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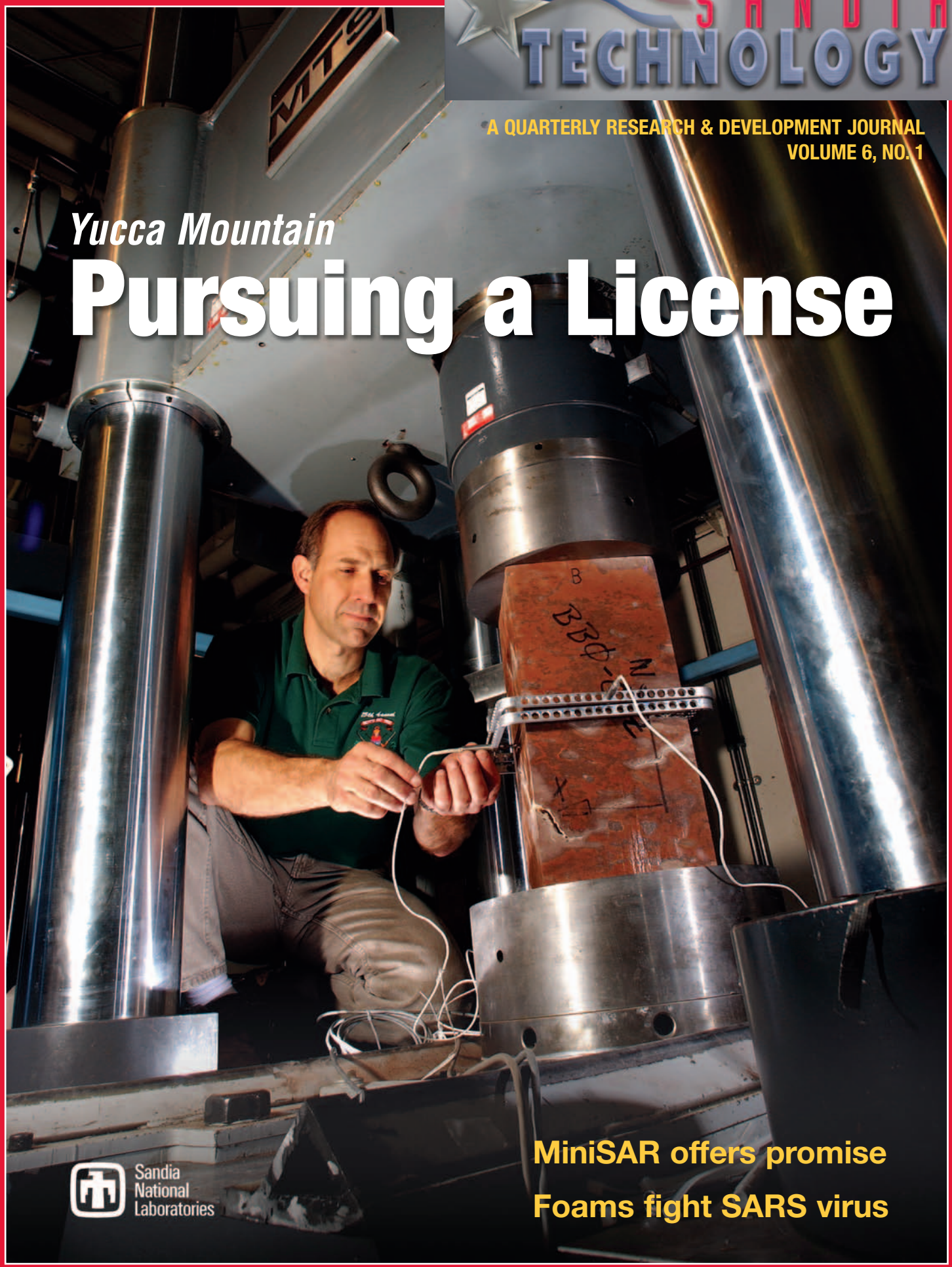

Yucca Mountain

Pursuing a License

MiniSAR offers promise

Foams fight SARS virus

Sandia National Laboratories

What is LDRD

Sandia's world-class science, technology, and engineering work define the Lab's value to the nation. These capabilities must remain on the cutting edge, because the security of the U.S. depends directly upon them. Sandia's Laboratory Directed Research and Development (LDRD) Program provides the flexibility to invest in long-term, high-risk, and potentally high-pay-off research and development that stretches the Labs' science and technology capabilities.

LDRD supports four primary strategic business objectives: nuclear weapons; nonproliferation and materials assessment; energy and infrastructure assurance; and military technologies and applications; and an emerging strategic objective in homeland security. LDRD also promotes creative and innovative research and develoment by funding projects that are discretionary, short term, and often high risk, attracting exceptional research talent from across many disciplines.

When the LDRD symbol appears in this issue, it indicates that at some state in the history of the technology or program, LDRD funding played a critical role.

On the Cover:

Sandia's Dave Bronowski sets up an experiment to test a rock sample from Yucca Mountain in Nevada. Sandia researchers analyze the results, calculating stress and strain at failure, and send the information to team project scientists for incorporation into numerical models. (Photo by Randy J. Montoya)

Sandia Technology (ISSN: 1547-5190) is a quarterly journal published by Sandia National Laboratories. Sandia is a multiprogram engineering and science laboratory operated by Sandia Corporation, a Lockheed Martin company, for the Department of Energy. With main facilities in Albuquerque, New Mexico, and Livermore, California, Sandia has broad-based research and development responsibilities for nuclear competitiveness and other areas of importance to the needs of the nation. The Laboratories' principal mission is to support national defense policies, by ensuring that the nuclear weapon stockpile meets the highest standards of performance. For more information on Sandia, see our Web site at *http://www.sandia.gov*

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Spring Issue 2004

FROM THE Editor

Dear Readers,

One-fifth of all U.S. electrical power is generated by nuclear reactors and high-level radioactive waste, including spent fuel rods from these nuclear power plants, is currently stored on the surface at numerous locations across the country.

