniques — LECIVA (low-energy charge-induced voltage alteration) and LIVA (light-induced voltage alteration) — for detecting integrated circuit (IC) defects previously difficult or impossible to find.

The LECIVA technique is used to locate open conductors: microscopic cracks that break electrical connections in ICs and present major reliability concerns throughout the microelectronics industry. Detecting open conductors has become more difficult as circuit line widths become smaller and microchip complexity increases.

The LECIVA technique, developed by Ed Cole in Sandia's Electronics Quality and Reliability Center, Failure Analysis Dept. 2275, uses a scanning electron microscope to produce a small amount of electric charge at a precise microscopic spot on the IC circuitry. If an open conductor exists, a change occurs in the IC power demands as a low-energy electron beam is scanned over the IC surface. With LECIVA, the IC surface is negatively charged, using a low-energy electron beam. "This is a new surface interaction phenomenon" that physicists had thought did not occur, Ed says. Using the low-energy electron beam eliminates the problem researchers and manufacturers were having of IC chips being damaged by powerful high-energy beams.

Help in 'debugging' technologies

Ed says LECIVA will be used to work out bugs in developing technologies, detect product defects, and ensure product reliability "in the field."

The second defect detection technique, LIVA, locates defects in flip-chips — integrated circuits turned over to mate face down with external connecting pins. Conventional analysis methods can't be used with a flip-chip because the chip front is totally obscured. LIVA overcomes this limitation by using photons from an infrared laser to penetrate the backside of the flip-chip die, mounted on a scanning optical microscope. The photons create a photocurrent, allowing a charge to flow between circuits where current ordinarily wouldn't flow. This flow changes the power demands of the chip, resulting in voltage changes as an optical beam from the microscope is scanned across the IC. The voltage changes are detectable as images.

LIVA can also be used to determine the on-off logic states of individual transistors in an IC. "A modern chip has millions of transistors covered by multiple levels of metal," Ed says. "Without LIVA, it's like trying to see all the trees by looking only at the edge of the forest. . . LIVA lets you go to the center of the forest."

The LIVA technique was developed by Ed Cole and Jerry Soden (2275).

Sandia has filed for patents on both the LECIVA and LIVA techniques.

Last Saturday night, Ed was named Sandia's Engineer of the Year for leading the development of LECIVA and LIVA (see "Four Sandians get special 'top' awards at 1995 Employee Recognition Night" on page 5).

Take Note

Albuquerque High School graduates from the class of 1965 will hold their 30-year reunion July 28-30. For more information, call Peter Armijo on 246-0839 or Millie (Oakleaf) Sanchez on 299-7743.

* * *

Retiring and not seen in *Lab News* pictures: Ernest Gurule (7809), 16 years, Louella Byrum (7613), 31 years.

Sandia LabNews

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Lab News 505/844-7841 fax 505/844-0645

Published Fortnightly on Fridays by
Employee Communications Dept. 12622, MS 0413

LOCKHEED MARTIN

For the record

We offer clarifications/amplifications concerning two matters that appeared recently in the *Lab News*:

- The Project Stage Right Hyster Automated Guided Vehicle pictured on the front page of the May 26 issue was part of Phase 2 of the project and had nothing to do with the project's award-winning Phase 1, which received one of the team Employee Recognition Awards June 3 (and a Sandia President's Quality Award last year). The Project Stage Right (Phase 1) team delivered to the Pantex Plant the Inventory Control Computer, Shielded Lift Truck, and Physical Inventory Pallet. These three systems were time- and mission-critical elements necessary for the Pantex Plant to successfully continue its dismantlement mission. The systems have been fully operational since August 1994. The success of Project Stage Right (Phase 1) was the result of a Labs-wide effort and successful industrial partnering.

- A local citizen who was on an invited tour of Sandia's Annular Core Research Reactor (ACRR) has objected to a phrase in a caption of a photo of the tour in our April 28 issue that said those who attended a public meeting the evening before and those who went along on the tour showed "near-universal" support for ACRR's proposed use in the production of medical isotopes. This person says he does not support the proposal and takes offense at any implication that he does. We're glad to set the record straight.

Combustion facility probes unburned-fuel mysteries

CRADA researchers apply diagnostic tools, including in-cylinder video, to cold-engine emissions

By Nancy Garcia

California Reporter

Combustion Research Facility researchers are diagnosing one of the most important problems in vehicle emissions — the release of unburned fuel when a cold engine is started.

The work is taking place under two cooperative research and development agreements (CRADAs) with the Low Emissions Partnership (LEP) of USCAR, a precompetitive research consortium formed by Ford Motor Co., Chrysler Corp., and General Motors Co. Over three years, DOE and LEP are contributing equally to \$2.25 million in funding for each project.

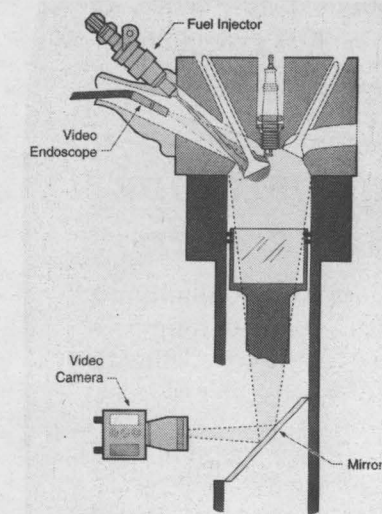
Under cold-start conditions, vehicles release unburned fuel for two main reasons. The catalytic converter isn't warmed up enough in the first two minutes to efficiently turn unburned fuel into harmless gases. Also, for quick starts, cold engines are effectively "primed" with excess fuel. However only a fraction of the liquid fuel vaporizes and burns, while the remainder goes out the tail pipe.

Pete Witze of Combustion in Engines & Furnaces Dept. 8362 has inserted the same sort of miniature video camera used for medical procedures (an endoscope no larger than a pencil eraser) into the intake port of a GM Quad 4 production head. With it, he takes "pseudo movies" that capture the spray of fuel striking the intake valves. With a strobe light, he records 10-microsecond-duration images obtained at slightly delayed times in the injection process. Successive images show how fuel injection progresses during the engine cycle. A computer program compiles the color footage into a series of images obtained from successive engine cycles, giving the appearance of a movie.

Video sent to partners

He reviews, edits, and narrates the footage before sending it to his collaborators in the Low Emissions Partnership, who can then view the video to see firsthand what Pete has accomplished in his laboratory. The partners are studying a variety of fuel injectors in benchtop

experiments and multi-cylinder production engines. After characterizing the performance of different injectors, the same injectors are sent to Pete for testing in his lab. A second partner in his CRADA is Los Alamos National Lab-



DIAGNOSTIC SETUP

oratory, where collaborators will use their KIVA fluid dynamic code to model this fuel preparation process on computers.

His engine consists of a single-cylinder block with a piston that contains a window to allow him to see into the chamber. Pete will look for fuel-wetting of the intake port walls for different fuel injectors and injection strategies. In addition, he will use the color and the progress of the flame along with the measured cylinder pressure to evaluate combustion performance as it relates to the fuel injection process.

Bob Green (8362) is also studying sources

Sandia California News

of unburned hydrocarbon emissions. Using laser induced fluorescence to visualize unburned fuel that escapes from cylinder crevices following the combustion phase of the engine cycle, Bob is examining the in-cylinder transport of this potential pollutant. For instance, preliminary data show a cloud of fuel accumulating near the small opening of the gap between the cylinder wall and piston as the piston rises during the exhaust stroke. In the hot post-flame environment, Bob says, some of this fuel may partially or completely oxidize, but the fuel near the cool cylinder wall or piston face probably will not be adequately consumed. His CRADA includes efforts by the Lawrence Livermore National Laboratory to model the chemical kinetics of this process.

Bob says that some of the fuel/air mixture survives the normal combustion process in cylinder crevices because the flame is quenched by wall heat transfer in such narrow gaps. This allows the fuel that has escaped burning to be expelled back into the cylinder during

the engine's exhaust stroke. Compounding the problem during cold starts, the catalytic converter isn't warm enough to effectively remove these pollutants from the exhaust.

"We're looking for a much better understanding of the mechanisms by which this source of unburned hydrocarbons impacts the emissions problem," Bob says.

These CRADAs represent two of four that were recently formalized between the CRF and car manufacturers. The LEP CRADAs are also noteworthy because they support goals that are also sought via the Partnership for a New Generation of Vehicles, a US industry/government alliance formed in 1993 to develop an affordable 80 miles-per-gallon automobile that will meet or beat all urban pollution and safety standards.



DIAGNOSTIC TEAM — Bob Green, Pete Witze, and Manager Bob Carling (all of Dept. 8362) in the laboratory where Pete carries out research for a cooperative research agreement with USCAR's Low Emissions Partnership.

Bob Carling returns from 10 months at Ford

A Sandia Combustion Research Facility department manager, Bob Carling (8362), recently returned from serving as the first researcher from a national laboratory to work on loan to a US automaker. A native of Michigan and the son of a General Motors Corp. employee, Bob believes his 10-month sojourn at Ford's R&D facility in Dearborn, Mich., allowed him to better understand the needs of the auto industry.

"I think I have better appreciation for some of their issues," he said after returning to his office at Sandia/California 10 months after the loan began. This sort of exchange was first suggested during discussions at a defense lab advisory board review. As a manager of engine research with ties to Michigan, Bob eventually volunteered.

While at Ford Motor Co., he helped coordinate a broad symposium on future areas for vehicle research. To assist the symposium, Bob helped coalesce invited presentations into six major areas, sorting through scores of automakers' suggestions. Participants came from government labs, industry, and academia. A summary of the symposium has been published, under sponsorship of DOE's Basic Energy Research division and the National Science Foundation, to provide guidance for researchers seeking project funding.

