Gas leaks prompt high-tech detection tools

BY JEFF DONN, ASSOCIATED PRESS

ROCHESTER, N.Y. — A single-engine plane eases into the sky above the corn and onion fields west of Rochester, and its underside opens like the bay of a World War II bomber.

The gap exposes an eight-inch opaque glass prism that fixes on the landscape below, like a bug's round eye.

It hides three lasers that pulse to the ground and reflect back 1,000 times a second while the plane cruises at 750 feet and 135 mph. It carries a digital camera ready to snap photographs automatically every three seconds.

Pilot Tim Dills stares at a monitor to keep the plane on a course set by computer. It traces the path of an underground pipeline. The high-tech equipment on board is prowling for leaks of natural gas.

Far too much of the increasingly valuable commodity vanishes into thin air, and efforts like this, inaugurated recently by ITT Industries, are on the cutting edge of slowing the loss.

"This has been what I've always looked for," says Dills from his warm cockpit during the flight in wintry western New York.

"Here, we're in a position where we see everything," he says. "This is a quantum leap forward."

Dills, a longtime pilot whose glass eye testifies to a low-altitude crash during a stunt roll as a teenager, knows firsthand how gas-leak detection has evolved.

He made the journey from crop duster to celebrity transport for the likes of Ben Affleck and Shania Twain, and then to corporate piloting. Flying for an oil company, he would glide high above pipeline inspectors who slogged the Alaskan bush tracking invisible leaks of natural gas with post-World War II technology.

Now he now pilots 2,000 pounds of advanced electronics worth millions of dollars. A ground crew converts signals generated by the invisible, computer-aimed laser light into pictures of each gas leak; these are then superimposed on the aerial photographs.

The ANGEL Service detects, quantifies, and maps natural gas emission from a quarter mile in the air.

Like little oil slicks, leaks show up in a rainbow of colors. Red signals the heaviest concentration.

For the first time, this question can be answered at a glance: Where is America's missing fuel?

The United States has 2.3 million miles of natural gas pipeline. Laid end-to-end, the pipes, mostly carrying methane, would circle the equator 92 times.

Errant bulldozers, imperfect seals, and other mishaps, disasters and defects cause leaks. But why fret over the wasted gas that is blown off into the air, usually harmlessly? After all, it only amounts to about 1.5%, according to industry and government estimates.

That percentage may sound trifling, but it's not. The country burns so much gas – more than 22 trillion cubic feet a year – that the leakage could fuel about 4 million more homes, government statistics indicate. The global supply is estimated to last only 70 more years.

Beyond economics, there are environmental and safety reasons for finding leaks. Methane is a greenhouse gas that traps heat and may contribute to global warming. And gas can cause powerful explosions, though they are rare.

Government standards mandate leak surveys up to four times a year along pipelines, which typically run 2-4 feet underground. Some are old and prone to corroding — there is still century-old cast iron under some Eastern streets. Almost $20 billion is needed just to replace existing pipe by the end of the next decade, according to one industry study.

The first long-distance gas pipelines, originally of hollowed wood, were run in the late 19th century. Until the 1950s, leak checking meant digging holes, sometimes through streets, because detectors weren't sensitive enough to read above ground.

Then along came a nimble little gadget with a ponderous name: the flame ionization detector, FID, or sniffer.

Sniffers, which burn gas samples in a little flame and measure the electrical charges, are portable and sensitive, though their drawbacks are also well known: They can sample only a single point at a time and only within gas clouds.

Still, they became the unchallenged standard until the late 1990s, when the industry saw a burst of technological progress.

"The real nifty thing is to be able to detect huge amounts of pipeline at a time," says Michael Clayton, who oversees the airborne surveillance project for ITT Industries. The company says it can survey up to 1,000 miles of pipeline per day.

The new generation of detectors exploits the basic wave properties of light. Methane gas, like other distinct molecules, absorbs its own set of specific wavelengths and no others, vibrating like the strings of a guitar with its own unique tuning.

The new scanners typically beam invisible infrared light – sometimes concentrated into laser strength – at wavelengths absorbed only by methane or some other component of natural gas. If there's no natural gas in the air, the signal stays powerful. If natural gas is present, it absorbs the light energy and weakens the signal, setting off an alarm.

The first such detectors recaptured their own light from about six feet away, like a ball juggled at the speed of light from one hand to another. They gave an almost instant reading, allowing inspectors to motor along at 25 mph. But their vehicles still had to pass through the gas cloud, which was often impossible on rough terrain or near buildings.

