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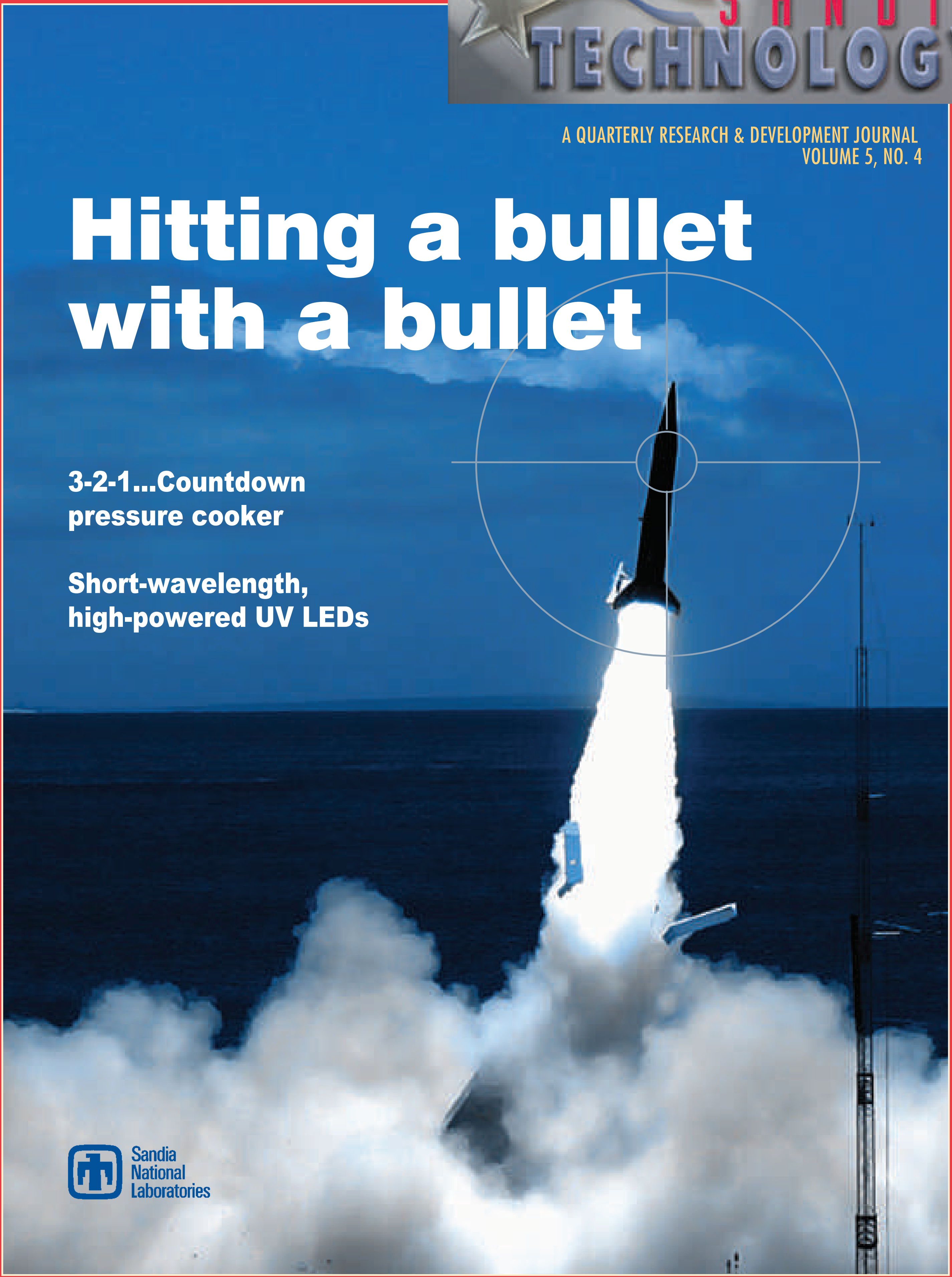
Hitting a bullet with a bullet



3-2-1...Countdown pressure cooker

Short-wavelength, high-powered UV LEDs

Sandia National Laboratories

What is LDRD?

Sandia's world-class science, technology, and engineering work define the Labs' 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 potentially high-payoff research and development that stretch the Labs' science and technology capabilities.

LDRD supports Sandia's 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 development 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:

The FM-5 target missile lifts off from Kauai Test Facility's Pad 1. For more information, see the stories and photos beginning on page 2. (Photo by Diana Helgesen.)

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FROM THE Editor

Dear Readers,

In this issue of *Sandia Technology*, we look at the Labs' contributions to national defense through operations at a remote Hawaiian site called the Kauai Test Facility, or KTF. The series of tests now underway, referred to by some as "hitting a bullet with a bullet," are the latest in a series of efforts Sandia has been involved in at Kauai since the Cold War days. John German's accounts of a practice launch in June 2003 and the real thing and the photos by Sandia's Diana Helgesen show some of what's involved in this highly challenging work.

Other accompanying stories look at past missions and Sandia's future at the far-flung site.

Later in the issue, News Notes touch on Sandia researchers involvement in a new online data-sharing Web portal that could eventually change the way chemical science is done; an Internet system for tracking the spread of disease in cattle; and a new record-breaking development in ultraviolet light-emitting diodes.