During his stay, he passed pertinent information back and forth among research colleagues whenever appropriate.

For instance, Bob was in touch with techni-

cal partners on four of the cooperative research and development agreements (CRADAs) issued through USCAR's Low Emissions Partnership (see "Combustion facility probes unburned-fuel mysteries" above), whose office was a couple of miles down the road from his temporary business quarters (he was placed next door to Ford's executive director of research). USCAR is a precompetitive research consortium of the Big Three automakers. Coincidentally, the CRADAs were all officially launched several weeks before his return to California.

'A pretty incredible process'

Another lab-industry project he tracked should shorten the time for servicing or troubleshooting machines on the factory floor. Currently, a drill press may have to be shut down for a half-day of servicing each time a drill bit breaks. However, sensors could be added to tell the automated control system to stop, alleviating the time spent correcting the problem. With Lawrence Livermore National Laboratory and the National Institute of Standards and Technology, a team is building closed-loop processors to provide such feedback. Previously, there was no way to modify or convey additional information to the proprietary control boxes used for machining, milling, and drilling auto parts.

Bob also helped write a proposal for the Big Three automakers to collaborate with seven aluminum companies on new ductile alloys

(Continued on page 8)

Performance

(Continued from page 1)

dia's mission and meeting customer needs."

"However," he says, "data gathered from employees over the last few years point time and again to our failure to effectively communicate the process."

"Before even completing this first year, there have been anecdotal reports," says Margaret, "confirming that the process, from planning performance, to obtaining and providing feedback, to renegotiating performance expectations, has helped managers to better appreciate the scope of work and commitment of effort by employees in the organization." And, "reportedly, some employees have noted a clearer focus on how to better support the organization's mission as well as where to make needed performance improvements."

Linking performance to pay

When the Performance Management Process was adopted, the employee information packet included this statement: "The evaluation of your performance relative to your established performance plans will be one factor considered when making compensation decisions in the 1995 Compensation Review."

In late 1993, the Sandia Quality Leadership Council tasked Human Resources Center 3500 to determine the link between performance and pay. In other words, the center was asked to define the other factors pertinent to compensation decisions. For 18 months, a team of directors, managers, and staff (see "Performance-to-pay-link team members") has studied the question. They surveyed 37 R&D companies on compensation strategies in support of business strategies, reviewed recent literature on industry (and specifically Malcolm Baldrige Award winner) trends for linking pay to performance, and considered the input of employee focus groups. The team even considered a Labs-wide application of a few different models for defining performance standards and value of contribution criteria.

As a product, says Margaret, the team guided the review and revision of Sandia's performance and compensation philosophy. She says team members also clarified and defined the two elements of the performance-to-pay link: (1) PERFORMANCE relative to expectations for comple-

What's performance? What's value of contribution?

The golf analogy

In negotiating their "Work Results," both Margaret and Ed agree to cut 6 strokes off their respective golf scores. Ed exceeds the expectation by cutting 10 strokes from his score; Margaret fails to achieve the goal by cutting only 4 strokes from hers. The final result has Ed shooting a 78 and Margaret a 68.

(Answer: Margaret's performance was not so good — didn't meet the expectations — but her value of contribution to the organization is significant.)

tion of major tasks, their priority, and applicable approaches agreed upon in the performance plan, and (2) VALUE OF CONTRIBUTION as a measure of the impact the employee tasks and activities have on the center's mission. (See "What's performance? What's value of contribution? The golf analogy" above.)

Centers to define criteria

While the concept of "value of contribution" is not new (as early as 1978, the *Supervisory Salary Manual* distinguished between performance and value), Margaret says 1995 is the year in which manager-employee discussions can focus separately on performance and value of contribution. Suggested "value of contribution" designators are IH (impact highest), IN (impact normal), and IL (impact lesser).

The need for clear communications has been the recurring theme throughout all of the study and work by the performance-to-pay-link team. Toward that end, the members identified the key features of a process linking performance to pay as:

- Performance management as one input into "value of contribution" determinations.
- Determination by centers of their criteria for "value of contribution."
- Communication by centers of those criteria, now and at the start of the new performance cycle.
- Pay decisions based on "value of contri-

bution" at the center level.

- Documentation of performance/value of contribution assessments.

- Communication by centers to their employees of the link between the "value of contribution" and compensation.

Transition period begins

Just as each center has different missions and different interpretations of "value of contribution," Margaret says some centers may not be able to define value-of-contribution criteria as they complete this review cycle. One employee asked to be notified of any value-of-contribution criteria the center may use in making pay decisions: "It would have been better to know the criteria at the beginning of the performance year, but you didn't have it. That's okay. But, you need to tell me as soon as you know what it is. When you know it, let me know it."

"As we conclude this performance year [July 1, 1994, through June 30, 1995]," Margaret says, "managers and employees should close the loop by discussing how well the employee performed relative to the agreed upon expectations — their goals. Then, center management will integrate the performance results with other center-based criteria, if any, to determine value of contribution. It's incumbent upon the center management to share with employees the basis for their value of contribution determinations and any corresponding pay decisions."

The performance-to-pay-link team says Sandians are in a "transition year" because the identification of center-based value of contribution criteria will provide new information for managers and employees to use as they complete their performance plans for the year beginning July 1, 1995.

As this performance review cycle is coming to its close, the message to Sandia management from Charlie Emery, Vice President of Human Resources Div. 3000, is to "encourage all of us to take performance planning seriously, provide feedback and coaching to support exceptional yet improving performance from our employees, apply sound criteria and appropriate input when evaluating performance, and communicate clearly. We need to say what we mean and document it, whether for exceptional performance, for improvement needs, or for clearly unsatisfactory performance."

Performance ratings defined

Sandia has introduced a uniform set of performance ratings that apply to all employee classifications (non-exempt through executive), except for represented employees. Ratings are defined for use in discussing employee performance relative to agreed-upon expectations developed for work results and work approaches. They are based on an assumption that performance standards are, and should be, high.

- EP (demonstrated exceptional performance). Those whose performance clearly exceeded the expectations and requirements of the job in the face of challenging demands. It is expected that few employees face this level of challenge year after year but that all employees are eligible to earn this rating when they do.

- HP (achieved high performance expectations). Those who did their job well and solidly achieved the agreed-upon expectations, high though they may be. It is

expected that the vast majority of employees would perform at this level; further qualification about an individual's performance may be reflected with the use of HP+ or HP-.

- BP (achieved below performance expectations). Those whose performance did not meet the high performance standards set and therefore need to make some improvements. It is expected that employees performing at this level would receive coaching on improvements needed, how they might be recognized, and additional support/assistance that might be required.

- UN (unsatisfactory). Those who do not meet established standards, therefore requiring a Performance Action Plan.

Employees who are new to the company or to a job classification at the time of the annual review may be rated PR (progressing) or NR (not rated), recognizing that there is insufficient experience with the employee to assign an annual rating.

Performance-to-pay-link team members

"Ensure employee understanding of the process to align compensation with contributed value" is the goal defined by the members of the performance-to-pay-link team:

Don Blanton (3500), Ralph Bonner (10500), Danny Brown (3090), Kim Brown (3545), Ed Cassidy (3545), Virgil Dugan (12100), Bob Eagan (1100), Charles Emery (3000), Shirley Emin (3545), Dennis Engi (6907), Margaret Harvey (3545), Dennis Hayes (5600), Howard Hirano (8412), Regina Hunter (6602), Mim John (8100), Shawn Leslie (2612), Dennis Miyoshi (5800), Mike Robles (13300), Anthony Thornton (3600) and Norm Wasson, (7816).

Sympathy

To Archie Stannish (10221) on the death of her mother in Albuquerque, May 12.

Four Sandians get special 'top' awards at 1995 Employee Recognition Night

Dean, Cole, Iman, Gosler honored for extraordinary accomplishments

When 104 individual Sandians and 12 teams received Employee Recognition Awards Saturday night, June 3, at the Marriott Hotel in Albuquerque, four of the individuals also received special honors. (See the May 26 *Lab News* for names and photos of the regular awardees.) The "Top Four" award winners were honored as the Inventor, Engineer, Author, and Manager of the Year.

Inventor of the Year: Craig Dean (Command and Control Program Office, Dept. 9403). "For his contributions to the development, implementation, and patenting of the CLERVER applications-sharing software that led to successful technology transfer to private industry and a commercial product."

Engineer of the Year: Ed Cole (Failure Analysis Dept. 2275). "For leading the development of two new failure analysis techniques for integrated circuits, 'Charge-Induced Voltage Alteration' and 'Light-Induced Voltage Alteration.' [See "Sandia-developed imaging techniques push microelectronics" on page 2.] These techniques have solved numerous industry analysis problems and led to significant technology transfer activities."

Author of the Year: Ron Iman (Manufacturing Systems Reliability Dept. 6613). "For his outstanding publications in the field of statistics, particularly for his recent publication of a statistics textbook, *A Data-Based Approach to Statistics*."

Manager of the Year: Jim Gosler (Vulnerability Assessment Projects Dept. 5903). "For extraordinary efforts in establishing the National Center of Excellence in Information Security. His

work has increased the customer base of the Vulnerability Assessment Projects and other information security organizations." In addition to his Manager of the Year Award, Jim has also been invited to Lockheed Martin's corporate Honors Night in Bethesda, Md., on June 23.

This was Sandia's second Recognition Night. The first, last year, marked the beginning of Sandia's participation in a Martin Marietta tradition. Lockheed Martin is continuing that tradition.



TOP FOUR: From left, Jim Gosler (5903), Ron Iman (6613), Craig Dean (9403), and Ed Cole (2275), after receiving the four top Employee Recognition Awards Saturday night.

Virtual testing

(Continued from page 1)

how well a jet's composite materials will hold up in the event of a nearby explosion.

