Boeing-Albuquerque employees Jeff Waitkus (from left), Matt Ross, Kurt Warden and Drew Riedle make adjustments to the B-SVS Relocatable High-Energy Laser System.

Tomorrow's in sight

Photos by Bob Ferguson

Welcome to Albuquerque, where the Boeing-SVS team works on high-tech electro-optical systems for IDS

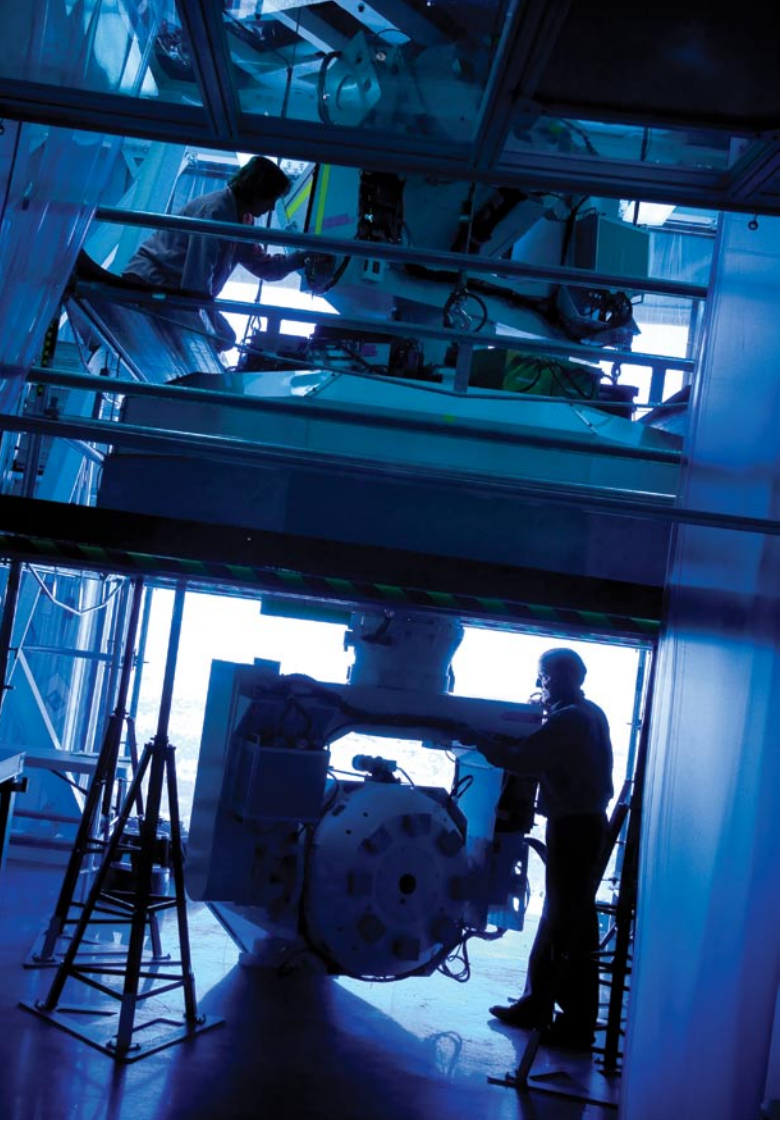
By Walter Polt

Boeing-SVS sits in the sunbaked, high desert of Albuquerque, N.M. The surrounding mountains and looming extinct volcanoes bring to mind prehistoric times. But B-SVS is a nerve center of "directed energy" technology—and proof Boeing is looking to tomorrow.

If you've tried zeroing in with binoculars on a soaring bird—especially while you're in a bouncing vehicle—you have a sense of the challenges B-SVS engineers tackle. Even if you catch sight of the bird for more than an instant, the smallest jiggle puts you back at square one. So imagine this: find a target 100 miles off (it's in motion, and you're on a pulsating plane in flight), "lock in" a close-up view of the target, and direct a beam of laser energy at it.

Impossible?

Boeing-SVS people design, develop and build the electro-optical answers to such challenges—which ultimately help support customers of Integrated Defense Systems. Their systems—intricate computer programs linking laser radar, cameras, telescopes, lenses, fast-steering mirrors, gyroscopes and GPS instruments—let you see remote objects and events. They can track speeding trucks or mortar rounds in flight and can help precisely eliminate a cell-phone node. They keep laser beams in line and correctly pointed through the swirling, light-bending "pool" of the atmosphere.



