New laser technology could protect soldiers from roadside bombs

by Bruce V. Bigelow

As a privately held government contractor, General Atomics generally maintains a low profile with its diversified work in industries that include nuclear energy, electromagnetic systems and robotic aircraft.

But the San Diego company that made the unmanned Predator spy plane essential for U.S. military operations recently lifted the veil on an internal "skunkworks" it formed to develop new technologies in lasers and optics.

From the beginning, one goal was to dramatically improve the imaging and targeting capabilities of robotic aircraft like the Predator, said Michael D. Perry, an expert in high-energy lasers who heads the company's photonics division.

The idea was "to change the Predator from a TV camera in the sky to a high-precision strike aircraft," Perry said. But the focus became more pragmatic and immediate after the Sept. 11, 2001, terrorist attacks, which came 18 months after Perry left the Lawrence Livermore National Laboratory to join General Atomics.

Among other things, laser technology that the company developed to improve the accuracy of bombs guided by global positioning satellites was adapted for use in Iraq to help U.S. forces spot deadly roadside bombs, Perry said.

THE CUTTING EDGE - Engineer Aaron Dodell, right, and David Krummwiede operated Everest, a laser designed for high-precision machining. San Diego-based General Atomics' laser and optics group developed Everest for commercial use, such as cutting holes for diesel fuel injectors. CNS Photo by Eduardo Contreras.

General Atomics installed its modified targeting technology on two conventional aircrafts operating in Iraq. The company also sent more than two dozen employees to work on the program, flying several missions a day in search of bombs known as IEDs, or improvised explosive devices. Anything beyond that is classified.

"All I can say is that we are heavily involved in the U.S. effort to defeat IEDs," Perry said.

The group also has gotten substantial Pentagon funding to develop a tactical laser weapon that could be used to shoot down short-range missiles - including shoulder-fired weapons used against aircraft.

With enough power, a high-energy laser is the equivalent of liquid fire, and can reach temperatures close to 1,000 degrees Fahrenheit. That is enough to melt metal - and knock down a missile. But the buildup of heat energy in most lasers creates enormous cooling requirements that make them too ponderous to be practical.

By demonstrating the feasibility of a liquid-cooled laser, however, Perry's group has offered a solution to this fundamental problem. "We now have one of the largest efforts on tactical laser weapons in the country, even though we only started this effort a few years ago," Perry said.

The Defense Advanced Research Projects Agency has been pushing for a breakthrough in the development of a liquid-cooled laser lightweight enough for use aboard a helicopter and other aircraft, including a Predator.

General Atomics, as the agency's prime contractor in the effort, hired Lockheed Martin in 2005 to perform systems engineering and integration studies for HELLADS, the High-Energy, Liquid-Laser Area Defense System. At that time, plans were under way to build a high-energy, 150-kilowatt laser that would weigh about 1,650 pounds. Perry said he could not comment specifically about the HELLADS program, which is classified.

But defense analyst John Pike of GlobalSecurity.org suggested such a laser could be a candidate for "Project Chloe," a test program scheduled for this summer at the Patuxent River Naval Air Station near Washington, D.C.

The tests will assess whether a robotic aircraft patrolling high above a busy airport could be used to protect conventional aircraft from being shot down by terrorists, according to a March 23 report in USA Today.

The Department of Homeland Security and the military have been overseeing the project, named after a character on "24," described as Homeland Security Secretary Michael Chertoff's favorite TV show. Pike said the "cloaked" Pentagon funding for classified work related to robotic military aircraft may be almost as big as the publicly disclosed money the Pentagon officially provides for UAVs, or unmanned aerial vehicles.

"There has been a really big increase over the past five years in the black budget, comparable in magnitude to what we saw under Reagan two decades ago," Pike said. "Surely some nontrivial chunk of the black budget is going to UAVs."

With the surge in defense spending, General Atomics' work on lasers and optics has grown from the six

employees Perry brought with him from Livermore in 2000 to a photonics division work force of 210 today.

The flourishing research and development effort represents a new high-technology presence that was created from nothing in San Diego, said E. Michael Campbell, senior vice president of General Atomics Energy Group.

"After defense, we still think there will be commercial applications for this technology," Campbell said.

While about 40 of those workers have advanced degrees, Perry said, "Our biggest impediment to growth right now is people." The company recruits internationally for laser and optics scientists and engineers, but Perry noted it also has had difficulty recruiting mechanical and electrical engineers.

Of the work that Perry can discuss, he is especially enthusiastic about the commercial potential for ultrawideband wireless communications technology.

In contrast to wireless communications that modulate radio waves by their amplitude or frequency, Perry said GA's ultrawideband technology transmits information by very short radio pulses spread across a wide frequency band. (For technophiles, he says the frequency spread is from about 3.5 gigahertz to 7.5 gigahertz.)

The optics group adopted the wireless technology because it was initially developed to accommodate the enormous high-speed data rates needed to process results in laser experiments at the federal lab in Livermore, Perry said.

General Atomics says its ultrawideband system transmits data at far higher rates than Bluetooth and other technologies developed for personal wireless networks that connect a desktop computer to printers and other peripherals.

The company has spent $20 million developing its ultrawideband chip sets, largely under a partnership reached with Royal Philips Electronics in 2003. The Federal Communications Commission gave its blessing to the company's "spectral keying" design in 2005. More recently, Perry said his group has been working on a wide variety of consumer applications with "a major consumer electronics" company, which a trade publication identified as the Hewlett-Packard Co. The company sees opportunities for its technology in the personal computer industry for wireless USB ports, in the consumer electronic industry for digital video and audio, and to government customers for long-range communications.

Perry said the technology also is ideally suited for "Watchkeeper," a General Atomics system of unattended ground sensors that can be set around the perimeter of a military base or along a national border. The technology connects the sensors in a wireless network that can alert authorities to any intruders or illegal border crossings.

Perry said the Watchkeeper technology is "very inexpensive" compared with costly proposals to erect an electronic fence along the U.S.-Mexico border.

"The cost savings comes in the fact that neither power nor communications wires are required," Perry said. "One simply sets the Watchkeeper node in place and it is ready to go."

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