A final article looks at Sandia's research in the use of microvalves to speed up species identification and the determination of chemical concentrations in microscale devices. This work was judged by editors of *R&D Magazine* as worthy of one of its R&D 100 awards in 2003. Sound familiar? We featured six of Sandia's seven awards in the last issue.

Will Keener
Editor

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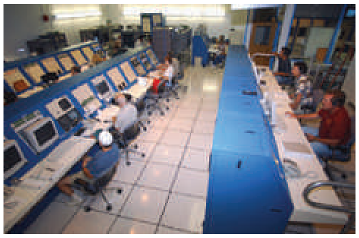

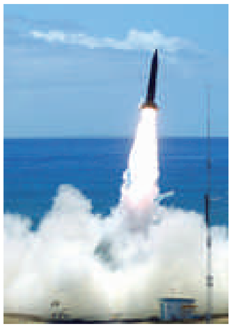

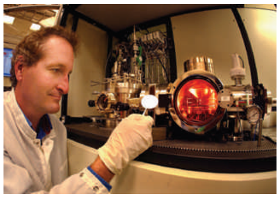

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Practice: "As real as it gets"

Stories by John German
Photos by Diana Helgesen

Consoles in the control room of KTF's Launch Operations Building are staffed for launch. At the control console (from near to far) sit Dean Manning, Steve Lautenschleger, and Al Lopez. Each has a set of decision-making responsibilities during countdown.

Know-how, preparation, and practice are all ingredients of a 'nominal launch,' as Sandia's Kauai Test Facility crew learns to thrive in trying circumstances.

1:15 a.m.
Pacific Missile Range Facility

"FM-5?" asks the backlit shape of the uniformed sentry.

FM-5 is shorthand for the missile defense launch I've been invited here to see. He cross-checks my credentials with a guest list, then motions me to pass.

Three miles north, at the end of a winding road, Dean Manning, who is Sandia's team supervisor at the Kauai Test Facility, climbs out of a red SUV, Hawaii license plate KTF-MGR, to meet me at the main office — a three-room trailer at the top of wooden stairs. At this dark hour, launch preparations at Sandia's KTF are the only thing happening on the U.S. Navy's Pacific Missile Range Facility, which surrounds the Sandia site.

Five cars are parked in front of a brightly lit cluster of more than two dozen aging but well-maintained trailers, all connected by white-painted wooden decking. A half-acre corrugated metal roof held high by square steel poles – no walls – covers this indoor village.

It's pitch black, except for a ring of lights that bathes a large white tent – Launch Pad 1 – about 400 yards to the southwest. Underneath the tent, says Manning, is the rocket.

A generator hums, and lazy waves slap against an unseen shore.

Sandia's Kauai Test Facility, looking north, with Makaha Ridge in the background. Trailer city and the Launch Operations Building are to the right. The launch pad area is near the center of the photo. KTF is on the US Navy's Pacific Missile Range Facility on the western shore of the island of Kauai, Hawaii.

At launch, numerous data streams will flow into these racks from various radars, trackers, and on-rocket telemetry systems, to be recorded and re-routed to other KTF stations.

We stop at the site's coffee pot and head downstairs into the bunker-walled Launch Operations Building, or LOB, one of a few permanent buildings at the site.

Inside the LOB, Sandia's Dave Salguero and Ed Mader preside over a wall of knobs and screens displaying squiggly lines that describe the ascent of a weather balloon launched a few hours earlier, one of three planned for today.

At about 30,000 feet the balloon encountered winds, the jet stream. It's expected, Salguero says, but high winds, particularly those that might carry rocket debris toward land or shipping lanes, could scrub a launch.

2:30 a.m.
Launch Operations Building

More people are arriving at the LOB now. Sandians Wilson Brooks and Shawn Garcia are in the data acquisition room troubleshooting a problem with a spaghetti dinner of connector cables. Brooks is an experienced hand at KTF. This is Garcia's first trip, but he's clearly been around racks of equipment before.

At launch, numerous data streams will flow into these racks from various radars, trackers, and on-rocket telemetry systems, to be recorded and re-routed to other KTF stations. A single, 3-1/2-minute rocket flight can generate many gigabytes of data, all synched to universal time code, says Brooks. This data will tell the story of the launch.

In the LOB's control room, Marc Kniskern and his manager Walt Rutledge of Sandia's Applied Aerospace Systems Department pore over atmospheric data they're getting from the balloon and from various weather Web sites. They are part of Sandia's flight safety crew, and their job is to advise the Pacific Missile Range Facility on safety conditions prior to launch. The Navy has ultimate authority to make and enforce flight safety decisions.

Rutledge and Kniskern run calculations on their laptops and on faraway supercomputers to determine the relative risks of the launch. They generate casualty-expectation estimates in the event of a launch mishap – in stark terms, if the rocket exploded before or after launch, or if it malfunctioned and had to be destroyed in mid-flight by launch controllers.

They predict the number and size of pieces of rocket debris following a hypothetical intercept or intentional destruction to produce maps of the Pacific overlaid with swaths of bright colors representing zones of risk.

Other factors, such as commercial air and shipping traffic and the number of visitors to a nearby public beach, must be watched as well, says Rutledge. "Our job is to consider all the things that can go wrong, backed up by analysis, to ensure that the test is as safe as possible for the public and test participants."