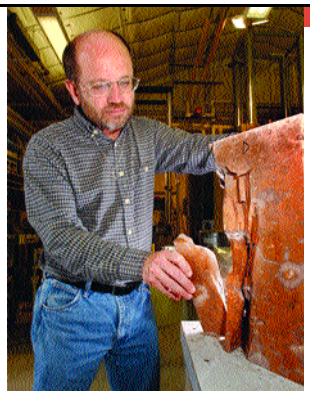
Sandia National Laboratories scientists, engineers and technicians are performing critical experiments deep in the volcanic heart of Nevada's Yucca Mountain to provide information that will assist in a key decision as to whether to license the remote site as a permanent repository for these radioactive wastes. Our feature story looks at Sandia's role in the 20-year project.

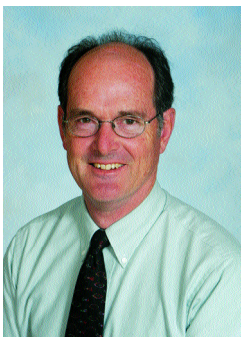
Other research projects reviewed in this issue will help to provide better support to our military forces. Within a year Sandia expects to fly the smallest synthetic aperture radar (SAR) ever used for reconnaissance — first on relatively small, unmanned aerial vehicles and eventually on precision-guided weapons and space applications. Sandia's miniSAR will be one-fourth the weight and one-tenth the volume of existing SARs and is the latest design in a 20-year Sandia history of related developments.

Building on more than 10 years of work, Sandia engineers have created a radar tag sensor that can be mounted on military vehicles and is recognizable to attack aircraft as "friendly." The device, tracked via aircraft radar, can be used to identify U.S. and coalition forces during combat to avoid unfortunate "friendly fire" incidents.

Articles on SARS virus-fighting foam and our Cooperative Monitoring Center in Amman, Jordan, underline Sandia's role as a national security laboratory.

Will Keener
Editor





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Pursuing a license

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Yucca Mountain worker adjusts heater assembly during construction for the drift scale test. Heater simulated spent fuel rods.

Sandia National Laboratories scientists, engineers and technicians are performing critical experiments deep in the volcanic heart of Nevada's Yucca Mountain. They are producing information that will assist the Nuclear Regulatory Commission (NRC) in deciding whether to license the Yucca Mountain Project (YMP) as a permanent repository for high-level radioactive wastes and spent fuel rods from nuclear power plants.

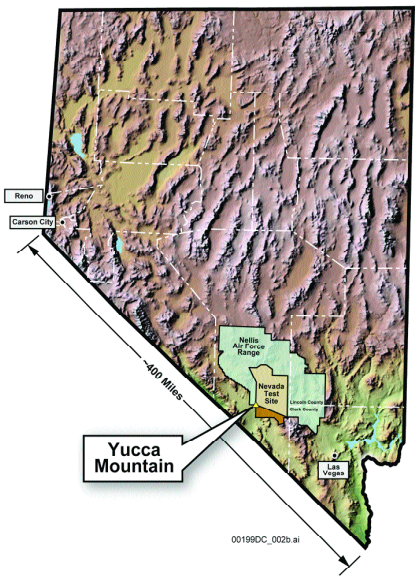
Work began more than 20 years ago at the Yucca Mountain site, located about 100 miles northwest of Las Vegas. It has accelerated in recent months as project managers Bechtel-SAIC, backed up by experimental evidence from Sandia and other participants, push to meet an approaching deadline. Formal application for construction authorization will be made to the NRC late this year.

Sandia held sole responsibility for scientific research at the Waste Isolation Pilot Project (WIPP) transuranic waste repository now receiving waste at a site near Carlsbad, New Mexico. But the Labs are just part of a much larger team at YMP. Sandia is one of six national laboratories working with the U.S. Geological Survey and several private companies.

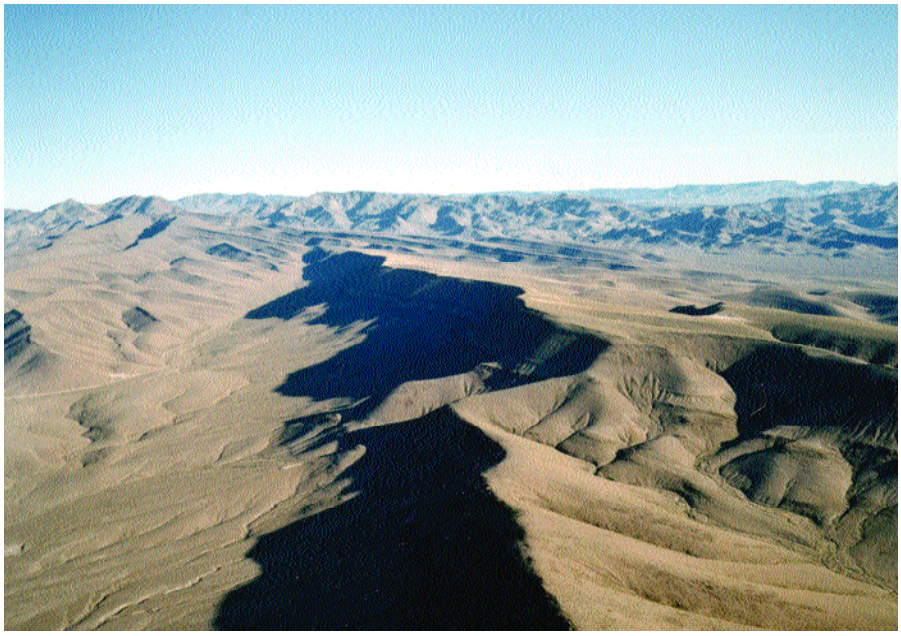
The main horizontal tunnel bores through four different geologic zones of volcanic rock called tuff.