Boeing-SVS Associate Technical Fellow Mary Jo Duncan (above) examines the transmitter telescope of the Aerospace Relay Mirror System at Kirtland Air Force Base in Albuquerque, while Bill Browning, ARMS program manager, checks the receiver telescope and its gimbal—a device that allows multidirectional movement.

"Acquisition [finding], tracking and pointing," said Drew Riedle of the B-SVS Test and Evaluation group, "are large, generic terms for what we do at B-SVS."

SVS TO B-SVS

In quest of the crest of this game-changing wave of technology, Boeing seven years ago spotted a small company called SVS Inc. Named after founders Sherman Seltzer, Robert Van Allen and Paul Shirley, SVS was working and competing with major high-technology companies in Albuquerque. The Directed Energy Directorate of the U.S. Air Force Research Lab is there, too—with an annual budget of more than $300 million. So in 2000 SVS Inc. became Boeing-SVS Inc., a wholly owned subsidiary of Boeing. It, along with Boeing-LTS (also in Albuquerque), is part of Boeing Directed Energy Systems (formerly Laser and Electro-Optical Systems).

B-SVS is the home of some important work—most of which isn't done anywhere else in the world. Examples:

• Dual Line of Site research. DLOS features two optical paths working at the same time: a receiver of a laser beam, and a transmitter that sends on the beam to a target. DLOS has become a part of other programs and systems, such as the Aerospace Relay Mirror System (see box on Page 35, and Page 5 of the March 2007 *Boeing Frontiers*). Also, Riedle's DLOS team is designing very-short-range (6-mile, or 10-kilometer) tactical weapons called the Relocatable High-Energy Laser System. Field tests in late 2006 showed its mirror system on wheels can align with a stationary laser source and receive an optical signal from it.

• Laser radar, or ladar. "Boeing needed a laser-radar base," said Joseph Paranto, B-SVS enterprise lead and head of discrimination and targeting and long-range strike. "A 3-D view of the field beats 2-D. In defense terms, that advanced precision sensing means you put the bomb in through the fifth window. You decide precisely where on the enemy plane to aim, track and maintain."

What's behind the superior B-SVS technical edge?

Michael Dimmler, Senior Technical Fellow at Boeing-Albuquerque, said 75 percent of its employees are engineers, and more than one in 10 of them is a member of the Boeing Technical Fellowship—a very high ratio in Boeing.

"The Tech Fellows' job is to support the rest of Boeing through the exchange of ideas," Dimmler said. Through the Fellowship, Boeing scientists advance their careers on a technical path; they don't have to switch to a management path to move forward.

On top of this, B-SVS has a tradition of its own. When its scientists move into management, they continue growing their unique technical expertise and contributing it alongside fellow scientists. Riedle, for example, is engineering manager for the B-SVS Test and Evaluation group—and still develops electronics for high-speed-tracking sensor interfaces.

How does B-SVS develop priceless electro-optical equipment and control costs?

"The answer is simulation and analysis," Riedle said. "You get the performance numbers from the simulation, so you know if your idea is feasible before you ever start making it."

From his B-SVS base—where complex algorithms even decorate walls—Senior Technical Fellow Mike Dimmler said he swaps specialized information with other members of the Boeing Technical Fellowship in Albuquerque and throughout the company.

Top: **Lee Gutheinz, B-SVS site executive and program director, observes the progress of a monthly meeting of the entire membership of the facility—around 285 employees.**

Above: **Elizabeth Tingwall, facility security officer (left), confers with Launi Ritter Freiwald, Human Resources site lead.**

Site executive Lee Gutheinz underscored the importance of cost containment. "[Competitors] Lockheed Martin [which manages prestigious Sandia National Labs for the U.S. Department of Energy], Northrop Grumman, Raytheon—they're all in town. They all go after the same business we do," he said.

Despite this competition, SVS has grown from more than 100 employees when Boeing purchased it in 2000 to about 285 employees in Albuquerque today. That's not including some 20 to 25 in other places, including Southern California, Boston, Maryland, Pennsylvania, and Huntsville, Ala.

Business has grown, too. However, the financial focus is on growing future markets.

"Since the Boeing purchase of SVS, this [Albuquerque] part of the business dealing with advanced precision sensing and long-range-strike approaches has shown significant growth," Paranto said, "and we believe the growth curve will continue."

Directed Energy Systems, Gutheinz added, is a market-creation organization. "We're trying very hard to create an acceptance and openness to directed-energy systems within the U.S. Department of Defense and other parts of the government. That will allow Boeing to enter a market that will be billions of dollars in five or 10 years." To this end B-SVS conducts its own R&D projects as well as receives support through Phantom Works (Boeing's advanced R&D unit).