Photographer Diana Helgesen sets up cameras atop a 40-ft. pole overlooking Pad 1.

Orbital's objective is to provide a "good target" – a rocket pitched at the proper trajectory and velocity right over the plate, an imaginary exoatmospheric batter's box that is 6 miles high by 6 miles wide by 54 miles long, and 55 miles above the Pacific.

4:00 a.m. "As real as it gets."

Site manager Al Lopez is running a meeting of 25 people representing the parties participating in today's practice launch – emissaries from Sandia, Orbital Sciences Corp., the Navy, Air Force, and Army, and from various other defense subcontractors.

A 5-1/2-hour countdown about to begin will be the final full "sim count" before the real launch two days from now. The FM-5 team of about 75 people will work through every procedure except launching the rocket.

The team already has conducted a dozen smaller simulations, including "off nominal" scenarios when mock obstacles are fed into the system by computer, testing the team's ability to overcome them.

"Today we put it all together," says Manning. "This is as real as it gets."

In two days the team will watch the fruit of their labor blast into the atmosphere.

Then they'll watch the monitors in the control room, anxiously, for evidence that the target missile has been destroyed in space by a SM-3 interceptor rocket, launched from a destroyer 160 miles northwest of the island.

The objective is to provide a "good target" – a rocket pitched at the proper trajectory and velocity right over the plate, an imaginary exoatmospheric batter's box that is 6 miles high by 6 miles wide by 54 miles long, and 55 miles above the Pacific.

The official countdown lists launch tasks along with the organization or person that must carry out each action on cue for the launch to proceed.

There are some 550 actions on KTF's list, ranging from pre-launch battery checks to confirming burnout of the rocket's boosters one minute after liftoff. The actions will be carried out during the six-hour countdown and the 3-1/2-minute rocket flight – some in rapid-fire succession, others during slow periods.

But Sandia's list represents only a fraction of the mission. The checklist of the Pacific Missile Range Facility contains some 800 tasks. A Navy destroyer crew will follow a similarly complex countdown.

4:25 a.m. "Report to your stations."

An electronic male voice reports over the PA system: "All range personnel report to your stations. All unnecessary personnel clear the launch pad now."

It's T-minus 5 hours and 30 minutes. Manning and Steve Lautenschleger, at the control console in the LOB, begin radio roll call.

I accompany launch photographer Diana Helgesen into the fenced launch pad area. Helgesen needs to run systems checks on her ten cameras, which sit in the sun for days. Come launch day, they must work. Minutes after launch Helgesen will rush into her trailer darkroom, choose an official launch photo, and print copies for the newspapers. More important, her photos become part of the documentation package KTF offers its customers.

Roy Apo and Sharon Cabral release a final weather balloon. Pad 1 is in the background.

KTF staff load the FM-5 target missile to its rail launcher weeks prior to launch.

Access is restricted during the count-down due to the multiple hazards out here, including 250 pounds of high explosives and four tons of rocket propellant.

She moves quickly from camera to camera to minimize the time she spends near the pad. Access is restricted during the count-down due to the multiple hazards out here, including 250 pounds of high explo-sives and four tons of rocket propellant.

On the way to a camera station we pass Roy Apo and Sharon Cabral, members of the full-time contractor crew, as they prepare a balloon for launch. They have tied on reflectors and GPS locators that allow the balloon to tracked until it expands and finally pops, at about 120,000 feet.

Three hundred feet away Andy Jones trains a radar dish on the balloon. Roy releases, and the balloon ascends. Cabral's walkie-talkie crackles as Jones reports that the radar has a valid radar track.

We return to the LOB, but in seconds I am headed out with pad chief Eva Renninger in a fast red golf cart. A dozen contractors, big guys driving trucks and forklifts and wearing NFL-team-logoed hard hats, fall in behind.

Andy Jones installs a motor assembly on a tracking radar in preparation for a balloon launch.

We stop at Pad 1. Before my feet hit the ground members of the pad crew are hurriedly unlatching tie wires and disconnecting air conditioning ducts and positioning a forklift next to the tent. They fold up one end of the tent accordion style and lift the whole thing up on wheels.

As they pull the tent away, the rocket emerges. It is in its horizontal position, affixed to a large rail launcher, and aimed right at a nearby sand dune. When I return to the LOB minutes later, Manning and Lautenschleger are remotely raising the launcher to its upward position from the control console. They watch the rocket on a video screen as they adjust the azimuth and elevation within tenths of a degree.

9:05 a.m.
Run-up to launch

At T-minus 46 minutes Renninger and Norm Corlis head out to the launch pad one last time to install the arming plug, a step that provides the electrical power to the rocket needed to initiate the launch sequence. They return to the LOB and return the launchpad key, which is kept in a lockbox as a safety precaution.

KTF crew readies the FM-5 missile for transport to Pad 1 several weeks before launch in the site's Missile Assembly Building, one of four permanent buildings constructed in the late 80s.

Towing the target vehicle to Pad 1. The Launch Operations Building is in the background.

"There's still a lot to do," says Steve. "There's a missile on the pad. We have to safe it and get it ready for the launch." But the KTF team has passed every one of its tests. The team is ready.

At T-minus 40 minutes the "terminal count" begins — the final and most critical run-up to launch. We are on schedule, says Manning. No anomalies so far. This is good, he says, but the team is taking nothing for granted.