DOE's Office of Civilian Radioactive Waste Management oversees YMP and its principal regulator is the NRC, rather than the Environmental Protection Agency (EPA), which has oversight of WIPP.

At WIPP, stable and uniform beds of salt run for miles, with tidy marker beds. The salt beds have remained intact for 225 million years. Marker beds help workers know exactly where they are mining. At YMP, the situation is radically different. The main horizontal tunnel bores through four different geologic zones of volcanic rock called tuff. Some of the rock was fractured by ancient seismic activity, causing faults to develop. Some contains voids caused by trapped gases during the formation of the rock. The tuff also contains zeolites, minerals that can slow the movement of radioactive materials.



Yucca Mountain is situated north and west of Las Vegas in the Basin and Range province of Nevada. Most of the facility is buried beneath the mountain.



10,000 years

"We have to demonstrate we can make confident predictions for performance over 10,000 years," says Cliff Howard, manager of Sandia's YMP Repository Test and Analysis department, "but generic approaches aren't appropriate here because of the distinctive rock types."

The Experimental Studies Facility at Yucca Mountain consists of support structures, two tunnels and a cluster of experimental alcoves along the tunnels, or drifts.

The main YMP drift is 25-feet in diameter, generally horizontal, and carves a five-mile U-shape through the mountain. A 16-foot diameter cross-drift has also been bored off the main tunnel into the rock horizon where most of the waste would be stored. A large-diameter air duct runs along the top of the tunnel. A conveyor belt, used to carry debris from the boring machine during the three-year drilling effort, runs down one wall. Along the other wall, thick high-voltage cables snake their way into the drift.

Sandia specialists are determining how Yucca Mountain's native volcanic rock responds, mechanically and thermally, to the heat and pressure expected during millennia of repository storage. This information is being combined with the results of other teams working on the project. These data are used in the creation of computer models for the assessment of the repository's long-term performance.

Sandia's is a tricky job, carried out in an unknown geological environment. "Because natural systems are inherently

Experiments at Yucca Mountain covered multiple scales from the single heater test (below) to a large-scale heat test (above) to determine response of the rock to storage of nuclear fuel rods.

uncertain, the test and analyses we conduct are designed to support a risk-informed decision process," explains Howard. "We ask ourselves, 'What are the chances of a certain scenario occurring?' and then, 'What are the consequences of that?'"

Howard and his fellow managers meet frequently with other team members to make sure experiments are on track, quality assurance issues are being addressed, and the architecture of having multiple teams feeding data for modeling repository performance and providing design information continues to be robust.

All in a day's work

In preparation for one such meeting, Howard gets started before 5 a.m., heading for Yucca Mountain from Las Vegas. As the desert flows past and the sun peeks over a range of mountains to the east, he briefs a visitor on the unique challenges posed by volcanic tuff, a dense, welded ash that showered down 12 million years ago.

At a building just outside the north portal of the Yucca Mountain drift, nearly 100 miners, experimenters and support staff are gathered for the 7 a.m. safety and operational briefing. To get this far — to the verge of a trip into the tunnel — visitors must have been trained in general

Moving to a safer place

Twenty percent of the electricity used in homes and businesses across the U.S. is generated by nuclear reactors, a percentage likely to increase as the U.S. grapples with its increasing dependency on imported fossil fuels. When the nuclear fuel is "spent" and no longer able to produce electricity efficiently, it is removed from the reactor and stored in cooling ponds or dry storage facilities. But this waste and some reprocessing residues, collectively known as "high-level radioactive waste," currently have no safe, permanent means of storage. Now they are designated for disposal at Yucca Mountain.

When licensed, the repository at Yucca Mountain will be in an active operating mode for about 75 years, with waste being put into storage before the site is permanently sealed. "We have to be able to answer questions about mechanical stability and worker protection in the mine," explains Cliff Howard. "How many rock bolts will we need to use? What about wire mesh? What other structures and components are needed to operate in the underground environment to emplace radioactive waste packages weighing in excess of 90,000 pounds?

"In order to build a safety case you'd normally go to civil project experience from the mining of tunnels and other similar work. But mining isn't done in volcanic rocks and there are few civil projects to turn to for analogs.

"There's almost nothing out there that's comparable, so you can't go to a textbook for clues."

Sandia workers install a flat-jack into a slot in the Yucca Mountain rock. Experimenters studied the effects of expanding pressure on the volcanic tuff of the mountain.

underground and radon safety and the operation of a self-rescue device, to be used in the unlikely event of a fire inside the tunnel. It's clear at the briefing that safety is important in this environment.