ENGAGED EMPLOYEES

Although the B-SVS site's population has increased, it's been one of the highest-scoring sites for several years on the Boeing Employee Survey. In fact, it's No. 1 on the summary metrics for engagement. In addition to scoring more than 10 points higher than the total enterprise on "recognition for doing a good job," B-SVS did exceptionally well in 2006 on the two diversity questions: "having a climate where diverse perspectives are valued" and "manager treats all employees fairly."

"Our motto from the beginning," Seltzer said, "was, 'Have fun; make a difference; and oh, by the way, make a profit.' We've always told employees, 'If you're not having fun, come in and talk. We'll try to do something about it and report back.'"

In addition, the site's small size helps it respond more specifically to employees' needs and desires. That size also enables recognizing accomplishments and disseminating information at standing-room-only meetings; indeed, at B-SVS, "all hands" means the whole facility.

The Albuquerque team participates in Boeing's Key Differentiators project to identify engagement characteristics/behaviors that are common across sites that score high on the Employee Survey.

COMMUNITY HEARTBEAT

And B-SVS people like being part of Albuquerque, a city of half a million. B-SVS has fewer than 300 employees but takes pride in being involved in the community. Business contributions of some $30,000 went to local schools and universities. Meanwhile, Albuquerque's University of New Mexico engineering research department provides Boeing-SVS with technical research and expertise. New Mexico State University in Las Cruces provides evaluation of the Boeing-SVS flight-test telemetry system—and, along with the University of Texas at El Paso, boosts Boeing technical capabilities and subcontracting opportunities.

Boeing-Albuquerque gave some $25,000 to community charities in 2005. More than $10,000 of that was Employees Community Fund money directly from employees' contributions. It benefited 12 charities, including schools, a shelter for battered women and their children, and the Hispanic Women's Council.

Volunteering thrives, too, including efforts such as these:

• Joining with Albuquerque's Kirtland Air Force Base and Sandia National Labs to sponsor students going to a "Marsville" event, where students built a sort of Mars module. This effort encouraged employees to support inner-city-school science.

• Allowing high schoolers to shadow engineers at a Junior Achievers "shadow day."

• Sponsoring a home-school Science Olympiad event at the New Mexico Institute of Mining and Technology. "Our team won state and went on to compete in the National Science Olympiad in Indianapolis," Roark said.

So seven years later, do Boeing-Albuquerque people like being a Boeing company?

"We have grown. We gained interesting work folks really enjoy doing. We've had investments from the company which have made everybody's professional lives better," said Gutheinz. "I don't think anybody here would disagree: Yes, it was a good thing to join Boeing." ■

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Sean Burkland, engineering technician, adjusts the Advanced Tactical Laser turret below a C-130 aircraft, as a transparent cover reflects images of Boeing-LTS mechanical engineer Jim Johnson (left) and engineering technician Stuart Penner.

Presents of the future

Boeing-Albuquerque's electro-optical projects are becoming products. Here are a few examples:

Airborne Laser fire control. ABL is a high-energy chemical oxygen-iodine laser (COIL) intended to shoot down missiles during their boost phase of flight. It's fired from the nose of a specially configured 747. About 25 Albuquerque people make up the fire-control-system team, said Mike Meline, B-SVS Systems Engineering manager and B-SVS Fire Control team lead for ABL. "Our job is to turn on the laser at the right time in the engagement," he said. "First, the fire control system tracks the target passively, then actively with illuminator lasers. Then the adaptive optics system measures the atmosphere and corrects for the aberrations that can affect the beam. Then the high-energy laser is enabled to propagate down the corrected path." Initial flight tests of the fire control system on ABL will be completed this spring.

Advanced Tactical Laser optical-control module, or beam director. ATL, a high-energy COIL smaller than the Airborne Laser and mounted in a C-130 transport aircraft, sends its beam from a mechanism lowered below the plane during flight. "Our team designed and built the optical-control element in little more than three years," said Ron Dauk, who led the Optical Control integrated product team at B-SVS. One of the system's many tasks: Correct for "jitter" (all airplane movements).

The Aerospace Relay Mirror System. The ARMS payload, a half-scale version of a future relay system to be suspended from a high-altitude airship, will relay a high-power laser beam to targets beyond the horizon (see Page 5 of the March 2007 *Boeing Frontiers*). William Browning, head of the ARMS team at B-SVS said ARMS has two directed mirrors: One receives a beam from a ground-based low-power laser now standing in for a high-energy laser; the other mirror directs the beam to the target.

—Walter Polt