"We start to get tense during this part," he says, "and it's not even real. Actually, I get nervous just typing the countdown."

Finally it's launch time. The automated PA voice reports 3 … 2 … 1. Everything is nominal, meaning within guidelines, and the team follows an imaginary rocket into space and reports its imaginary destruction.

While the rocket is in flight, KTF team members receive and record telemetry information from the rocket, provide useful real-time data displays, and capture launch video.

Four minutes later, people are scattering from the control room.

"There's still a lot to do," says Lautenschleger. "There's a missile on the pad. We have to safe it and get it ready for the launch." But the KTF team has passed every one of its tests. The team is ready.

2 p.m.
"Mini sims" tomorrow

Tomorrow a limited staff will convene and run through a series of mini simulations. For now, site manager Al Lopez sends everyone home for a good night's rest.

KTF'S pad crew disassembles a cooling conduit used to keep parts of the rocket at the optimum temperature prior to launch. Clockwise from lower left are Warren Kawaguchi, Jim "Mack" McDonald (Orbital Sciences), and Hovey Corbin.

The FM-5 target missile lifts off from KTF's Pad 1 on its way to planned intercept 55 miles above the Pacific. The private Hawaiian island of Niihau 18 miles southwest of Kauai is seen in the background.

Scenario – Hitting a bullet with a bullet

The target rocket is intended to simulate, roughly, the trajectory of a scud-type missile fired at a Navy ship formation.

The purpose of the Missile Defense Agency's (MDA) Aegis Ballistic Missile Defense mission – designated FM-5 and nicknamed "Stellar Hammer" – was to intercept a target vehicle launched from the Kauai Test Facility during the "midcourse" portion of its flight. The interceptor was a radar-assisted SM-3 missile launched from a Navy cruiser 160 miles offshore.

Midcourse refers to the rocket's long flight through space, after booster separation and before reentry.

The target rocket, an M-56A missile made from the recycled second stage of a Minuteman I ICBM, is intended to simulate, roughly, the trajectory of a scud-type missile fired at a Navy ship formation. Observers have described the difficulty of such an intercept with the phrase "hitting a bullet with a bullet."

In the test described here, the target missile was overlaid with a grid of coaxial cables so data could be collected about where exactly the interceptor struck the warhead. In addition, the target contained a payload of high explosives so a successful intercept would create an explosion in space that could be verified by radar on the ground.

"This was the first time the MDA has looked at the aftermath of an intercept," says Al Lopez, Manager of Sandia's Kauai Test Facility and the Labs' Remote Ranges Department. "The goal was to gather radiometric data to help the customer answer the questions: "How do we know we've achieved a kill?" and "What does a kill look like from ground radar?"

3-2-1 . . .
Countdown pressure cooker

On launch day, the Launch Operations Building is a hive of activity…

Out on a launch pad a thousand feet away sits a rocket containing high explosives and thousands of pounds of rocket fuel.

The world is watching. Generals, legislators, critics, the president, and the world's bad guys all have a stake in the outcome of the work that takes place here today.

A 10 a.m. to 2 p.m. launch window — defined in part by the fly-by schedules of orbiting satellites — provides a finite deadline for getting the job done.

FM-5 target missile on Pad 1's rail launcher ready for liftoff. The flexible conduit supplies cold air to a fall-away cooling chamber, which keeps critical electronics cool until launch.

FM-5's international profile, high safety standards, and unforgiving schedule add up to a great deal of stress for the KTF launch team as it focuses on the highly complex work of launching a target missile for a defense test, says Jerry McDowell, Director of Sandia's Aerospace Systems Development Center.

"I can't say enough about the professionalism of the Sandia team," he says. "They are remarkably adept at balancing the needs and demands of customers with responsible management of one of Sandia's most valuable assets, all in the midst of a fishbowl of oversight and stringent requirements."

At the helm — a console atop a raised floor at the back of the LOB's control room — sit Dean Manning, Steve Lautenschleger, and Al Lopez.

Manning serves as the intra-range test director, communicating with KTF personnel and verifying completion of a torrent of on-screen launch tasks.

Steve serves as the supervisor of test operations (STO), the inter-range point of contact who communicates KTF's progress to the Pacific Missile Range Facility (PMRF) launch team stationed in a similar control room two miles south. PMRF is the lead test range for this launch.

Hovey Corbin in the saddle of an ME-16 tracking telescope one mile south of Pad 1. The ME-16 follows the rocket's trajectory shooting video and pulling film at 100 frames per second.

PMRF pushes back the launch time by an hour, then two as the Navy realizes that because of the delay, two of its observatory aircraft will need to land and refuel.

Lopez assumes the role of troubleshooter, moving about the LOB helping solve problems and readying contingencies in case something goes wrong.

Accumulation of problems

At T-minus 3:30:00, launch operations are suspended for an hour because a cargo freighter wanders into the impact zone. PMRF tries to hail the captain.

PMRF pushes back the launch time by an hour, then two as the Navy realizes that because of the delay, two of its observatory aircraft will need to land and refuel.

Then Orbital Sciences, which built the rocket, has a problem – it can't talk to the target missile's navigation system. Could be an electronics problem or a cable connection. Orbital's engineers pull out the circuit designs. Someone needs to visit the pad to check the connection.