After strapping on a belt with the self-rescuer and a battery-powered lamp that attaches to his hardhat, Howard is ready for a trip inside the mountain. Visitors carry a radon dosimeter and a card that shows they have received safety briefings. Paperwork to ensure accountability for all workers is also a part of the process. Soon in a diesel-powered, open mining train, Howard joins other workers rolling into the five-mile-long drift. Just beyond a cross-drift, the train comes to a stop at Alcove 5, where two key experiments were conducted.

To determine how heat will influence the rock, experimenters placed an electric heater of several thousand watts into a small bore and measured heat flow in the surrounding rock to help calculate its thermal conductivity. Nearby, along the alcove, several technicians sample water and study the temperature and physical response of a large section of rock. Heated from December 1997 to January 2002 with a large cylindrical heater, the rock section will take several years to cool down. Measurements continue from time to time to understand processes that conceivably could cause corrosion of waste packages.

Later in the morning, Howard walks past the bulk of a giant boring machine at the South portal to examine another large-scale Sandia test. Inside the portal workers used hydraulic jacks to squeeze sections of rock to measure strength. The results gathered will help in the design of support systems and to help assess the repository's stability if and when seismic events occur.

Before returning to Las Vegas, Howard takes a radio, clears with ranch control, and starts up toward the crest of Yucca Mountain in a government pickup. From the top, the classic basin and range topography spreads in all directions. There is still a lot of work ahead for Sandia on the application to the NRC, he cautions. "There are hard decisions yet to be made."

Twilight view of a 25-foot boring machine entering the north portal of Yucca Mountain during drilling of the main drift.

Dave Bronowski (above) and Ron Price (below) study fracture properties of Yucca Mountain's rocks in their Albuquerque laboratory.

Ron Price's work is critical to understanding the rock matrix at Yucca Mountain to provide numerical and descriptive informational modeling for the repositiory.

Crushing rocks the scientific way

In order to develop a sound basis for licensing the proposed Yucca Mountain high-level waste repository, Sandia's Ron Price is studying the site one rock at a time.

Price has been breaking rock samples of tuff from the Nevada site for the past two decades. His work is critical to an understanding of the matrix rock properties, providing numerical and descriptive information needed for repository modeling, design and performance assessment.

The thick layer of tuff at Yucca Mountain is generally divided into three horizons, with the central zone the most dense and homogeneous. As Price explains, "heat and pressure rearranged molecules in the center into a dense hard rock, and this is the zone where most of the data has been collected." By the late 1990s, volumes of valuable data had been amassed on the central zone.

But then, after crews began mining the main drift, the design concept changed, and more data were needed on the upper and lower parts of the three zones — zones rich in lithophysae, which are voids in the rock that affect the material's mechanical strength. These formed during deposition of the rock, when pockets of gas were trapped by ashfalls with the consistency of molasses.

Subsequently the Albuquerque lab run by Price and co-worker Dave Bronowski was stocked with a large collection of specimens of red tuff, ranging in size from one-inch-diameter to one-foot-diameter cylinders. Samples were carefully mounted in a one-million pound rock press, instrumented, squeezed and the results recorded.

Price analyzes the results, calculating stress and strain at failure, and sends the information along to Bechtel-SAIC and Sandia scientists for incorporation into numerical models. Part of the analysis is a physical description of how the samples failed. "The rock is so ultra-fine-grained, it behaves more like glass than a classic igneous rock," Price comments.

"We want to know how the rock changes under stress. As the rock is squeezed, for example, it decreases in length and broadens. These measurements give us the necessary elastic properties. We continue to test until it fails, then we note the stress, strain and other information and feed that into our models." Sometimes the samples come out fairly intact. "Other times they come out like this," he says, holding a plastic bag filled with rubble.

Though a major part of the experimental work for the license application is now complete, Price and Bronowski are not likely to soon be out of work. "We'll continue to gather data for performance confirmation as operations begin," he says. "We want to know if it's going to perform the way we said it would."

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Tag-on sensor

Eliminating 'friendly fire' during combat

LDRD

A tagging device to help eliminate "friendly fire" during military combat has been created by Sandia engineers. The radar sensor has the potential to help U.S. military identify friendly forces and can be monitored from the air.

Lars Wells displays radar tag sensor prototype. (Photo by Randy Montoya)

Building on more than 10 years of research and development, Sandia engineers have created a radar tag sensor that can be mounted on military vehicles and is recognizable to an attack aircraft as a "friendly." The device, tracked via aircraft radar, can be used to identify U.S. and coalition forces during combat to avoid fratricide — the act of killing one's own soldiers in combat.

Fratricide is also referred to as "friendly fire" in some cases.

Lars Wells, manager of Sandia's Radar and Systems Analysis Department, and a team of Sandia engineers have completed numerous tests and identified partners and potential customers for the sensor, which will be tested by the Army.

One of the selling points is that the researchers have shown the sensor can work with multiple radars and multiple aircraft, says Wells.

"It is mature enough to consider as a solution now and for the long term," he says.

Radar echoes

The sensor, dubbed "Athena" — protector of the troops — by the Army, is not a radio transmitter that broadcasts a signal for the aircraft to receive. Instead, it is a sensor that creates synthetic radar echoes. The probing radar picks up the sensor signal in the same way it picks up radar echoes from tanks, trucks or other objects.

In general, radar transmits a pulse of energy then looks for the reflections of that energy from objects on the ground. The tag sees the radar's transmitted pulse and sends it back to the radar, except it adds a little bit of data to the reflection.

"Developing the capability to identify 'friendly' vehicles in battle will bring about a great reduction of fratricide."