Sandia is also known for its leadership in scalable, distributed-memory computing and its gargantuan Intel Paragon XP/S supercomputer. With 1,840 computational nodes, 3,680 Intel i860 XP processors, 38 gigabytes of memory, and 380 gigabytes of disk storage, the Sandia machine is the world's most powerful production supercomputer. A team of scientists from Sandia, the University of New Mexico (UNM), and Intel used the machine to win the 1994 Gordon Bell Performance Prize with a parallel dense equation solver implemented in four Sandia applications. Sandia also spearheaded the development of SUNMOS (the Sandia/UNM operating system), a high-performance operating system kernel for the Paragon supercomputer.

Preparing for the improbable

Sandia scientists are combining PCTH and the Paragon supercomputer to explore a number of weapon performance issues that are beyond the ability of lesser machines.

For example, nuclear weapons are designed and certified so that accidentally detonating the high-explosive components will not trigger a nuclear detonation. But what if two nuclear weapons are in a storage area and an explosive component in one of them accidentally detonates? The chemical explosion would generate thousands of fragments moving at thousands of miles per hour. While the chances of a nuclear detonation are virtually zero, an important con-

sideration is: What kind of protection is required against the impact of these fragments on an adjacent weapon in order to prevent materials from being even more widely scattered?

In studying the problem, Sandia analysts determined the size, velocity, and spatial distribution of the debris generated by an explosion. The analysts then modeled the movement of the debris and its interaction with an initial container (see sequence of simulations on page 1) with an adjacent container. Three-dimensional calculations showed that the structure of the container would help mitigate damage to neighboring weapons.

The challenges of this problem were considerable. The computational mesh had to be fine enough to resolve the fragments, each about a centimeter in size. At the same time, it had to cover a large enough area to include the shipping containers, which are more on the scale of feet or yards. The mesh had approximately 10 million cells and ran overnight on the supercomputer system.

"The Paragon supercomputer has taken us a quantum leap forward in our computational capabilities," says Mike. "We've seen a 15- to 20-fold speedup over the other supercomputers available to us. Calculations that were impossible to consider a year or two ago, we now do in a week. Calculations that took over a month, we do over a weekend."

The system has also enabled the study of larger problems, Mike notes. "A year or so ago, we'd run a problem with two or three million cells and it took a week. Now, we run problems with 14 million cells over a weekend."

Along with the increasing problem sizes, the resolution of the meshes has become finer, providing greater confidence in the scientific results. The finer zone size is desirable for a

variety of tough problems, including multimerials models of advanced armors, from tanks down to ceramic body armor.

Next time: A big machine

Still, for full-scale virtual testing, Sandia scientists say they need orders of magnitude more power than even the current system can provide. To run problems with 64 million cells and with more complex physics, scientists need computers with vastly more memory, and even more computational power. Memory requirements rise with the third power of the zone size, but processing requirements increase by the fourth power of the zone size, so achieving an order of magnitude more memory calls for more than a 20-fold increase in floating-point performance.

New algorithms and software are also needed, particularly codes that combine multiple functions with advanced physics. For example, CTH and PCTH are what their developers call "bang and splat codes," designed for events occurring at supersonic velocities. One of the codes that's being tested on the Paragon system, ALEGRA, combines bang and splat physics with "shake, rattle and roll" physics, which describes events occurring at slower, car-crash velocities. ALEGRA will enable scientists to analyze, for example, how the shock wave from a projectile hitting an army tank might damage the tank's electronics system.

Meanwhile, the need for solutions isn't going away.

"When you're talking about nuclear weapons issues, you don't want any surprises," says Mike. "The Paragon is a powerful system, but what I tell my boss is, 'Next time, get me a really big machine.'"

— Jan Rowell (for Intel)/Neal Singer (12620)



Members of the Kirtland Air Force Base Fire Department, dressed in protective gear, plan their approach into Bldg. 913.



Entry team members Mike Strosinski (second from right) of Safety Engineering Dept. 7732 and Kim Merritt (left) of Radiation Protection Operations Dept. 7714 assist victims Lorraine Padilla (right) and Nancy Gay, both of Presbyterian Hospital, who tried to walk away from the accident scene.



Mike Thomas (1114) waits for help minutes after a simulated explosion in Area 2 "injured" a number of people and "killed" three. Prior to the exercise, a moulage team from Los Alamos National Laboratory applied makeup to many of the victims to make their simulated injuries seem realistic to the responders.



A responder from the Kirtland Air Force Base Fire Department assists a distraught Arlene Martin of the Veterans Administration Hospital, who played an injured victim during the "Operation Rubble Glow" emergency exercise in Area 2 May 17.

Photography by Randy Montoya



Guinness, a member of the Albuquerque Urban Search and Rescue team, sniffs simulated rubble for buried victims while Letta Burn, his handler, gives directions.

Full-scale emergency exercise asks 'What if . . .?'

Labs, Kirtland, city, state, and DOE Headquarters participated

It began as an ordinary morning in Tech Area 2. Six Sandia workers were unloading a shipment of radioactive neutron generators and high explosives into a receiving bay in Bldg. 913. Because only 5 pounds of explosives can be in the room at any time, the workers were hurriedly inventorying the materials and moving them into a storage igloo.

Two of the technicians began to separate neutron generators from their explosive drivers in preparation for refurbishing them. That's when the day became extraordinary.

A phone rings. A bus load of 15 international inspectors is on its way to inspect the building for compliance with chemical warfare treaties. The workers rush to get the delicate materials inventoried and packed away before the inspectors arrive.

A tool slips. An explosion. Walls crumble. People scream. Mayhem.

Fictional, but challenging

Thus began Operation Rubble Glow at 8 a.m. May 17, a multi-agency exercise designed to test Sandia's ability to respond to an emergency involving multiple victims, foreign visitors, building structural damage, radiation contamination, unreacted explosives and chemicals, evacuations, and missing persons.

DOE requires Sandia to conduct such a "full-participation" exercise, requiring cooperation from outside agencies and the community, once a year.

"Although the scenario was based on hazards present at Sandia, an emergency like this probably wouldn't happen at Sandia," says Gwen Gorman (7311), who helped write the Rubble Glow scenario along with other representatives of emergency response organizations and agencies. "To make the exercise more challenging, we superimposed several hazards from different Sandia locations into one area."

Players, drawn from Sandia, area hospitals, Kirtland Air Force Base, and the University of New Mexico, acted out the roles of "victims." Others acted as victims' family members, community representatives, and reporters.

Responders — including members of Sandia's Emergency Management, Security, Medical, ES&H, Facilities, Media Relations, and Human Resources organizations — responded as if the emergency and players were real. Because none of the responders had read the scenario, they gleaned

new information (called "earned information") from victims (written on 3x5 cards if the victim was "unconscious") and from orange-aproned controllers (who accompanied the responders and "ran the show").

Other responders included the Kirtland Air Force Base Fire Department, Kirtland Security Police, Albuquerque Fire Department, Albuquerque Urban Search and Rescue team, Kirtland's Security and Explosive Ordnance Disposal teams, Albuquerque Ambulance Service, and local area hospitals.

Also on the scene were some 25 evaluators from DOE, Kirtland, Sandia, and other agencies, who observed and evaluated the responders based on how well they followed emergency response plans and procedures, used

information, and allocated resources.

In all, 21 victims were either inside the building or just outside when the fictional explosion occurred. Three people were "killed," and 18 others were injured or contaminated with radiation. Some were buried under simulated rubble.

Cautious response to uncertain hazards

Within minutes Sandia security arrived on the scene, followed by Kirtland fire engines, the Sandia Incident Commander, and a Sandia ambulance. By 8:30 a.m., the area was cordoned off and an on-scene Incident Command Structure was activated.

(Continued on page 8)



Controllers and evaluators observe as four members of the Kirtland Air Force Base Fire Department evacuate a "critically wounded" victim from the accident scene.

Sandia Technical Library opens new information 'horizon'

Horizon — a new automated client-server library system replacing DOBIS — is up and running at Sandia's Technical Library (Bldg. 804) and, according to Judy Geitgey of Technical Library Information Research Dept. 13415, has been well received. "We've gotten a lot of positive feedback," Judy says. Horizon and more than 20 newly acquired electronic CD-ROM databases were demonstrated May 19 when the Technical Library hosted its Electronic Resources Open House.

Sandians, from their desktop computers, can connect to Horizon through the Technical Library homepage on Sandia's internal web to access bibliographic listings for books, periodicals, unclassified technical reports, videos, and maps. Sally Landenberger, Manager of Technical Library Information Resources & Access Dept. 13414, says that for the last few years, the Library's strategic vision has been for Sandians to have desktop access to Library resources. "Horizon is an information management system that's a gateway to the world of information."

A physically separate classified Horizon system is being developed that will use the same software as the unclassified system. When this system goes on-line, Sandians who have a need-to-know can have full bibliographic access to classified and limited information

through Sandia's secure network.

John Abbott (13312), who at the open house demonstrated several ways to connect to Horizon, says downloading Horizon client software using the graphical method for a PC or Macintosh is the most commonly used connection method. The PC or Mac user must have access to the internal restricted network. From the Sandia homepage, the user selects menu options in this order: Services, Service Organizations, Technical Library, Electronic Resources, then one of the Horizon options.

"We'd like to provide access to the corporate file server so you don't have to download Horizon," John says, "but it's not available yet." He says using the corporate file server will be the best way to connect to Horizon; when this option becomes available, a notice will be posted on the Library's homepage.

Personal Horizon demonstrations are offered in the Library; call Connie Souza on 845-8187 or Sharon Gorman on 845-8287 (both in 13415) for information. Connie and Sharon are also available to answer Sandians' Horizon questions. For assistance in connecting to Horizon, call the Central Computing Help Desk on 845-2243.

