DRONE-BASED GAS LEAK DETECTION IS TAKING OFF

With ambitious climate change targets that need to be met by 2030, the oil and gas industry is under pressure to find ways to cut methane emissions. Doug Baer, Global Product Line Manager - Laser Analyzers for ABB Measurement & Analytics, explains why drone-based analyzer systems offer an accurate and highly effective solution for detecting methane leaks from gas pipelines.

Finding ways to limit the escape of methane from natural gas pipelines is becoming a pressing problem for oil and gas operators worldwide. With recent studies revealing that the contribution of escaped natural gas to the atmosphere from oil and gas pipelines is much greater than had previously been anticipated, the industry is coming under growing pressure to take action to find and fix gas leaks.

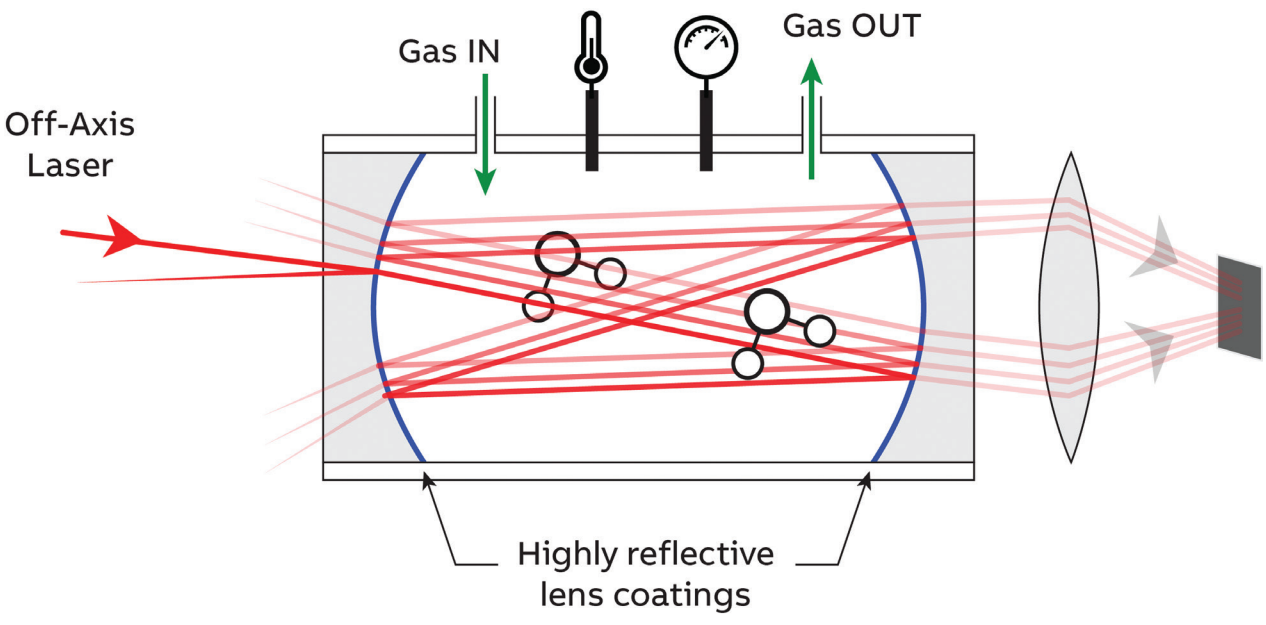
Supporting the evidence of the continuous rise in methane emissions is a 2021 report by the International Energy Agency, which states that around 70Mt of methane gas escaped from gas pipelines into the Earth's atmosphere in 2020, equivalent to around five per cent of total world energy-related greenhouse gas emissi-ons.

While atmospheric methane has a considerably shorter life than carbon dioxide, being a stronger absorber of Earth's emitted infrared radiation than CO2 it can cause significantly more damage. It is described as being around 84 times more potent than carbon dioxide in its first 20 years. As the second biggest greenhouse gas after CO2, methane is a major focus of the Paris Agreement, which obliges its 195 signatories to put in place measures to help control climate change by ensuring that global temperatures do not rise above 2°C.

To help counter these issues, countries around the world are putting in place increasingly strict legislation to try to contain the problem posed by leaking gas pipelines. The U.S. Environmental Protection Agency (EPA), for example, is focused on securing a reduction in methane emissions from oil and gas-related activities of up to 45 per cent by 2025.

As similar legislation driven by environmental targets is being put in place in other countries worldwide, operators must ensure they are using the most effective technologies to help measure and control natural gas leaks at all points in the distribution network.