As the radar picks up reflections from the ground, it looks for that unique data signal. Once the radar sees the data on an echo, it acknowledges the tag by placing an icon on the pilot's screen to alert him. The project has good system integration between tag and radar, Wells says, which is key to making it usable.

"Friendly fire"

According to the Department of Defense, 24 percent of the 146 American battle deaths during Operation Desert Storm were by so-called friendly fire. Fifteen percent of the 480 wounded were also caused by fire from friendly forces. Historically, fratricide has accounted for 10-15 percent of wartime casualties.

These incidents have long been a problem during war, says Wells. "Developing the capability to identify 'friendly' vehicles in battle will bring about a great reduction of fratricide."

The sensor has shown the potential to truly save lives on the battlefield, "But it can also assist in battlefield situational awareness," he says. "Many times during combat the military has to pull back from an attack plan because they don't know who is on ground."

Wells says a future path of the project is to include tags on every soldier.

Keeping costs down

Longtime Sandia tag expert Mike Murphy says one way of keeping costs down is to make the tag work easily with existing systems.

Sandia's radar tag sensor adds information to the echo sent back from aircraft radar, identifying the tank as "friendly" with an icon on the pilot's display.

"Our industrial partners will be able to take this technology and drive the cost down quickly so that it is affordable for every Army vehicle and Air Force fighter jet," says Murphy.

"The aim of affordability is a big factor of the project," says Murphy, who is manager of the Labs' Special Radars and Communications Systems Department. "By adding tagging to existing radars, we don't need to build new equipment for the aircraft."

Costs can also be kept to a minimum by partnering with industry and with various military agencies.

"Our industrial partners will be able to take this technology and drive the cost down quickly so that it is affordable for every Army vehicle and Air Force fighter jet," says Murphy.

Technological support

Some recent development has been supported by the Department of Energy's Nonproliferation Office, which has an eye toward using the technology to track proliferants. In fact, this application was how Sandia started to create what became Athena, says Wells.

The current project is being sponsored by the Army's Communication Electronics Research, Development, and Engineering Center, which is staging a large exercise this fall to demonstrate the tag system for high-ranking officers and regular soldiers alike.

"Sandia was the only developer that could ready a tag to support the short deadline," says project leader Rick Ormesher, a project engineer. "We were able to do an initial demonstration for the Army in January 2003 with only a few months worth of effort."

The success of that initial demonstration helped lead to the current effort, he says.

"We are really excited about the prospect of deploying this technology and seeing it make an impact," says Wells.

In addition to a dozen different Sandia researchers in five departments, the project is also teaming with General Atomics Corp. and Sierra Monolithics Inc.

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Synthetic Aperture Radar
MiniSAR offers promise

A primary application of miniSAR will be reconnaissance on small UAVs, such as the AAI Corp. Shadow seen in this picture.

LDRD

Within a year Sandia expects to be flying the smallest synthetic aperture radar ever used for reconnaissance — first on relatively small, unmanned aerial vehicles and eventually on precision-guided weapons and space applications.

Weighing less than 30 pounds, Sandia National Laboratories' miniSAR (synthetic aperture radar) will be one-fourth the weight and one-tenth the volume of conventional SARs that now fly on larger unmanned aerial vehicles (UAVs). It is the latest design produced by Sandia in a history that involves more than 20 years of related research and development.

Like the larger class of Sandia SARs, the new version will be able to take high-resolution (four-inch) images through weather, at night and in dust storms. However, while the larger SAR, flown on platforms such as General Atomics' Predator, can produce an image from as far away as 35 kilometers with its larger antenna and higher transmitter power, the miniSAR is expected to operate at a range of about 15 kilometers — more than adequate for most small UAV applications.

Future versions of the miniSAR are contemplated that will shrink the total weight to less than 10 pounds by leveraging both in-development and yet-to-be developed Sandia microsystems technologies.

Current approach

George Sloan, Sandia's project lead for miniSAR development, created the current approach for miniaturized SARs with colleagues Dale Dubbert and Armin Doerry several years ago. The effort incorporated a number of key technologies, including mechanical design, digital miniaturization, radio frequency miniaturization and navigation expertise. Last November, after the Sandia teams got the miniSAR down to its diminutive 30 pounds, they introduced it at a UAV conference. Since then, more than 30 potential customers, including intelligence agencies, UAV manufacturers and major radar vendors, have visited Sandia to discuss possible licensing and use of the miniSAR.

"We look to make the miniSAR small, light, and affordable," Sloan says.

Previous SAR versions were too big, too heavy and too expensive to use in precision-guidance applications.

The new design incorporates two major subsystems:

The antenna gimbal assembly, a pointing system that consists of the antenna, gimbal and transmitter that sends the radio frequency signal and receives it back.

The radar electronics assembly, combining signal generator, receiver and processors in an electronics package that generates radar signals, controls the system, processes the data and transforms it into an image.

Two applications

Sloan says the miniSAR will have two primary applications. First it will be used for reconnaissance on small UAVs that can carry a payload of 50 pounds, considerably less than existing radars. Second, it will then be adapted for use in precision-guided weapons. Current guidance systems for these weapons rely on target designation methods that are subject to jamming and have trouble operating in bad weather and dust storms. MiniSAR is resistant to these problems.

Previous SAR versions were too big, too heavy and too expensive to use in precision-guidance applications.