Features available via the Library homepage:

- Mosaic pathfinders. Judy Geitgey has developed Mosaic pathfinders, available from the Technical Library's homepage. The pathfinders are a group of pointers, organized by topics relevant to Sandians such as physics, chemistry, and government, which Judy collects from the external Web. From the Technical Library homepage, select Internet Tools to see the list of pointers gathered so far. Sally Landenberger encourages all Sandians to let the Library know of any relevant "outside" Web sources of information, "so

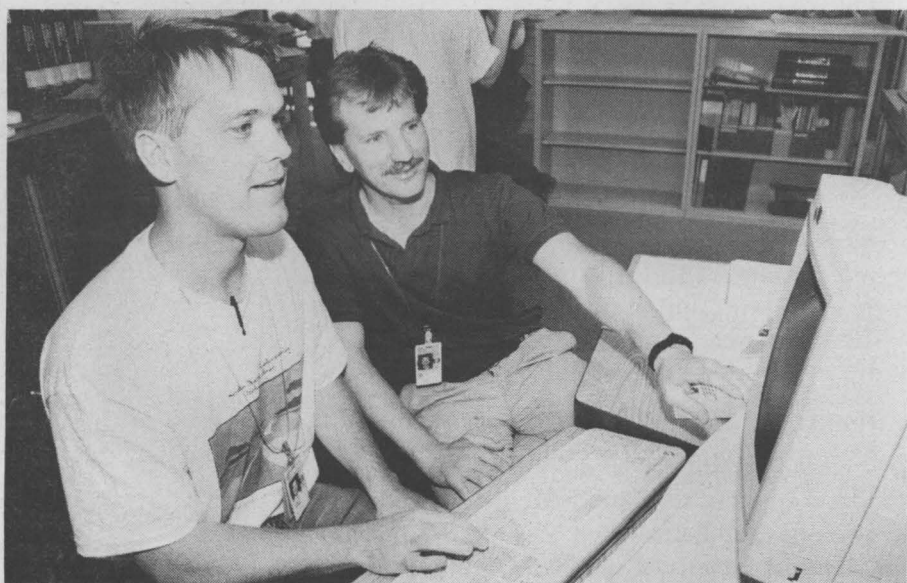
we can share it with all Sandians."

• SAND reports. So far, only one full SAND report has been scanned into a database available from the Library's homepage. (Horizon is currently useful for obtaining bibliographic listings of SAND reports, but does not provide full text reports.) However, the Technical Library plans to make available unclassified, unlimited distribution, full-text reports. "By the end of FY95," Sally says, "we hope all SAND reports that currently exist in electronic format (such as Word or FrameMaker) will be available on-line." Next, all new SAND reports will be put on Horizon if authors provide the Library with their reports in electronic format. After this, the tedious job of scanning in old reports from hardcopy begins.

• Access to other libraries. Right now, from the Library's homepage, Sandians can access information from the libraries of New Mexico Library Services Alliance members. These include: the University of New Mexico, New Mexico State University, and Los Alamos National Laboratory. Judy says the Library would like to make information from other libraries accessible through Horizon and is trying to get more libraries on-line, including the Air Force's Phillips Laboratory library.

A variety of technical databases are available on terminals at the Technical Library. Eventually, Sandians will access these databases through their desktop computers. As Mary Compton (13415) says, "We want this information to be accessible to all Sandians through their desktops, but we haven't yet overcome the technical difficulties."

Some of the databases currently available include unpublished aerospace research; artificial intelligence abstracts; all DOE unlimited reports produced since 1974; INSPEC citations with abstracts to worldwide literature in physics and electronics; the CIS nuclear database, containing nonproliferation information from the former Soviet Union; patent search information; maps of the world; and a Science Citation Index, which Sandians can access to see if their papers have been cited in other mainstream scientific journals.



OPENING NEW 'HORIZONS' — Kenneth Cutshall (left), technical information specialist in Sandia's Technical Library Information Research Dept. 13415, explains Horizon's capabilities to Ronald Goeke (2471) at the Library's Electronic Resources open house May 19.

Carling returns

(Continued from page 3)

that are needed to feasibly use lower-temperature, semisolid metal forming that was pioneered at the Massachusetts Institute of Technology 20 years ago. In what Bob describes as a "really pretty incredible process," semisolid metals have enough cohesion to be lifted and moved by a robot, but are soft enough to cut with a butter knife. The lower temperature lets dies last longer, and the consistency allows near-net-shape forming with virtually no porosity.

While he was away, Bob was always accessible by e-mail to employees in his Combustion in Engines & Furnaces Department. In his absence, supervision of engine and furnace research was divided between Jay Keller (8362) and Chuck Hartwig (8366).

Since the start of Bob's auto industry sabbatical, both Los Alamos National Laboratory and Pacific Northwest Laboratory have loaned researchers to another US automaker. Each of those facilities sent a staff member to Delphi Systems, a division of General Motors in Flint, Mich.

— Nancy Garcia (8502)



Emergency

(Continued from page 7)

By 8:40, DOE's Kirtland Area Office and several Sandia managers representing the Medical, ES&H, Media Relations, Facilities, and Security organizations had been called to staff Sandia's Emergency Operations Center (EOC), which provides oversight of major emergency operations on Sandia property.

Soon, similar EOCs at Kirtland, the City of Albuquerque, the State of New Mexico, DOE/AL, and DOE Headquarters were activated as well. (The scenario was purposely written with international political ramifications so that DOE Headquarters would be involved.)

Because the scenario involved a radiation release and other uncertain hazards, the response team approached the accident scene cautiously at first. There, in protective gear, they administered first aid to some victims and began transporting the most critical ones out of Area 2 for decontamination.

Later in the day, after all chemical and radiation sources had been contained, search dogs

sniffed through rubble in hopes of finding live buried victims. Back at the EOC, long-term recovery issues were being discussed to keep Sandia management, DOE, reporters, and community leaders abreast of developments.

Valuable practice, confidence builder

Gwen says an exercise as elaborate as Rubble Glow serves several purposes. "Foremost, it tests the value of our formal plans for dealing with emergencies," she says.

Also, she adds, it shows DOE and the community that Sandia is proficient in dealing with emergencies based on hazards relevant to its programs, and in interfacing with the community during an emergency that may have impact on local residents.

Such a large-scale exercise also gives Sandia, city and state governments, local hospitals, and other participating agencies valuable practice in working together in an emergency situation.

"Working together is the hardest part," she says. "If we can practice getting all these people to work together to solve a common problem, we'll be more effective if a real emergency ever occurs."

Team answers compressed-workweek questions

New 9/80 schedule option offers eligible Sandians three-day weekend every other week

As reported in the April 28 *Lab News*, Sandia has adopted a 9/80 compressed workweek option available to nonrepresented exempt and non-exempt employees, and Labs-wide implementation of the program is scheduled to begin June 30. The Compressed Workweek (CWW) Project Team has prepared the following information to clear up some of the confusion about the new 9/80 schedule and the implementation plan. The questions are some of the common ones being asked.

Q: Whom do I call if I have a question about the 9/80 program?

A: The answer depends on what your question is. If you have a question about the policy or implementation of the 9/80 program, you should call the CWW Line on 844-3263. This line is answered Tuesdays through Thursdays from 1 to 3 p.m. MST; during other hours, leave a message on the voicemail and someone will reply as soon as possible. If your question is about completing/correcting your timecard, you should call the Payroll Helpline on 844-2848.

Q: How does this new schedule affect contractors?

A: This is a tricky question, and the answer depends on what is stated in each specific contract and the policies of the contractor company. Some of our contracts specify certain hours that the contractor must be here, such as Monday through Friday from 8 to 4:30, while other contracts simply suggest hours or identify Sandia's normal working hours. If the contract specifies specific hours to be worked, Sandia must abide by those terms. Because modifications to contracts result in additional expenses to Sandia, contracts will not be modified for the sole purpose of allowing contractors to work a 9/80 schedule. If the hours are simply suggested and a contractor employee wishes to observe a 9/80 schedule and this meets the business needs of the Sandia organization owning the contract, the contractor employee should approach his or her own company to inquire about the possibilities. If the contractor's company is not willing to support compressed workweek, Sandia will not intercede. If the contractor's company is willing but indicates that its administrative systems cannot support a 9/80 schedule without resulting in overtime or other additional expenses being incurred by Sandia, the contractor employee will not be allowed to work a 9/80 schedule. The bottom line here is that Sandia is unwilling to incur any additional expenses as a result of the 9/80 schedule and will not request that our contractors incur such expenses.

Q: How does vacation work?

A: Vacation is accrued in hour increments and taken in "half-day" increments. The vacation accruals will not change nor will the manner in which we take vacation. What will change is the number of hours in a day or half-day. A day in the 9/80 schedule will now have either 8 or 9 hours. If you are on the 9/80 schedule and take a "day" of vacation on Monday, you will charge 9 hours to A241. Assuming the same schedule and you take a half-day off on Tuesday, you will charge 4 hours and 30 minutes to A241.

Q: What if I start working the 9/80 schedule and don't like it or for some reason need to revert to the standard schedule?

A: Employees may change their schedule after the end of the 80-hour period defined in the 9/80 schedule, commonly referred to as a

Workweek Two event. Changing to and from the 9/80 schedule should be minimized to ensure minimal impact on the needs of the business and must have manager approval.

Q: What is the first Friday available for me to take off on the 9/80 schedule and what do I have to do?

A: The first thing you must do is cancel your "case-of-record" approximately three weeks before you begin. After that, the first available Friday to be taken off (for non-pilot groups) will be June 30. Because managers will need to ensure adequate coverage five days a week, about half of the eligible employee desiring to participate will take off beginning June 30 and the other half will begin their 9/80 schedule the following Friday, July 7. People who have joined the prototype divisions (Divisions 4000, 5000, and 6000) after the prototype can take the 9/80 plan immediately after receiving training from their manager.