With gas pipeline networks typically stretching for thousands of kilometres across a variety of terrains, inclu-ding built-up areas, tracking gas leaks has traditionally represented a major challenge for pipeline operators. The variety of factors at play in operating and maintaining a network, including age, network pressures and the efficiency of any maintenance regimes, mean that leakage in a network can at best only ever be limited rather than eliminated.



To help tackle the problem of locating gas leakage, operators have been looking to new developments in technology to help replace traditional manual-based methods, especially those involving on-foot inspection which can be both costly and, in areas where high concentrations of gas may be present, potentially unsafe.

One solution being widely deployed is the use of sensor based IoT technologies, which detect leaks by mea-suring key parameters such as pressure, flow and temperature. While these can be effective in detecting leaks, this effectiveness is limited to their proximity to the leak and the sheer number of sensors that are needed to service a typical pipeline, especially in situations where there may be multiple leaks per kilometer of pipeline.

Another innovative solution to address these drawbacks is the use of mobile gas leak detection platforms, including, most recently, the use of unmanned aerial vehicles (UAVs) such as drones, which are fitted with powerful miniaturized gas analyzers capable of detecting variations in ambient methane gas concentrations – normally about 2ppm – with a precision of parts per billion (ppb).

Sniffing out leaks from up in the air

When methane is leaking from a pipeline, it is carried by the wind, mixing with the air and decreasing in concentration as it travels further from the point of origin. By passing the airborne analyzer through the methane diffused in the air, the methane can be detected, and its concentration levels calculated.

Able to gather accurate gas concentration data over large areas whilst moving at speed, UAV solutions offer a fast, low cost and safe solution for identifying potential leakage points, especially when compared to foot-based techniques. They also offer the ability to reach areas that would not otherwise be accessible either by foot or to a vehicle-based analyzer, such as bridges, high-rise buildings, inhospitable locations, areas with right-of-way

HoverGuard™ flying over a city

restrictions and storage vessels. They can also offer a much less costly alternative to aircraft-based analyzers, with the ability to safely gather data at much lower heights than would otherwise be possib-le.

One example of how drones are being utilized as part of mobile gas leak detection is ABB's HoverGuard™ UAV-based gas leak detection system. At the heart of the system is a high sensitivity analyzer capable of measuring both methane concentrations at rates of up to 2.5Hz. The analyzer uses a principle called Off-Axis Integrated Cavity Output Spectroscopy (OA-ICOS), which works by using a tunable laser source that pro-duces light at a selected wavelength for interacting with the gas being analyzed.

The laser enters a highly reflective mirrored cavity, where it is reflected thousands of times before exiting onto a photodetector. This creates an effectively very long optical path amounting to many kilometers, increa-sing sensitivity and producing strong absorptions as the infrared light interacts with the gas present within the cavity. By changing the wavelength over which the laser operates, the concentration of the gas can be measured with high precision.

With a sensitivity over 1,000 times higher than conventional leak detection technologies, the OA-ICOS method enables the analyzer to detect single parts per billion (ppb) levels of the target gases every second, enabling variations in atmospheric concentrations to be quickly measured from long distances where other technologies would be ineffective.

By enabling the drone to sample the air at a rate of five times per second as it flies, this approach offers a number of advantages over other techniques. Firstly, it offers greatly enhanced accuracy over laser-based systems using a scattered or reflected laser beam, allowing spatially resolved concentration measurements to be gathered rather than a path-averaged approximation.

Secondly, the speed with which data can be gathered without compromising accuracy means that the drone can detect, locate, and estimate the size of natural gas leaks while covering 10-15 times more land area per minute than traditional methods.

Additionally, with its extremely sensitive technology and fast response rate, it can quickly detect leaks more than 100 meters (328 ft) from their source.

To enable the exact location of a leak to be pinpointed, the HoverGuard solution also combines an anemome-ter and GNSS (Global Navigation Satellite System) sensor to gather data on wind speed and position, together with mapping software which uses the data to produce detailed reports on leak locations. Able to be shared either directly or via the cloud, these reports can be easily made available to help pipeline operators to devise a suitable find and fix strategy.

A solution that is taking off

The solution detailed is a leading example of drone-based gas leak detection systems that are increasingly finding their way into applications both within and outside the oil and gas industry. While their deployment is currently restricted by regulations that limit their operational range to within line-of-sight, developments in technology that allow drones to travel safely over longer distances are likely to persuade regulators to extend their use.

With industries across all sectors under growing pressure to reduce the environmental and societal impact of their operations, the use of the latest emissions measurement technologies is becoming increasingly im-portant.

The OA-ICOS based analyzer is one of several proven options available to help industrial operators measure gas concentrations more accurately, with developments in measurement and digital technologies increasingly combining to offer highly accurate measurement solutions that are increasingly easy to use and integrate.