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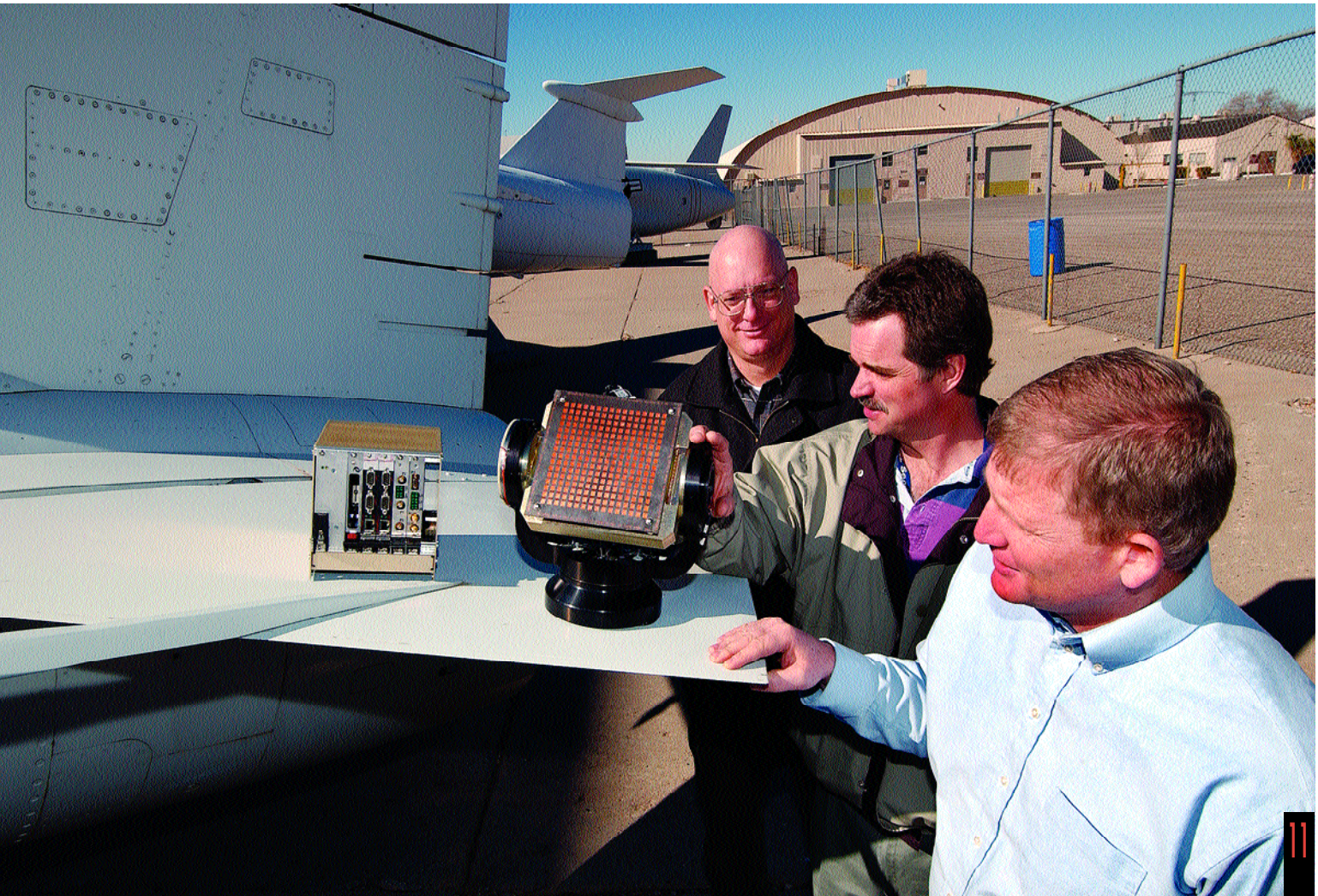
Sandia researchers, front to back, George Sloan, Dale Dubbert, and Armin Doerry look at miniSAR assemblies meant to be used on unmanned aerial vehicles and precision-guided weapons and space applications. (Photo by Randy Montoya)



Cooperative Monitoring Center

Amman targeting Middle East cooperation

The Cooperative Monitoring Center – Amman (Jordan), modeled after Sandia's Cooperative Monitoring Center in Albuquerque, New Mexico, has officially opened. Sandia germinated the idea for the new center, worked to bring it to reality and continues to assist center staff to help it succeed.

Maj. General Mohammad Shiyyab, director of the Cooperative Monitoring Center — Amman (center) leads a tour of the facility.

Amir Mohagheghi, of Sandia's Cooperative Monitoring Center (CMC) in Albuquerque, New Mexico, says he is hopeful the newly opened CMC – Amman will grow and develop its own solutions for expanding cooperation and collaboration among nations in the Middle East.

"There are, of course, border issues that need to be addressed, as well as regional water management issues," Mohagheghi says. "It's important to find regionally developed solutions to these problems, rather than impose solutions from the outside."

Serving the Middle East

The new CMC – Amman will serve the region in much the same way Sandia's CMC has promoted international cooperation. The new center's objectives are to:

- Promote the role of science and technology to help resolve nonproliferation, arms control and other security issues,
- Develop a cooperative-monitoring culture within the Middle East through education and training,

"We are trying to get them to develop their own ideas for solving regional problems."

Arian Pregenzer of Sandia's Cooperative Monitoring Center

- Deploy monitoring technology projects that allow multiple countries in the Middle East to experiment with the technology and to share their experiences, and
- Help regional security officials bridge the gap between technical and political issues.

Major activities will include research and analysis to identify areas of mutual interest and to establish dialogue among experts; workshops to train Jordanian and regional participants on applications of technology for border security, resource management, arms control, explosives detection and public health; and collaborations to develop new concepts for applying technology to these issues.