Q: The standard hours for the 9/80 schedule have been defined as 7:30 a.m. to 5 p.m. Can I start my day earlier or later?

A: Yes, with manager approval, you can vary your start and stop times under the current flexible work schedule policy (SLP 4110). Sandia's core hours for nonrepresented employees are defined as 10 a.m. to 2:30 p.m. To deviate your schedule, you must document your start and stop times and gain the approval of your manager. Your hours must include the 10 to 2:30 time-frame and a 30-minute lunch to be taken between 11:30 a.m. and 1 p.m. The approved memo is to be filed in the department personnel file.

Q: I liked one of the discontinued options offered in the pilot program. Can I use one of those schedules?

A: No, the only schedules available at this time are the standard schedule of 8 hours each day; the 9/80 schedule with 9 hours on Mon-

day through Thursday and 8 hours every other Friday; and (with the limitations listed in SLP 4110) the 4-day workweek working 10 hours per day. However, as mentioned earlier, you may invent different start and stop times as approved by your management and given the guidelines in SLP 4110. All employees in the pilot organizations must phase off the other pilot schedules by June 30.

Q: Can my manager stop me from participating in the 9/80 schedule or force me to participate?

A: Managers cannot force employees to participate in the 9/80 schedule, but they can disapprove participation. Management approval to participate is required and will be based on the needs of the business, also considering the performance and reliability of the employee. Some organizations or positions will not be able to accommodate the 9/80 schedule.

Q: Can student employees participate in the 9/80 schedule?

A: Students cannot participate in the 9/80 schedule. Students are "positive paid" and anyone who is "positive paid," whether full-time or part-time, cannot participate in the 9/80 schedule.

Q: Can represented employees participate in the 9/80 schedule?

A: Represented employees will not be allowed to participate in the 9/80 schedule until this option is bargained with each of the unions. Represented employees should refer to their union leadership for more in-depth answers to their questions.

★ Congratulations

To Liz (2782) and Victor Schexnayder, a son, Nikolaus Jontré, May 12.

To Christi and Kevin (4701) Boyack, a son, Taylor, May 25.



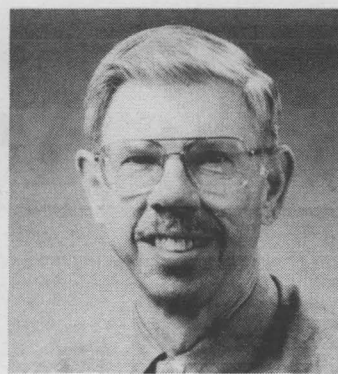
GETTING THE SCOOP — Bill Uncapher of Transportation Systems Dept. 6642, left, describes the On-Site Container behind him to Silas Cochise, a member of a delegation from the Mescalero Apache tribe that visited Sandia recently. The On-site Container was developed by Sandia for the Army's Office of Chemical Demilitarization. The Mescalero delegation spent two days at the Labs, discussing a cooperative research and development agreement on education and Sandia technology that might be useful in the tribe's efforts to establish a radioactive waste storage facility on its reservation in southern New Mexico. (Photo by Randy Montoya)

Mileposts

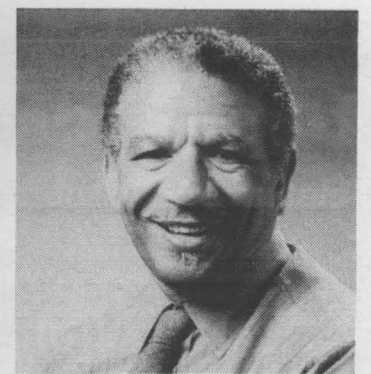
June 1995



Roxanna Sippio 15
2784



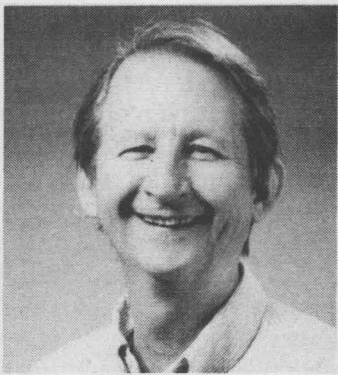
David Ryerson 30
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Conrad Carrington 15
7432



Duwayne Branscombe 35
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Herb Sutherland 25
6214



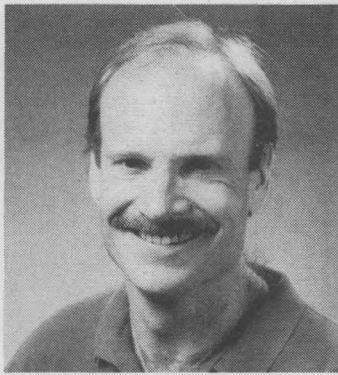
Gloria Gibson 15
13312



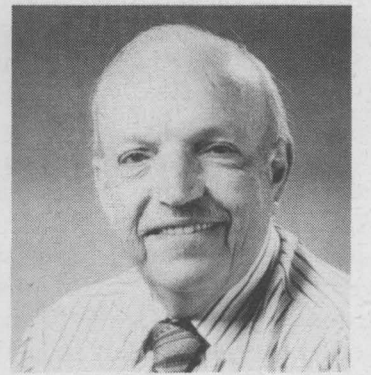
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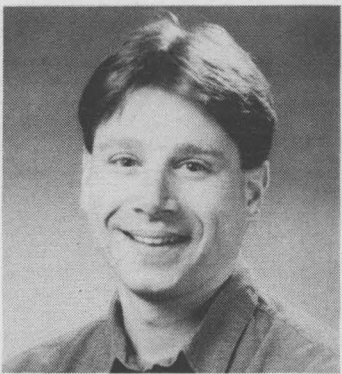
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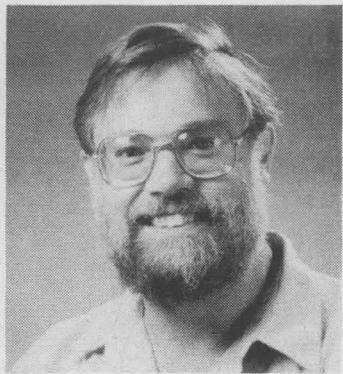
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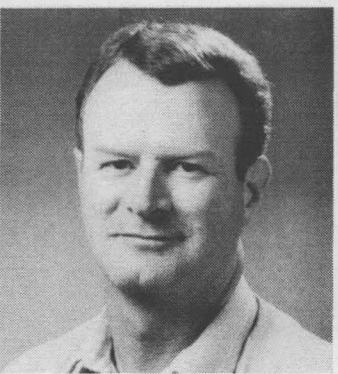
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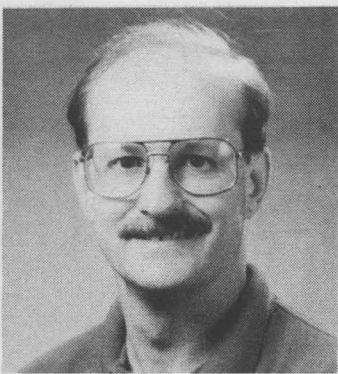
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Jim Stanley 15
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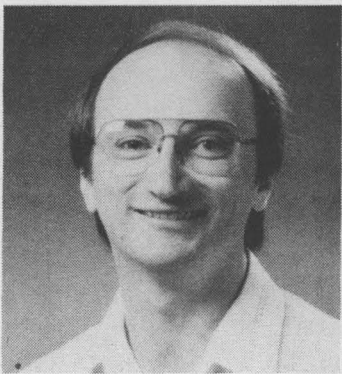
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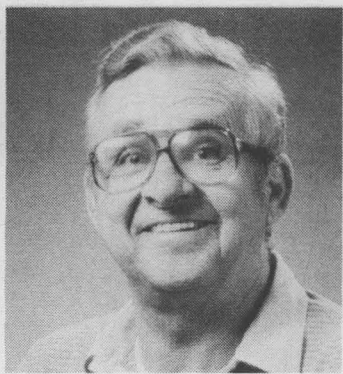
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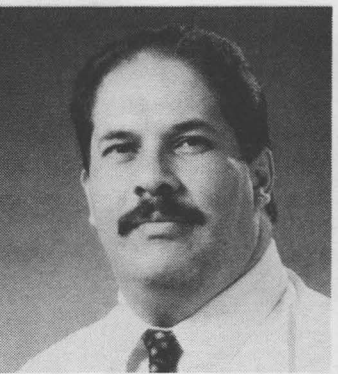
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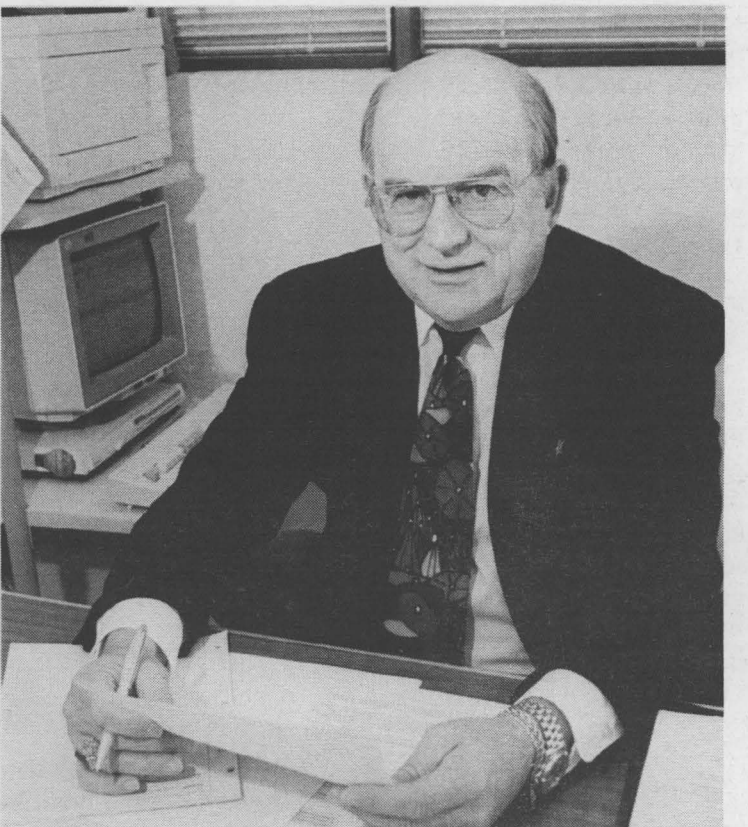
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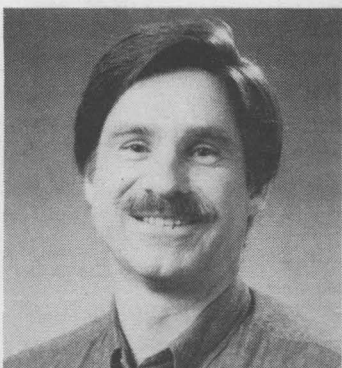
Kenneth Mazze 15
7613