ABB offers an extensive range of options that can be deployed to measure a variety of different industrial gases, enabling you to ensure your operation meets the relevant regulatory and environmental standards.

For more information about how ABB can help to make emissions measurement easy, visit www.abb.com/measurement.

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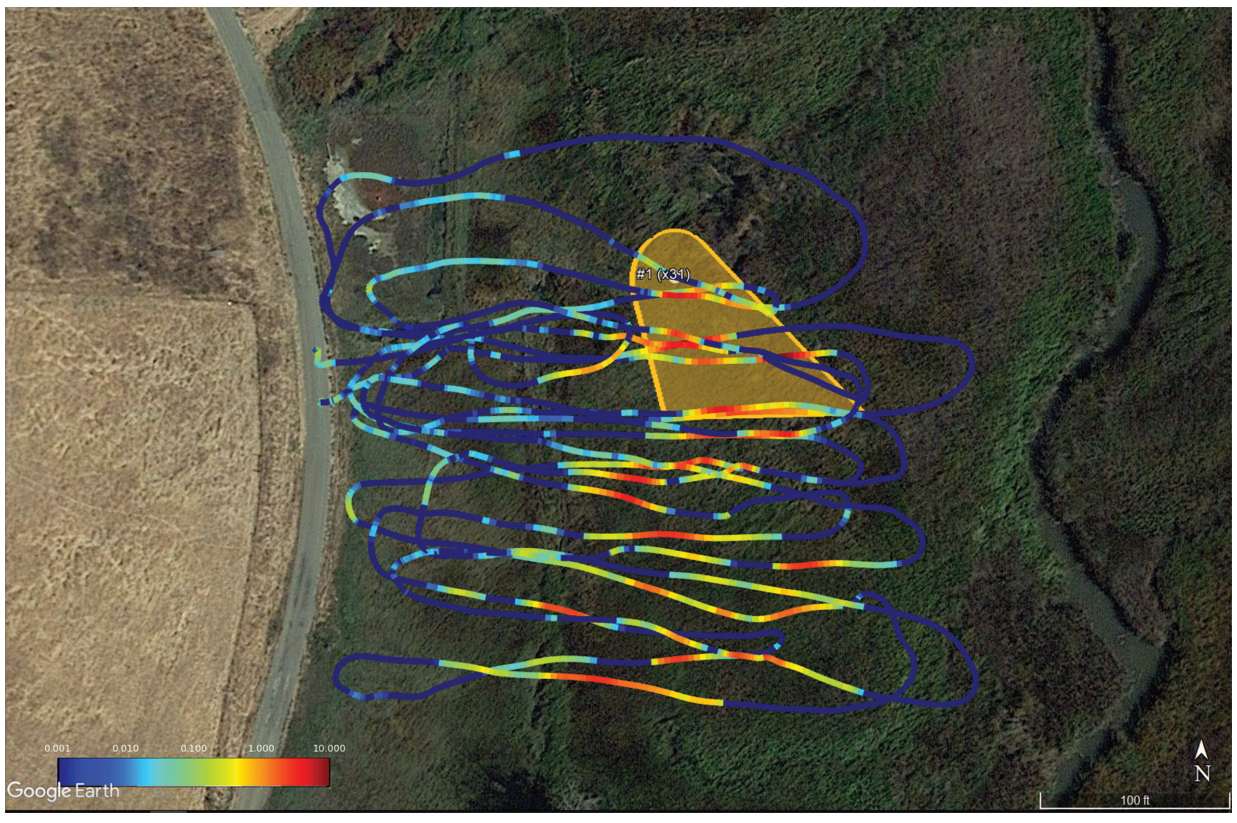

HoverGuard™ survey map generated after field investigation

Doug Baer, Ph.D., is the Global Product Line Manager for Laser Analyzers at ABB Measurement and Analytics Division where he invents, develops, manufactures, and sells laser-based instrumentation for ul-tra-sensitive and accurate measurements of gases, liquids and isotope ratios for atmospheric and environmental monitoring, industrial process control, and homeland security. Based in San Jose, CA, Doug is an inventor of ABB's patented laser-based technology and the industry-leading natural gas leak detection platform. Before joining ABB, Doug was the President of Los Gatos Research. Doug has degrees in Mechanical Engineering (Ph.D., M.S., Stanford University) and in Engineering Physics (B.S., University of California Berkeley).

Author Contact Details

Doug Baer, ABB • Howard Road, Saint Neots, Cambridge, UK, PE18 8EU • Tel: 0870 600 6122 • Email: enquiries.mp.uk@gb.abb.com • **www.abb.com/measurement**

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