Later something, perhaps rogue radio traffic, is interfering with KTF range communications. "Somebody's walking all over us," says Dave Salguero.

A few minutes later Orbital overcomes the electrical problem, but KTF's countdown computers lock up. Another setback could scrub the launch for today. What's worse, it could be KTF's fault.

Powering up the rocket from the missile control console is Norm Corlis.

Game on

Salguero, and Sandia's Wilson Brooks and Kenny Abigania work some magic, and the computers are up. The cable connection is fixed, the radios are working, and the freighter is gone. But KTF is 20 minutes behind PMRF's count.

"If the coffee doesn't wake you up, some red on your computer screen will," says Manning. (Red highlighting denotes launch tasks that haven't been completed on schedule.) "No problem," he says. "We practiced this. We can catch up."

Lautenschleger is stoic, but Manning's feet do a nervous tap dance under his chair. The two speak quickly and clearly into their headsets as they plow through the count list, checking off tasks, gaining ground. At T-minus 40 minutes the red is gone and KTF is back on schedule.

Lopez smiles. "There's an old rocketeer's superstition," he says. "The ones that beat you up the worst are the ones that fly the straightest."

Here at last

"Range is green, sensors green, ship is green," reports PMRF over the radio.

Finally, at 1:30 p.m., the final count … 5 … 4 … 3 … 2 …1 … then silence.

From where I now sit, one mile south of the launch pad in the shade of a tracking telescope operated by Sandia's Hovey Corbin, I see white smoke engulf the lower half of the rocket. Then the missile slowly rises, picks up speed. Blue pieces of Styrofoam from an external cooling chamber slough off and slalom down.

The roar reaches us.

The white contrail curls like a ribbon against a clear blue sky, and the missile is out of sight.

The radio crackles: "Target away … telemetry good … radar good … TM track good … trajectory is nominal … cross range is nominal … motor pressure nominal … we have target burnout." Then more silence. It's T+60 seconds.

"We have a good target," reports Lautenschleger's voice over the radio.

"Roger that. Good target," reports PMRF. That's the signal: KTF has accomplished its

Target rocket for the FM-3 Navy Aegis Ballistic Missile Defense test lifts off from KTF on June 13, 2002.

At this point, no one knows for sure what happened up there. That will come later, after a lot of study of the data. The good news is that the customer will learn something from the test.

During countdown, KTF site manager Dean Manning communicates with range personnel and checks off launch tasks that scroll by his computer screen. A typical launch "to do" list has hundreds of tasks.

part of the mission. Now the KTF team sits back and listens.

"Mark India"

Corbin switches to auto track, and the telescope robotically follows the rocket's expected trajectory, still shooting video and pulling film at 100 frames per second. He doubts we will be able to see the intercept – too far away – but you never know.

"If something goes wrong, we'd like to document what happened," says Hovey.

Another countdown … 3 … 2 … 1 … and we're told the interceptor is away from the Navy cruiser 160 miles downrange.

Thirty seconds later a third countdown marks the anticipated intercept.

Then silence. Hovey and Photographer Diana Helgesen exchange looks. We should have heard "Mark India" – the official designation for an intercept. We didn't. Something went wrong. No intercept.

Good news and bad

Back at Pad 1, the smell of rocket propellant hangs in the air like 1,000 just-popped firecrackers. People are picking up debris. Some are pocketing small pieces as souvenirs. The faces tell the story. There is relief, but no one is smiling.

Sandia provided as good a target as possible. But there's disappointment the overall mission did not succeed.

At this point, no one knows for sure what happened up there. That will come later, after a lot of study of the data. The good news is that the customer will learn something from the test.

The ceremony is brief. Already trucks and people are moving toward Pad 15, where the FM-5 backup rocket, identical to the one just launched, sits under a tent. The KTF team will move it indoors and prepare it to be the primary target for the next mission, scheduled in several months.

Getting ready for the next launch. It is the continuation of a cycle that has continued for 30-plus years at KTF. The cycle has resulted in the launches of more than 350 rockets and has involved many hundreds of Sandians.

KTF's future
a moving target

Today the nature of work at Sandia's Kauai Test Facility is changing – again – says Jerry McDowell, Director of Aerospace Systems Development Center. The capabilities available at the facility are as relevant today as they were in the early 1960s, but the missions that drive the use of those capabilities are shifting, he says.

This building at the peak of Maui's 10,000-ft. Mt. Haleakala is probably Sandia's highest-altitude site. During flight tests that take rockets down the Hawaiian island chain, bay doors at the back of the building can be opened so instruments, such as tracking telescopes, can be used to observe the flight. Sandia has occupied the site since 1962 under an agreement with the Federal Aviation Administration.

In early1962 the Atomic Energy Commission acquired the use of part of a military reservation on western Kauai known as Barking Sands. From the site Sandia launched diagnostic rockets to measure the effects of the 29 Operation Dominic air bursts and five Dominic Fishbowl high-altitude tests conducted that year.

The Barking Sands site later became the Kauai Test Facility (KTF).