Joseph Costales 15
7618



David Bray 35
10104



Robert Tooley 15
9417



T. J. Allard 15
2205



Sue Henderson 15
12111

Sandia Classified Ads Sandia Classified Ads Sandia Classified Ads Sandia Classified Ads

MISCELLANEOUS

HOT TUB, seats four, \$1,000 or trade for good pool table; Autumn Wood table & chairs \$250 firm. Steel, 298-3815.

FULL-SIZE CAMCORDER, Magnavox, w/access., \$375; Smith-Corona Se-lectric II, \$125; new Coleman camp stove, \$35. Woodward, 293-4369.

CAR SEAT, Fisher Price, \$40; umbrella stroller, \$10; Hotpoint washer, \$80; "stepper" machine, \$90. Sanchez, 873-2058.

WATERBED, \$125; dresser, \$125; hot tub, \$500; bar, \$500; TV/VCR stand, \$35; desk, \$25; bookcases, \$20/\$30. Wernicke, 237-9332.

486 DX-33Mhz, Super VGA monitor, 14,400 fax modem, 4M RAM, 120M HD, 24-pin printer, \$1,000. Brimble, 296-4130.

SWIVELING STENO CHAIR, Eck-Adams, brown/beige, metal frame, base, casters, adj. seat height, tilt-angle, tension, \$45. Schkade, 292-5126.

FOUR NEW TIRES 185/70 R14 & rims, for '90 Honda Accord, \$250. Padilla, 345-7660, after 6 p.m., ask for Joe.

NEWLY CUT TREE, free wood available if you cut up & haul away. Brigham, 293-6914, after 6 p.m.

COUCH, excellent condition. Sanchez, 836-5672, after 4 p.m.

FOUR WROUGHT-IRON CHAIRS, \$10 ea.; rocker, \$20; folding redwood picnic table/benches, metal legs, \$30. Wright, 256-9210.

MOVING BOXES: 3.1 cu. ft., \$1.75; pictures, \$2.75; 5.25 cu. ft., \$3.75; 14.9 cu. ft. wardrobes, \$6. Foster, 299-6240.

LAWN MOWER, Black & Decker, electric, Model M200, w/grass catcher. Gruda, 291-8433.

FREE BLACK LAB, neutered, has shots, housebroken, 1-1/2 yrs. old, excellent temperament, needs good home. Ortega, 298-6109.

HONDA GENERATOR, used 2 months, best offer; compact refrigerator, approx. 2 cu. ft. food compartment, \$45. Sparks, 884-5644.

NEW CHIPPER, 5-hp, \$300; dresser w/mirror, \$110; freezer, \$200; single bed, \$75; wood tables, \$25. Axness, 296-4691.

CHOICE BURIAL PLOTS, Sunset Memorial Park, Sandia Memory Gardens in Masonic Garden. Babcock, 299-3121, leave message.

SATELLITE DISH, complete. Lovato, 265-7949.

AMERICAN RACING RIMS, chrome & black, 14-in., must see, 3 mos. wear, must sell, \$400 OBO. Abeyta, 864-3670.

THREE-PIECE SECTIONAL couch, Southwest pattern; toaster oven; patio table w/four chairs. Lange, 856-1952.

ANTIQUA COUCH & CHAIR, 1930's, spindle maple, clipped red/black floral velvet, good condition, \$400 firm. Sackett, 292-1048.

NORDICTRACK 50S (Sequoia model) w/rear wheels for easy portability, \$250. Huning, 889-3044.

REFRIGERATOR, Frigidaire, 20 cu. ft., frost-free, good condition, almond color, \$150. Maloney, 299-4330.

CASUAL DINING TABLE, 42-in. round, glass, light rattan, 4 chairs w/cushions, 2 matching bar stools, set \$165. Detlefs, 298-8653.

FOUR TIRES, BF Goodrich LT235/75R15, A/T with 7/32-in. tread depth remaining (16/32-in. new), \$75 OBO. Beer, 262-9873.

DRUM SET, CB 700, \$350 OBO. Moya, 864-4582.

TWO FRENCH DOORS w/wrought-iron screen, \$100. Colgan, 344-3776.

FURNITURE, APPLIANCES, kitchen cabinets, more, come see before huge garage sale. Rael, 884-4778.

COLLECTOR PLATES, 35 (birds, ducks, owls), must sell, \$1,625 new, sacrifice for \$350. Locher, 256-3406.

CHILDRENS PLAYHOUSE, ages 3-6 yrs. old, beautifully constructed, must see to appreciate, \$225. Chavez, 842-6374, after 6 p.m.

WATERBED, king-size, oak, 12-drawer pedestal, Taos headboard, \$1,100 new, sell for \$350. Wernicke, 298-4819.

386/16 PACKARD BELL PC, monitor, 4MB RAM, 150MB HD, fax modem, VGA/1MB, soundblaster, \$300. Childers, 344-9281.

ELECTRIC MOTORS, various HP; Delco alternator, rotating parts bin, \$5; hex concrete stepping stone, \$.50 ea. Silverman, 298-1308.

EXERCISE EQUIPMENT, bench mark, weight lift, bar bells, \$130 OBO. Tripp, 831-4973.

SOUTHWEST BEDROOM SET, white-wash finish, queen headboard, dresser w/mirror, armoire, two nightstands, excellent condition, \$1,500 OBO. Castillo, 898-7405.

PICKUP SHELL, fits '87 Dakota long-bed pickup, tan, \$150 OBO. Ehrhorn, 822-1544.

STAIR CLIMBER, variable resistance Tunturi 416, programmable electronics, excellent condition, moving, \$85. Sena, 237-1480.

TWO SEMI-AUTOMATIC PISTOLS, AMT, stainless 22-mag., \$300; H&K, P95 45-cal., \$650. Rasmussen, 266-1097.

DOUBLE MATTRESS, box spring/frame, \$175; sofa & chair, beige, \$75; bookcase, \$15; single futon, \$75. Proud, 268-2526.

COMPUTER DESK, 26" x 30" x 60," wood, \$70. Vigil, 296-3590.

BED, firm twin-size, less than 3 yrs. old, \$110. Greene, 899-1405.

SIMMONS CRIB & changing table in ash, w/Sealy mattress, excellent condition, \$350 for both. Peebles, 822-1288.

ELECTRIC STOVE TOP, Thermador, stainless-steel, electric, 4 burners plus grill/griddle, \$350 (new \$700). Aidun, 265-4792.

COUCH, 7-ft., neutral Southwestern colors, 8 decorative pillows, good condition, \$200. Kovarik, 897-2188.

TOW DOLLEY, heavy-duty, new \$1,295, sell for \$750 OBO. Mulligan, 291-8539.

COUCH, white leather, \$400; cream-colored leather loveseat & ottoman, like new, \$350. Smith, 275-1666.

BUILT-IN DOUBLE OVEN, electric, white, used but works well, \$65. Brown, 884-8581.

DINETTE, farm-style, wooden table, 5 wooden chairs, new \$385, sell \$100; dresser, 5-drawer, rustic pine, \$50. Malcomb, 294-6975.

WEDDING RING SET, yellow gold, 14-ct. gold w/1/2-ct. diamond, appraised \$900, asking \$600. Hart, 254-0155.

SPINET PIANO, Baldwin Acrosonic, French provincial style, mint condition, tuned yearly, \$2,000 OBO. Wagner, 823-9323.

STORM DOORS, combination, 30in., natural aluminum, w/pet door, \$10; 36-in. black aluminum, w/bars \$50. Newcom, 293-5180.

NORDICFLEX GOLD, \$750 OBO; rowing machine, \$500 OBO, both like new. Tucker, 888-9786.

PATIO FURNITURE, white metal coated swivel rocker, chair & loveseat, w/pads, \$65 OBO. Lane, 884-4566.

DOGHOUSE, new, never used, brown, small-to-medium-sized dog, \$70. Baldonado, 248-0241.

WATERBED HEATER, new, never used, 5-yr. warranty; king-size waterbed liner, \$30 for both. Huber, 867-1681.

COUCH, white w/blue/mauve accents, \$200 OBO; oak coffee table, 4' x 4', \$80 OBO. Kane, 291-8576.

MAC POWERBOOK 140, \$900; Mac Performa 460, \$800 w/ color StyleWriter Pro, \$500, both for \$1,200. Griego, 899-2324.

BED RAILS, hospital-type, \$95; walker w/wheels, \$40; folding aluminum army cot, \$40. Auerback, 296-1489.