Exhibit hall

Examples of current technology demonstrations at the CMC – Amman exhibit hall include border-control technologies, explosives, detection, environmental monitoring and assessment, commercial satellite imagery, sustainable land-use, and disease monitoring. Additional capabilities will be added as new projects develop.

The CMC – Amman is located at the Royal Scientific Society (RSS), situated on an 85-acre site in northern Amman. The center occupies about 2,000 square feet on the third floor of one of the RSS buildings. Retired Jordanian Maj. Gen. Mohammad K. Shiyyab is director.

RSS engineers and scientists currently staff the center. Staff members are responsible for organizing future training workshops and developing cooperative technology projects. Depending on the needs of a particular workshop or project, the staff will draw upon the technical strengths of the 700-person RSS.

Arian Pregenzer of the Cooperative Monitoring Center said while a number of factors pointed to selecting Jordan as the site of the new cooperative monitoring center, a major reason was that it is an Arab country that has recognized Israel. "We are trying to get them to develop their own ideas for solving regional problems," she said. "With regard to border security, perhaps there can be an Israeli/Palestinian partnership."

Jordanian military officials sit in on a CMC – Amman class on border control technologies.

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SARS Foam

Sandia foams fight SARS virus

LDRD

Research carried out in cooperation with Kansas State University indicates that the Severe Acute Respiratory Syndrome (SARS) virus can be inactivated by chemical formulations developed by Sandia to decontaminate chemical and biological warfare agents.

Cecilia Williams (left) and Jill Bieker, two members of the Sandia/K-State research team, test Sandia's decontamination formulation. (Photo by Bill Doty)

In a series of tests conducted at Kansas State University on Bovine coronavirus (BCV) — the internationally accepted surrogate for the Severe Acute Respiratory Syndrome (SARS) coronavirus — Sandia versions of its DF-200 formulation fully inactivated samples in one minute or less.

Two commercially available versions of the Sandia formulation also were effective in inactivating the virus in the tests.

The team now is pursuing funding to conduct similar tests on the SARS coronavirus itself and hopes to test other emerging viruses such as the avian influenza virus (bird flu). "Flu and other viruses have similarities that give us reason to believe our formulations would be useful for general viral disinfection and decontamination if used for regular cleaning of certain facilities," says Jill Bieker, a Sandia intern currently working on a doctorate degree at K-State.

Active for days

Recent research suggests that the SARS virus can remain active on contaminated surfaces for days, and health officials speculate that places where infected people congregate, such as airports and hospital wards, might have served as

To give researchers enough scientific confidence that the formulation would reliably stamp out SARS regardless of the circumstances, the team tested the formulations against BCV using cell culture methods with and without organic material present.

"superspreaders" during the SARS outbreak.

The Sandia/K-State researchers believe that cleaning facilities with chemicals proven to inactivate the virus might significantly blunt an outbreak and possibly prevent regional epidemics from becoming worldwide epidemics.

To give researchers enough scientific confidence that the formulation would reliably stamp out SARS regardless of the circumstances, the Sandia/K-State team tested the formulations against BCV using cell culture methods with and without organic material present. Organic materials such as soil and feces may improve the survival rate of coronaviruses and can react directly with the disinfectant to make it less effective.

They also used diluted concentrations of the formulation, down to 10 percent of normal, and altered recipes of the formulation with similar results.

Deployment modes

The Sandia decontamination formulations can be deployed as a foam, fog, mist or spray, meaning they could be sprayed on walls or dispersed as a fog throughout the air-handling system of a building, says Cecelia Williams of Sandia.

The work to inactivate SARS is part of a larger Sandia program to develop a toolkit of technologies useful for responding to future infectious disease outbreaks. The program includes research to model airflow and predict the transport of airborne chemical and biological agents through buildings or aircraft.

Currently no disinfectant products are registered with the Environmental Protection Agency (EPA) specifically for killing the SARS virus on surfaces. Kansas State University is a comprehensive, research, land-grant institution serving students, the people of Kansas, the nation and the world.

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By Dr. Richard Oberst **INSIGHTS**

Dr. Richard Oberst
Kansas State Unversity

Agricultural biosecurity taking on increased importance

Improving upon food safety and animal health has been an important aspect of veterinary medicine and the U.S. livestock industries for many years. Unfortunately, since 9/11 we face a different security challenge with agricultural biosecurity taking on an increased importance. Our current agricultural food safety and security programs have provided the citizens of the U.S. the safest food production system the world has ever seen. But these programs were not designed to identify or respond to intentional acts of bioterrorism using either conventional or unconventional biological agents to contaminate our food or food processing/distribution system.

Because the potential consequences of agricultural bioterrorism are high and the vulnerabilities widespread, a lot of work awaits the American agricultural industry and its research allies in academia and government. Right now, we do not have effective systems for detecting, reporting and effectively mitigating outbreaks of new diseases or pests. Our decision-making process is ambiguous. We also do not have validated intervention strategies that could be applied to our food production, processing and distribution systems once an event has occurred. Existing strategies could actually make the problems worse and amplify the economic impact.

Many have recommended that what is needed is a suite of new strategies and technologies that can be integrated with the existing food production infrastructure. These strategies and technologies need to be based on solid systems analysis that emphasizes the vulnerabilities and critical nodes in the agriculture and food distribution system.