"We no longer expect to use KTF to launch diagnostic rockets in support of high-altitude nuclear tests, and it's been a decade since a nuclear weapon development program used the site," says Jerry McDowell, Sandia's Director of Aerospace Systems Development. "We are instead busy applying our expertise and KTF to support the nation's missile defense program for the Department of Defense (DoD). Our work aligns very well with the new strategic triad laid out in the most recent Nuclear Posture Review." In recent years, Sandia's management team has worked hard, especially back in Washington, to assure continued support for KTF from customers such as the Missile Defense Agency (MDA) and the Navy, with good success, he says.

Developing partnerships

"I think the future is reasonably bright," says Eric Reece, Labs' Deputy Director of Aerospace Systems Development and Manager of the Missile Defense Systems Program. "We are continuing to develop a partnership with the Pacific Missile Range Facility (PMRF). Our customers from top to bottom continue to express their desire to have Sandia be a major player on the island. We are expecting some significant upgrades to expand our launch capability. And although we have a lull this year, next year appears to be very busy."

"KTF is better known outside of Sandia than inside," says Walt Rutledge, Manager for the Labs' Applied Aerospace Systems Department. "We're small, but what we do per person exceeds what anyone else is doing. The KTF customer gets a heck of a bang for the buck."

In the late 1990s, KTF provided launch support for a steady stream of missile defense missions and in 1998 began to support Navy Aegis Ballistic Missile Defense tests, such as FM-5, by launching missiles that simulate enemy offensive systems. That work continues.

In the mid-1980s, the Reagan administration sought to revive rocket launch capabilities for the Star Wars development program, and KTF was modernized. In 1990 the site got a new launch pad, new electronics, new computer systems, and several permanent buildings. The upgrades included a 54-ft. missile service tower to accommodate vertical launches of large missiles.

Four Strategic Target System (STARS) three-stage missiles were launched at KTF from 1991 through 1996. A fifth STARS launch from KTF is in planning, according to Sandia's Eric Schindwolf, who manages the Labs' STARS program.

Keys to success

KTF team supervisor Dean Manning says Sandia's high number of advanced degrees and a can-do attitude are keys to success. Little details, like custom launch software hand written by Sandia's Dave Salguero, make a difference, says Manning. "That's what makes this a successful operation," he says. "We are just surrounded by gifted people."

In the late 1990s, KTF provided launch support for a steady stream of missile defense missions and in 1998 began to support Navy Aegis Ballistic Missile Defense tests, such as FM-5, by launching missiles that simulate enemy offensive systems. That work continues.

Manning is working to integrate KTF with the Pacific Missile Range Facility, and to build trust. "We need to change the old model, where we were an autonomous entity," he says. "These days, autonomy will drive us out of business. We depend on PMRF, and they are starting to see how we can help them. We're making progress."

National security dimension

"We say at Sandia that we are a national security lab," adds McDowell. "I'm excited about building on that assertion and using places like KTF to continue to play an important role in a dimension of national security that complements our nuclear mission."

The work the KTF team does in support of the defense department also exercises critical skills and expertise that are relevant to the future needs of the Department of Energy (DOE) and the National Nuclear Security Administration (NNSA), McDowell says. But the management and leadership challenge is to get the DOE, NNSA, and DoD to recognize that investments in KTF benefit each party and, collectively, the nation's security, he says.

"I've been very pleased in recent years at the progress we've made inside Sandia in viewing KTF as an important element of the Labs' work," McDowell notes. He cites efforts within Sandia to reduce the cost to outside customers at KTF by reducing the administrative tax burden at the range. "That is one example of Sandia saying to the Missile Defense Agency that we are real partners in delivering 'exceptional service in the national interest,'" McDowell says.

For more information, contact:
Al Lopez, 505-845-8783, or
aalopez@sandia.gov

During the early 1990s, the Kauai site launched four large, three-stage missiles, like this one, as part of the Strategic Target Systems (STARS) missile defense program. At least one more STARS launch is planned.

NEWS NOTES

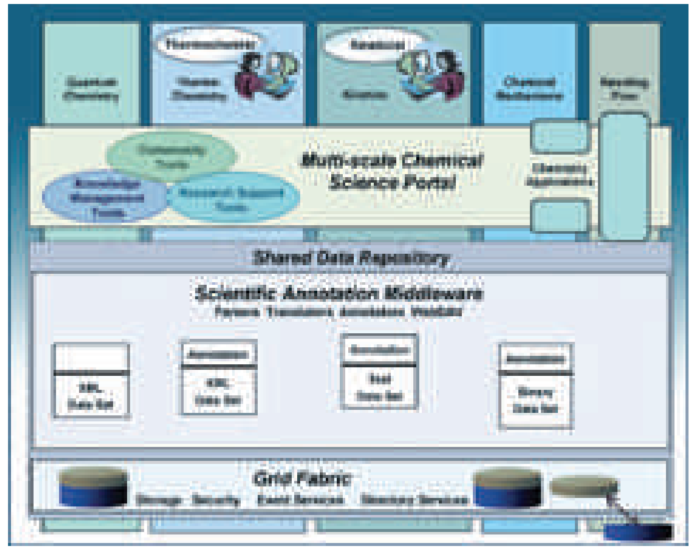
LDRD

Data sharing Web portal

At the Supercomputing 2003 show, held in Phoenix, Arizona, last November, Sandia National Laboratories and a...team of scientists representing seven other institutions demonstrated a new online data-sharing Web portal that may eventually change the way chemical science is done.