GARAGE SALE, Saturday 6/10, toys, dishes, clothes, books, kitchen stuff, computer software, misc., 3721 Madrid NE. Barham, 293-2412.

SIX KITTENS, free to good homes, 5-6 wks., medium length, white fur/gray markings, blue eyes. Furch, 345-1411.

DRYER, Sears Kenmore Advantage, used 18 mos., gas, white, \$275; sectional sofa/queen sleeper, \$500, combining households. Garcia, 343-8091.

HEDGE TRIMMER, cordless, electric, MOD-CEHT-2, 14-in. blade w/charger & guard disston, \$30; Big-Bertha driver graph-firm, \$155. Stang, 256-7793.

WATERBED, king-size, fiber-filled mattress, like new, 6-drawer under-dresser, light oak, mirrored headboard, \$300. Blaich, 271-8470.

DEADLINE: Friday noon before week of publication unless changed by holiday. MAIL to Dept. 12622, MS 0413, or FAX to 844-0645. You may also send ads by e-mail to Nancy Campanozzi (nrcampa@sandia.gov). Questions? Call Nancy on 844-7522.

Note: The number of ads received is steadily increasing; our space is not. To resolve this, we are now limiting people to one ad per issue. We will also strictly enforce the word limit and ask your help to keep ads as short as possible.

Ad Rules

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

JACUZZI HOT TUB, 5' x 7', w/insulated cover, excellent condition, 110V or 220V connections, \$950 firm. Salazar, 281-0560.

LARGE WALL UNIT, contains desk, bookshelves, drawers, cabinets, pull-out computer keyboard tray, maple stain, \$875. Caskey, 298-6428.

MISCELLANEOUS BARGAINS, evaporative cooler motors, outboard motors, used operable toilets, tele-phones. Luikens, 881-1382.

RABBITS, free to good homes. Fischer, 296-6122, leave message.

WHEELS, 195/70R14 tires, mounted on five-star progressive rims, many miles remaining, were on Chev. Cavalier, \$400. Bouchard, 831-4766.

COLEMAN CAMPSTOVE, \$20; lantern, \$15; child's rocker, \$25; chair, \$12; Graco swing, \$55; hamper, \$15. Levan, 293-0079.

TWO WROUGHT-IRON GATES, 36" wide x 42" tall, free. Porter, 821-7813.

YAKIMA IA, raingutter tower rack mounts (4 ea.), wind fairing w/hardware, all excellent condition, \$85. Brooks, 275-0056.

AMIGO, front-wheel drive, excellent condition, like new, \$650. Flores, 881-8086.

APPLE IIC COMPUTER, 2 monitors, ImageWriter printer, software, \$250; Smith-Corona word-processing typewriter, w/spell/write dictionary, \$100. Langwell, 293-2728.

TRANSPORTATION

'86 RENAULT ALLIANCE, stout motor, good, dependable car, \$500 OBO. Crosby, 858-3128.

'84 NISSAN PICKUP, 5-spd., standard-size flatbed camper shell, CB, new tires, almost 96K miles, \$2,400. Wanya, 294-2050.

'73 FORD LTD, 429 high-performance engine, runs great, new carburetor, starter motor, tires & battery. Farnsworth, 865-6160.

'94 HONDA PRELUDE V-TECH, blue/green, tinted windows, CD changer, gold kit, excellent condition, 11K miles, \$23,000. Robertson, 828-1278.

'75 DODGE PICKUP, 3/4-ton, 4-spd., PS, AC, cap, 7 wheels, \$1,500. Armijo, 881-1110, ask for Jim.

'83 FIREBIRD, V6, 5-spd., PS, PB, AM/FM cassette, T-roof, 88K miles, one owner, runs well, no rust/dents, \$2,000. Homicz, 294-1676.

'87 PLYMOUTH TURISMO, 5-spd., AC, tinted windows, original owner, 55K miles, AM/FM stereo cassette, \$2,000. Campbell, 294-1374.

'90 MAZDA B2200, w/camper shell, 5-spd., AM/FM stereo, \$6,000. Ewen, 836-3563.

'92 HONDA PRELUDE, 28K miles, warranty, AC, spoiler, AM/FM cassette, sunroof, 5-spd., security system, \$14,900. Snowden, 856-7215.

'88 MAZDA 323 LX, 4-dr., low miles, loaded, excellent commuter car, very dependable, \$3,995. Phillips, 293-6499.

'79 MONTE CARLO (Landau) 63K original miles, all power, new tires, excellent condition, one owner. Torres, 831-1988.

'84 HONDA ACCORD HATCHBACK, looks good, high mileage, runs well, good tires, no AC, \$1,600. Perrine, 293-1429.

'82 MAZDA RX-7, GSL package, new brakes, 5-spd., well maintained, nice, 103K miles, \$2,500. Hollis, 881-8623.

'94 Z-28 CAMARO, 9K miles, all options, looks new, \$17,800. Cross, 897-1580.

'85 PONTIAC TRANS AM, V8, new 5-spd., AC, excellent condition, below book. Cook, 296-3064.

'79 TOYOTA CORONA LIFTBACK, 2.2-lt., AT, PS, PB, AC, 89K miles, one owner, all records, superb condition, \$2,200. Hollister, 296-3655.

'88 FORD TAURUS L WAGON, AC, PS, PB, cruise, tilt, runs great, \$2,850. Hart, 291-8774 after 8 p.m. or 292-5110.

'89 TOYOTA CELICA GT convertible, 5-spd., red, new top, timing belt, brakes, clutch, cruise, excellent condition, 89K miles, \$9,500. Briom, 298-1761.

'88 HONDA PRELUDE 4WS, 5-spd., black, like new, 85K miles, new timing belt, \$7,800. Hoffman, 821-6946.

'87 MAZDA 323 LX, 4-dr., great family car, \$2,500. Wix, 898-9086.

'89 LINCOLN MARK VII, loaded, 91K miles, new transmission, \$7,500 OBO. Portlock, 299-3240.

'90 VW CABRIOLET convertible, white w/red interior, 26K miles, AT, AC, \$8,750. Bartel, 281-9094.

'88 MAZDA RX-7 convertible, 5-spd., AC, PW, equal./CD, 74K miles, looks/runs great, \$11,900. Aeschliman, 268-5968.

'90 ACURA LEGEND, 2-dr., AT, AC, sunroof, power everything, only 47K miles, excellent condition throughout, \$16,500. Evans, 265-5229.

'86 FORD RANGER, 4-cyl., 2WD, new clutch, shell, 96.6K miles, great condition, \$3,500 OBO. Brown, 296-4130.

'89 FORD TEMPO, 65K miles, PS, PB, AC, AM/FM cassette, metallic red, gray interior, \$4,000. Zamorski, 293-7706.

RECREATIONAL

HYBRID COMMUTING BICYCLE, 64cm, \$300; 700c front wheel, \$25; 2-bike trunk rack, \$35. Mann, 268-3108.

GITANE 10-spd., \$80. Dobranich, 298-4547.

TWO BOYS BIKES, 10-spd. Schwinn, dirt bike, \$75 each. Wing, 296-3826.

TWO BICYCLES, 10-spd & 3-spd., tricycles. Nation, 298-5605.

PEUGEOT 10-spd. bike, \$65. Newmann, 266-6928.

12-FT. PORTABOAT, 2 years old. Upchurch, 296-8591.

'92 DUTCHMAN CLASSIC 24-ft. travel trailer, microwave, full bath, separate bdr., awning, stereo, AC, loaded, \$13,000. Harrison, 833-1161.

MOUNTAIN BIKE, '95 Specialized FSR, XTR components, Ringle wheels, Magura brakes, \$2,500 firm. Letz, 293-4525.

'88 PALOMINO POP-UP tent trailer, used once, second owner, \$2,500 OBO. Roberts, 822-9125.

'80 KAWASAKI 100 Enduro, ultra low miles, \$550 or trade. Roeschke, 266-8988.

MOUNTAIN BIKE, Specialized Hard Rock, red, 16-in. frame, \$115. Van Den Avyle, 898-6474.

BACKPACK TENT, 2-person Kelty Canyon Ridge, like new, \$95. Brammer, 266-5158.

'84 TRAVEL TRAILER, 31-ft., Fleetwood Terry, loaded, extras, nice, w/hitch, \$6,250 OBO. Garcia, 293-3937.

'79 HOLIDAY RAMBLER MOTORHOME, Ford chassis, 24-ft., Class C, loaded, \$7,900. Garcia, 299-7803.

'92 ALUMACRAFT BOAT, Model T14S, 15-hp Johnson w/6-gal. tank, Accutrak trailer w/12-in. wheels, always garaged, \$2,400. Freyermuth, 299-2053.

SWIMMING POOL, above ground Doughboy, 15K gal., excellent condition, complete summer fun package, \$1,000 OBO. Gallegos, 271-0061.

WINDSURFERS, excellent stability, \$165 each. Buy both, will add extra booms & double sail bag. Gage, 293-1707.

2-BDR. FLORIDA TIME-SHARE CONDO, 2 baths, third week in January. On Astero Island, RCI member, magnificent gulf view. Watkins, 884-7015.

REAL ESTATE

4-BDR. ADOBE STYLE HOME, Belen, 2 baths, 2 fireplaces, large screened porch, Manzanos view, quiet neighborhood, landscaped. 2 minutes to I-25, Kercheval, 864-6549.

3-BDR. HOME, NE Heights, 1 bath, 1-car garage, excellent condition inside, outside totally updated, \$94,900. Goodnight, 294-2003.

4-BDR. HOME, 1,750 sq. ft., 10312 Delta Ct. NW, Paradise Hills, new roof, refinance, \$105,000. Gibson, 898-3529.