Beginning with discussions and deliberations on how to improve security to counter the threat of agricultural bioterrorism, the Agricultural and Food Security Consortium was formed in the fall of 2002 and was embodied in a formal agreement between Sandia, New Mexico State University, and Kansas State University. What was described as a "Unique Partnership for Defense" has evolved into a relationship whereby our academic strengths and expertise in agriculture, animal health, food production and food safety are working with Sandia's capabilities in security systems engineering, system analysis and consequence management.

As a veterinarian who has spent a good part of the last 15 years developing diagnostic tests for veterinary and food safety applications, developing a collaborative relationship with Sandia National Laboratories has been a win-win opportunity with impact on the agricultural security programs at Kansas State University, particularly in the College of Agriculture and the College of Veterinary Medicine. Initial collaborations have included the Rapid Syndrome Validation Project for Animals (RSVP-A), the Severe Acute Respiratory Syndrome (SARS) and Biological Security Decontamination Technology projects.

Using K-State's Veterinary Diagnostic Laboratory capabilities to handle pathogens that can't be handled at Sandia,

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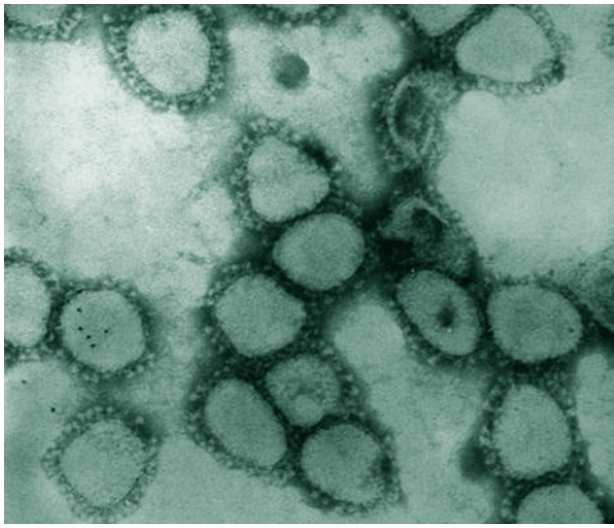
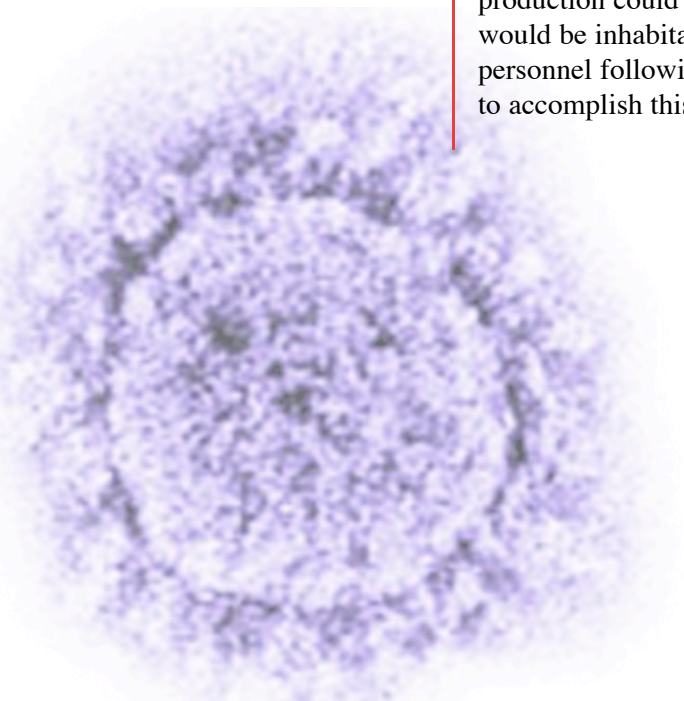
we have rapidly and relatively inexpensively evaluated the decontamination formulation's effectiveness on a viral agent that infects cattle (Bovine coronaviruses) and has impacted the U.S. livestock industry for many years. An added advantage of this research approach is that Bovine coronaviruses are also recognized as a surrogate research model for the SARS virus that has recently emerged as a disease in people. We believe this validation process that uses surrogates or very similar model agents will demonstrate the dual-usage applications of the formulation for responding to natural or unintentional contaminating events and nontraditional or intentional contaminating events.

Another valuable spin-off of this collaboration is the opportunity to define the mechanism of action that allows the decontamination formulation or other disinfectants to kill or inactivate select biological agents. Knowing this, we hope to specifically develop improved detection methods looking for specific footprints (proteins or nucleic acids) that allow us to detect and differentiate killed or inactivated agents from infectious or viable biological agents.

The former determination would be necessary before any return to normal production could begin or before a facility would be inhabitable by livestock or personnel following an event. Being able to accomplish this rapidly and with confidence is a key component of consequence management and a major goal of our collaboration as we address this challenge.



Bovine coronaviruses (above) are recognized as surrogate models for the SARS virus shown below (purple).



Dr. Richard D. Oberst is director of the Molecular Diagnostic Laboratory, Veterinary Diagnostic Laboratory and a faculty member in the Food Animal Health and Management Center and the Food Science Institute at Kansas State University, Manhattan, Kansas. His current research goal is to develop, evaluate and apply nucleic acid-based detection systems to food-animal production systems and the practice of Veterinary Medicine via food safety, environmental sampling and animal-public health.

Sandia's is a tricky job, carried out in an unknown geologi - cal environment. "Because natural systems are inherently uncertain, the test and analyses we conduct are designed to support a risk-informed decision process. We ask ourselves 'What are the chances of a certain sce - nario occurring?' and then, 'What are the consequences of that?'"

Cliff Howard,
Sandia Manager
YMP Repository Test and Analysis Department

Sandia National Laboratories

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