Scientists from Sandia and seven other institutions have unveiled a "Collaboratory," designed to improve information sharing for geographically dispersed researchers with high-performance networks that may change the way collaborative scientific interactions are conducted.

According to Larry Rahn, a senior scientist at Sandia and the director of the project, the Collaboratory for Multi-scale Chemical Science, or CMCS, is designed to break down existing barriers to rapid sharing of validated chemical science information and open new paradigms for collaborative science.



This diagram represents the major conceptual elements of the Collaboratory for Multi-scale Chemical Science informatics.

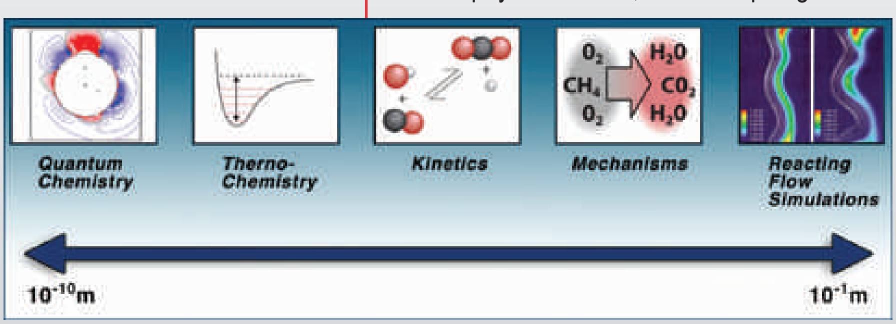
Initiated in July 2001, the genesis of the CMCS project was a call by the Department of Energy's Scientific Discovery through Advanced Computing (SciDAC) program to develop more collaborative, team-based approaches to science. "Collaboratories," as defined by SciDAC, link geographically dispersed researchers, data, and tools via high performance networks to enable remote access to facilities, access to large datasets, shared environments, and ease of collaboration.

The CMCS data sharing portal is a set of collaborative tools and a flexible user interface built on a variety of standards and open-source information technologies that can easily be enhanced or customized. The portal enables scientists to rapidly form collaborative teams around complex problems, share and evaluate data regardless of format, discover and use data across physical scales, track the 'pedigree' of data, annotate entries, share analysis tools, and to make results available to the broader scientific and industrial community.

Interdisciplinary teams of scientists that span the sub-disciplines of combustion science are already working to take advantage of the CMCS data portal, and are providing feedback to guide advanced development. Motivated by a "systems-science approach" to knowledge creation, these teams are integrating information across physical scales of combustion science that range from the electronic structure of atoms and molecules to direct simulations of turbulent combustion phenomena that occur in engines or industrial processes.

Teams include chemical science programs led by the national labs, as well as other collaborations. The CMCS project's collaborative team also includes researchers from Pacific Northwest National Laboratory, Argonne National Laboratory, Lawrence Livermore National Laboratory, Los Alamos National Laboratory, National Institute of Standards and Technology, Massachusetts Institute of Technology, and the University of California, Berkeley.

Complex chemical processes like combustion involve many phenomena at different physical scales and scientists in multiple disciplines and locations.



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NEWS NOTES

Rapid disease detection for farm animals

LDRD

"This joint effort offers a unique opportunity to build on the strengths of both institutions — the agricultural expertise and experience of Kansas State and the security and systems engineering capabilities of Sandia," says Cecelia V. Williams, Sandia researcher.

As veterinarian Mike Whitehair moves through a pen of cattle in Abilene Kansas, something captures his attention. The veterinarian pauses, pulls out a cell phone, and punches in a code. He's not making a call, but starting through a series of questions on a tiny screen involving the clinical signs he is seeing in the cattle and in the illnesses they may represent.

This is the vision of Rapid Syndrome Validation Project for Animals, or RSVP-A, being developed jointly by Sandia and Kansas State University. The project is an Internet-based system for rapid detection and reporting.

"This joint effort offers a unique opportunity to build on the strengths of both institutions — the agricultural expertise and experience of Kansas State and the security and systems engineering capabilities of Sandia," says Cecelia V. Williams, Sandia researcher.

In fact, the animal disease detection and reporting system was adapted from a project to track disease trends in human populations, says Susan Caskey, Sandia researcher and project lead for the original RSVP. "With the success of RSVP within the human population, it seemed the ideal model to use for monitoring of animals," Caskey notes.

"The need to quickly recognize disease symptoms has never been more important," says K-State research veterinarian Mark Spire, who is project leader. At stake is a multi-billion-dollar industry in Kansas that is the state's leading income generator. Kansas ranks at or near the top in cattle feeding and beef processing annually in the U.S. As a net importer of millions of cattle, the state has the potential to bring in diseases not native to the area.

RSVP-A will help scientists determine on a county-by-county basis where clusters of animals are showing similar, but unusual symptoms. The project fills a gap in livestock disease diagnostics, says Kevin Varner, Topeka, Kansas, veterinarian with the U.S. Department of Agriculture. "We have an excellent system for finding diseases that we expect to find, that we already know about," he explains. "We've historically not done a good job of quickly detecting emerging diseases in this country."

The project is currently being funded by the U.S. Department of Agriculture's Animal and Plant Health Inspection services.Testing in Kansas will last for two years, followed by evaluations and possible national trials.