"In a city, it takes forever," says engineer Paul Beckendorf at the Gas Technology Institute, which does research for the industry.

The next step came just last spring, when handheld remote detectors reached market. They let inspectors detect leaks quickly and safely from outside the cloud.

Understandably, remote detectors risk missing smaller leaks, because they sense at a distance. However, they are becoming more sensitive. At Lasen, a company in Las Cruces, N.M., some customers have asked that the helicopter-mounted detector be turned down, says physicist Egor Degtiarev.

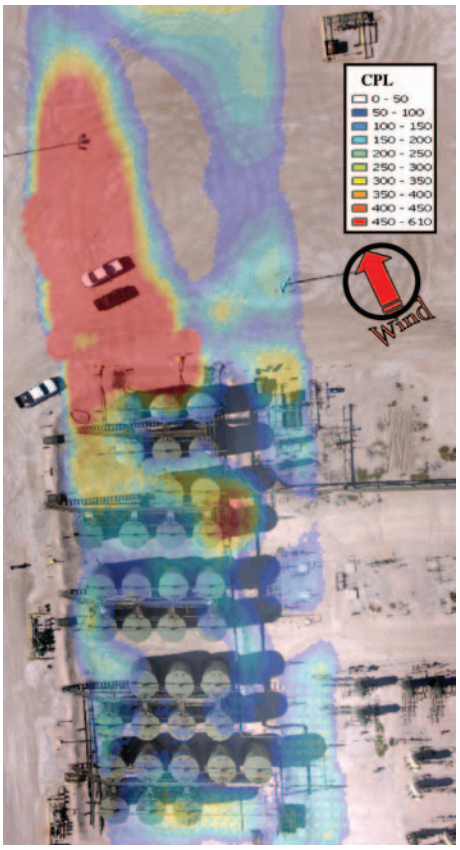
The problem? It sometimes detects methane from flatulent cows.

"Right now, this is where we are," says Dills, as he banks his plane toward the airport with snow clouds blowing in. He's not talking about the plane, but about leak-testing technology.

He and others see many more improvements ahead. Dills, for instance, envisions that remote-control drones will eventually do the work of finding leaks. And those imagining the next generation of detectors ask: Since lasers are a form of light, why can't plain daylight detect natural gas?

Turns out, it can.

In Edmonton, Canada, Synodon is building a camera-like detector that analyzes ordinary reflected daylight from a helicopter at 1,000 feet. It scans for missing wavelengths of natural gas, says Synodon CEO Adrian Banica.



ANGEL Service report showing hydrocarbon emissions from condensate tanks. Plume concentrations are clearly defined and integrated with aerial imagery.

For a stratospheric panorama, the National Energy Technology Laboratory has considered lifting such airborne imaging up to 80,000 feet high on balloons or circling drones. "All of a sudden it takes very few of these sensors to cover the entire United States," said a government physicist who spoke on condition of anonymity under Energy Department rules.

Another government project has aimed at finding leaks from space, sensing them from nearby plants when their roots are choked by natural gas. The damage shows up in certain wavelengths of light.

"In order to realistically monitor a pipeline network, you need satellites," says physicist William L. Pickles at Lawrence Livermore National Laboratory. "It's impractical to be able to be out flying these pipelines all the time."

However, such systems might never be sensitive enough to uncover small leaks quickly. Also, air and ground systems can be tricked, because gas can stray as it rises to the surface.

The ultimate detector would prowl inside pipes, pinpoint leaks or potential leaks, and automatically map them.

Some engineers have started to toy with the idea of very small robots – maybe even microscopic particles – to home in on trouble spots and instantaneously clue inspectors to their whereabouts.

General Electric has begun early work on self-propelled, smart robots with existing magnetic or ultrasound sensing that would nose through pipeline twists and bottlenecks and maybe decide to linger where leaks are most likely, says Michael Simmons, a manager at GE's pipeline services unit.

"Can we imagine a point in time where technology is used in such a way that it reduces the risk so far as to be minuscule? Yeah, I think so," he says.

Future pipelines might even carry built-in sensors to alert to rusting, cracking or outright leaks. "That in my mind is ultimate technology," says engineer Christina Sames at the industry's American Gas Association.

Inspectors would park themselves indoors, warm and safe, keeping the country's fuel flowing. And Dills might have to go back to crop dusting.

Jeff Donn is AP's Boston-based Northeast writer.

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