3-BDR. HOME, 1 bath, living room, den, 1-car garage, nice yard, neighborhood, schools, extras, under \$90,000. Martinez, 884-1679.

3-BDR. HOME, 2 baths, 2-car garage, 1,598 sq. ft., 9 mos. old, Willow Wood, \$145,000. Bashore, 275-5757.

3-BDR. HOME, 2.5 baths, paved, secure area, Cedar Crest, 3,200 sq. ft. plus 425 sq. ft. heated work area. Bushmire, 281-9552.

4-BDR. VICTORIAN FARMHOUSE, Edgewood, 2,434 sq. ft., 2-1/2 baths, 7-1/2 acres, oak floors, 3-car garage. Harris, 281-8145.

2-BDR. SUMMER HOME near Clinton, Ark., on 10 acres, living room, family room, \$20,000. Koenig, 294-2264.

4/5-BDR. HOME, 1 yr. old, brick, Opel-jenkins, 3-1/2 baths, 2,850 sq. ft., 2 miles from Sandia, \$217,000. Goldberg, 291-9756.

3-BDR. HOME, 2-story, 2-1/2 baths, 1,500+ sq. ft., solar heat/air, sprinklers, near Indian School/Chelwood, \$120,000. Barnette, 292-5186, by appt.

WANTED

TYPEWRITER ELEMENTS for IBM correcting Selectric II typewriter. Kellogg, 299-3737.

PERSON TO SHARE DRIVE to Sandia Labs from Belen, willing to work w/your hours. Chavez, 864-7034.

TO RENT, small apartment, house, or trailer for one adult. References. Eckles, 843-8686.

LITTLE TIKES activity gym or similar; grinder for workshop. York, 828-9505.

MOTORIZED TREADMILL, w/digital distance timer, good condition, good price. Serafin, 864-3524.

COUNT-DOWN TIMER for Sandia Basketball League; medium-size doghouse, good shape. Nickerson, 888-4159.

USERS MANUAL for Star NX-1000 printer. Kelly, 237-9709.

TAILGATE to fit Ford pickup. McCoy, 898-7188.

LOST & FOUND

LOST: Motorola flip cellular phone w/slim battery, Serial #674GTSPP12, May 24, Area 1 Bldg. 890, name/number engraved on back. Aguilar, 873-1952.

Sandia News Briefs

\$100 million CRADA to boost US competitiveness in global electronics market

Sandia, Los Alamos, and Lawrence Livermore national laboratories, in collaboration with Semiconductor Research Corp. (SRC, a North Carolina-based consortium of more than 60 semiconductor companies and government agencies), have joined forces under a \$100 million, five-year cooperative research and development agreement — one of the largest ever — aimed at preserving the US lead in semiconductor manufacturing. DOE has established a Center for Semiconductor Modeling and Simulation at Los Alamos to coordinate the work of the three labs. The team plans to develop fundamental new models of solid state and atomic physics to vastly reduce the amount of costly trial and error required to advance manufacturing. Continuously reducing integrated circuit (IC) feature size while increasing performance and reducing costs is the goal of today's semiconductor industry; new processes and materials are needed to shrink the next generation of IC features to atomic scales. SRC and DOE will fund the cooperative research effort.

Sandians investigate recycling of nuclear weapons parts

Jim Lutz and Ted Wheelis of Sandia's Environmentally Conscious Life Cycle Systems Dept. 6625 and Ibrahim Gundiler of New Mexico Bureau of Mines and Mineral Resources have investigated the recovery and recycling of aluminum, copper, and precious metals from dismantled nuclear weapon components. The US nuclear weapons stockpile will be reduced by thousands of weapons, resulting in 100 to 300 tons of materials per year for 10 to 15 years, the researchers have concluded. "If separated properly, the majority of the material can be recovered through recycling rather than disposed of as hazardous waste," they say in a recent report. "In addition, the value of the material, in terms of precious metal content, is sufficient to offset the cost of separation processing." Gundiler appraised the value of precious metals that can be extracted at \$5,000 to \$15,000 for each ton of material processed for recycling.

Kevin Bieg selected American Institute of Physics Congressional Fellow

Kevin Bieg of Defense Programs Technology Transfer Program Management Dept. 4231 has been selected the American Institute of Physics' 1995-96 Congressional Fellow. He will be one of approximately 25 fellows nationwide sponsored by various scientific and engineering societies under a program coordinated by the American Association for the Advancement of Science (AAAS). The AAAS fellowship program provides a unique public policy learning experience, demonstrates the value of science and government interaction, and encourages contributions of scientific and technical knowledge to government. Kevin will begin his one-year US Congress assignment in September.

Send potential Sandia News Briefs to Lab News, Dept. 12622; MS 0413, fax 844-0645.

Fun & Games

Tennis — A Round-Robin Doubles Tennis Tournament will be held July 8-9 at the Coronado Club tennis courts. Events include men's and women's doubles and mixed doubles. Gift certificates and other prizes will be presented to winners and runners-up. SERP and Coronado Club members and military personnel are invited to participate, and participants' guests may play doubles. Round-robin match play format will be used. Entry deadline is Monday, July 3. For more information call the SERP office on 844-8486.

Results are in for the Memorial Day Tennis Tournament played May 27-29 at the Coro-

nado Club tennis courts. Men's Singles — Alex Pimentel (1824) defeated Cliff Ho (6115), 6-4 and 7-6; Men's Doubles — Roy Palmer (13918) and Wendell Archer (2251) defeated Larry Schneider (1243) and Cliff Ho, 6-3, 1-6, and 6-4; Mixed Doubles — Gary Porter (USAF) and Shige Porter defeated Roy Palmer and Libby Greene (2612), 6-1 and 6-4. In round-robin events, Carmen Allen (9215) won Women's Singles; Carmen Allen and Frances Kilpatrick won Women's Doubles.

Golf — The Fourth Annual High Desert

Golf Classic will be held Sunday, June 25, at the Paradise Hills Golf Club. Proceeds benefit the High Desert Pipes and Drums, a non-profit organization promoting culture and the performing arts. The entry fee for the tournament is \$55 (\$12 of which supports band activities) and includes cart rental, box lunch, and greens fees. The entry deadline is June 10. However, enrollment for this city-wide competition is on a first-come basis, so early entry is encouraged. For more information, call Patricia Sharp on 281-5548 or Elaine Wright (10105) on 281-3505.

Coronado Club

June 11 — Sunday brunch buffet, 10 a.m.-2 p.m. \$7.95 adult members, \$8.95 guests, \$2.95 for children 4 to 12, free for children 3 and under. Music for buffet by Best Shot, 1-4 p.m.

June 15, 22, 29, July 6 — Thursday bingo nights. Card sales and buffet start at 5 p.m., early birds' bingo at 6:45 p.m.

June 16 — Friday night buffet/dance. \$7.95 buffet, 6-9 p.m. Music by Isleta Poorboys, 7-11 p.m.

June 18 (Sunday) — Father's Day Brunch. Baked ham, turkey, baron of beef, breakfast items. Adults \$8.95, children 4-12 \$4.95, children 3 and under free. Reservations are required and will be taken for 10 a.m., 12 p.m., and 2 p.m. only.

June 23 (Friday) — Kids' bingo night. Buffet, 5 p.m., with cartoons and movies. Bingo starts at 7 p.m. Free hot dog and soft drink for all kids playing bingo.

June 25 — Sunday brunch buffet, 10 a.m.-2 p.m. \$7.95 adult members, \$8.95 guests, \$2.95 for children 4 to 12, free for children 3 and under. Music for buffet by Bob Weiler and Los Gatos, 1-4 p.m.

July 4 (Tuesday) — Fourth of July Celebration, 11 a.m.-6 p.m. Low-cost buffet served noon-5 p.m. Children's games, 1-5 p.m. Pool open 11 a.m.-6 p.m. Admission free for C-Club members, guests \$2. Music for celebration by The Dukes of Albuquerque Orchestra, noon-2 p.m., and Bob Weiler and Los Gatos, 2-6 p.m.

Sandia in the News

This is a periodic column listing a selection of recent print and broadcast news reports about Sandia. It is provided by Media Relations Dept. 12621 to give Sandians a sense of what is being said about Labs work in national and international media.

Science magazine ran an extensive article on collaborations between the Department of Energy weapons laboratories and their Russian counterparts to control the spread of nuclear materials. The DOE labs have also cooperated with the former Soviet Union on basic science programs; Sandia's work with the Russians in metallurgy, materials research, and computing was referenced.

Newsweek's "Cyberscope" column reported on an identification system Sandia is testing that uses infrared images of faces. The testing is being done for Technology Recognition Systems. This is Sandia's second appearance in the "Cyberscope" column this year.

The Associated Press ran an update on Sandia's work in nonlethal weapons technology. Dennis Miyoshi (5800) talked about the potential of these developments in law enforcement and military applications.

The Houston Chronicle did a major story on the work of the Energy Department labs helping small businesses. Olen Thompson (4201) was quoted about Sandia's cooperative research work in microelectronics; Kevin Murphy (4221) suggested ways businesses could begin their work with the labs.

The "Industry Outlook" section of Aviation Week & Space Technology reported on Sandia's technology transfer leave of absence program that enables scientists and engineers to take up to a two-year sabbatical to start technology-related businesses.

—Kathy Kuhlmann (12621)



WOK'S COOKING? — Jim Finch, a contractor in Division Management Services Dept. 5502, had a close-up seat to watch master chef Martin Yan's cooking demonstration at the Coronado Club during National Asian Pacific American Month, but got even closer. He was summoned by Yan to provide "muscle power" stirring what the chef was putting into the wok, a job Jim said required more work than he had imagined. It paid off however: When Jim's part in the demonstration ended, Yan pronounced him Master of the Wok.