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NEWSNOTES

Short-wavelength, high-power UV LEDs

LDRD

Building on three and a half years of effort, Sandia researchers recently demonstrated new ultraviolet (UV) light-emitting diodes (LEDs) that set records for wavelength/power output. The two deep UV semiconductor optical devices emit at wavelengths of 290 and 275 nanometers and produce 1.3 milliwatts and 0.4 milliwats of output power, respectively.

"Emission at these wavelengths with such high power outputs is a major breakthrough in UV LED development," says Bob Biefeld, Manager of Sandia's Chemical Processing Science Department. "Only a handful of research groups around the world have come anywhere close."

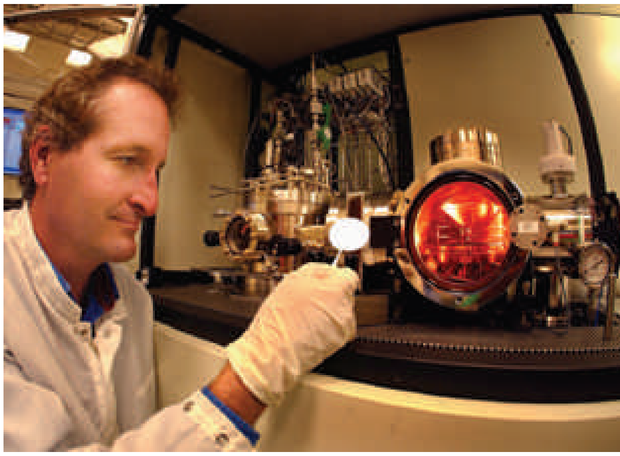
Mary Crawford tests the output of one of Sandia's newly developed ultraviolet light-emitting diodes.

Applications for the shorter UV wavelengths include building miniaturized devices to detect biological agents, perform covert communi-cations, purify water, cure polymers and other chemicals, and decontaminate equipment.

The Sandia team is funded by the Defense Advanced Research Projects Agency, as part of an effort to develop deep UV compact semiconductor optical sources. (Deep UV is defined as having wavelengths of less than 300 nanometers.)

The device has a sapphire substrate with conductive layers of aluminum nitride and aluminum gallium nitride. A key step in achieving the high-power levels was getting high-quality material growth with high aluminum percentages, considered a persistent problem by researchers. The mix that achieved 275 nanometers wavelengths is about 50 percent aluminum, says Andy Allerman, lead scientist on the semiconductor materials growth research.

A smart packaging technology that flips the LED chip onto a thermally conductive substrate and creates a bottom-emitting device also contributed to the success. This geometry allows more light to be extracted, because it is not blocked by metal contacts on the top of the LED. The substrate also pulls heat away from the device, says Kate Bogart, of the Chemical Processing Science Department at Sandia.



Andy Allerman in the laboratory where he helped grow semiconductor materials for the new ultraviolet light-emitting diodes.

The outputs measured during testing were in continuous-wave mode, another unique aspect of the work. "These were continuous-wave power measurements under direct current operation, unlike other UV LED groups have reported," Biefeld says. Controlling heat issues made this possible he explained.

There has been a great deal of interest in the advance, says Sandia researcher Mary Crawford, who presented the team's results at a technical conference last fall. "One of our long-term program goals was to reach 1 milliwatt levels. And now our team has gone beyond that. Everyone was very excited about the power levels."

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NEWS NOTES

Isolated cast-in-place microvalves

LDRD

The resulting systems are commercially applicable to the miniaturization of procedures that are crucial to both drug discovery and evaluation in the pharmaceutical industry.

Sandia's David Reichmuth (left), Tim Shepodd, (center) and Brian Kirby shared in an R&D 100 Award for their developments in photopatterned polymer microvalve systems. The development by the California-based researchers will speed chemical analyses and minimize environmental impacts. (Sandia Photo by Bud Pelletier)

Brian Kirby and David Reichmuth, of Sandia's Microfluidics Department, and Tim Shepodd, Manager of Sandia's Materials Chemistry Department, were named R&D 100 Award winners for developing microvalve materials that allow a wide variety of reagents to be controlled as easily in microfluidic chips as they are on a traditional laboratory benchtop.

These valves enable micro-scale systems to apply high-pressure analytical or synthetic techniques with a wide range of chemical solvents while retaining facile control of microfluidic pathways. The resulting systems are commercially applicable to the miniaturization of procedures that are crucial to both drug discovery and evaluation in the pharmaceutical industry.

The microvalve systems are actuated by applying pressure to move polymer elements inside microchips to open and close flow pathways, isolating and manipulating the fluids of interest. The polymer elements are photopatterned in seconds from liquid monomer solutions. Due to recent materials developments, they are robust enough to operate in both aqueous and organic solvents. Control of the flow of analytes facilitates measurements and aids in identification of chemical species and quantification of concentrations, while miniaturization speeds process times and minimizes reagent volumes.

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Editor's note: This R&D 100 Award winner is one of seven, altogether, that Sandia shared in. The other six were reviewed in the last issue of Sandia Technology.

"Kauai Test Facility is better known outside of Sandia than inside. We're small, but what we do per person exceeds what anyone else is doing. The KTF customer gets a heck of a bang for the buck."

Walt Rutledge,
Manager, Applied Aerospace
Systems Department

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