LAYERS OF SAFETY STRATEGY DETECTS DANGEROUS GAS LEAKS WITH MULTIPLE SENSING TECHNOLOGIES

Compared to only 20 to 30 years ago, the most recent advances in gas sensing technologies have led to more reliable and efficient gas and flame detection systems. The latest generation of fixed point gas sensors is now being joined by newer technologies including ultrasonic gas leak detection (UGLD) and enhanced laser diode spectroscopy (ELDS) to maximize effectiveness and mitigate risk.

As effective as conventional fixed point gas sensors are, they still have one limitation: there is always the real possibility that leaking gas can fail to reach them in sufficient concentration and in enough time to prevent a serious incident or accident. In general, the faster a gas sensing technology can detect a leak the quicker the safety system can respond and prevent a potential accident for a safer workplace.

This reality is leading to a new "layered" gas detection strategy for safety. This strategy begins with conventional point fixed gas detectors and adds another layer of newer gas sensing technologies such as UGLD and ELDS to provide more comprehensive protection.

Fig 1. ULTIMA X5000 Gas Detector

Fixed Point Gas Detection

With the next-generation of MSA ULTIMA® X5000 and S5000 Gas Detectors (Fig 1), conventional fixed point gas detection takes a giant step forward. This new platform integrates cutting-edge gas detection technologies with non-intrusive touch button operation, dual sensor capability, extended calibration cycles and Bluetooth® wireless communication.

These gas detectors offer several distinct improvements in gas detection starting with their sensor technologies. Their unique XCell® gas sensors with TruCal® technology offer calibration cycles of up to 18 months (local calibration respected). Every six hours, TruCal sends an electrical pulse through the sensor to measure the sensors capacity. As humidity, temperature, and pressure change the sensor's capacity, it is detected and corrected for by TruCal. TruCal also notifies users if and when a manual calibration is required, or if the sensor is no longer capable of detecting gas due to loss of sensitivity.

Due to tight plant equipment layouts, gas detectors are often placed in difficult to reach high locations or crowded equipment areas near piping, valves and other installed equipment where gas leaks can potentially occur. Plant technicians can now securely connect wirelessly to these gas detectors from up to 75 feet (23 meters) away using their Bluetooth enabled smartphone or tablet. The real-time availability of this data helps workers rapidly set-up, operate and maintain the detectors for better efficiency and use of their time.

This platform's capability to connect two gas detection sensor inputs into one transmitter also reduces the cost of wiring, conduit and installation time to make safety even more affordable. During routine maintenance or scheduled retrofit projects, these detectors have been designed for simple swap-out with their predecessors. They share the exact same mounting footprint, making installation simple using the existing conduit and wiring. All of these innovations lead to lower maintenance and a higher level of safety.

Ultrasonic Gas Leak Detection

In outdoor industrial facilities, conventional gas detectors have to be installed so the leaking gas will most likely reach the detector. If there is just a small amount of wind, the gas can be carried away from the gas detector. A dangerous gas leak can go undetected for a very long time under these conditions.

Windblown gas clouds also can be a source of false alarms when they reach detectors that are some distance away from the location of the actual gas leak. In fact, the real danger is at the point of the gas leak's origin where the gas concentration is the highest—and yet there is no alarm there to alert staff to the real leak source. The failure to detect and alarm at the leak's point of origin is a serious issue that can lead to accidents.

Fig 2. UGLD Gas Detector

Ultrasonic Gas Leak Detectors (UGLDs), in comparison, are a non-physical contact sensing technology that is nearly impervious to windy conditions (Fig 2). UGLD sensors "listen" for a specific acoustic noise signature from a leaking gas source and issue an alarm when leaking gases are detected from pressurized pipes or tanks. UGLDs react instantly when the leak starts so that the plant safety system can adjust operations to reduce the flow of the gas within a fast response time--essential in all effective safety systems.

In comparison to UGLDs, point gas detectors rely on a gas concentration measurement, which is measured as ppm for toxic gases and LEL (Lower Explosive Limit) for flammable gases.

Point gas detectors report a gas concentration value to control the safety system, which is equal to the gas concentration at the physical location of the gas detector.

As described before, this concentration will be dependent on the distance and dilution factor between the gas leak and the detector. In most cases, this is unpredictable. How fast a gas cloud can accumulate into a dangerous ppm or LEL level depends on environmental conditions such as wind velocity and the gas leak rate.

In an outdoor windy environment, the leak rate (measured as kilograms per second [kg/sec]) will determine if a potential gas leak can accumulate and ultimately be picked up by conventional gas detectors (Fig 3). The UGLD relies on the acoustic sound level generated by the pressurized gas directly proportional with the leak rate at a fixed distance.

By detecting the leak rate from the gas leak, the UGLD will therefore not need to wait for gas to accumulate. It will detect and produce an alarm instantly when the leak hits a pre-defined leak rate. From oil/gas industry studies*, the following gas leak rate classification has been developed based on how much damage a gas leak will cause if ignited:

- Minor gas leak: 0 – 0.1 kg/sec
- Significant gas leak: 0.1 – 1 kg/sec
- Major gas leak: < 1 kg/sec

The acoustic frequency range of a UGLD is typically from 20 kHz to 75 kHz. This range indicates the sound frequency range at which the detectors are "listening" for the acoustic sound. The detection range for UGLD is also directly proportional with the leak rate. Some manufacturers claim very impressive detection ranges (40 meters in radius) without mentioning at what leak rate this detection range is valid.

MSA's UGLDs are designed with highly sensitive and intelligent microphones that are trained with artificial neural network (ANN) intelligence to detect gas leaks at 0.1 kg/sec . They reliably distinguish between actual gas leaks and other sources of background noise interference to prevent false alarms.

Laser-Based Gas Detection Technology (ELDS)

The gas sensing technology behind the Senscient Enhanced Laser Diode Spectroscopy Gas Detectors (ELDS) is an open-path non-contacting method to detect specific toxic or flammable gases. In the event of a gas leak, the sensor's laser optical technology recognizes and analyzes a gas's specific harmonic fingerprint.

During operation some of the detector's laser light is reflected continuously through a sample of the target gas in a hermetically-sealed reference cell. This design ensures the laser remains locked on the selected target gas's unique wavelength.
The detector's harmonic fingerprint technology (Fig 4) helps ensure precise gas recognition, eliminating the potential for false alarms, even during adverse environmental conditions.

False alarms caused by interference gases, which are experienced with other detection technologies, are no longer a problem.
Unlike electrochemical cells, Senscient ELDS sensors are also immune to sensor poisoning and interferent gases, due to their gas specific harmonic fingerprint detection method.

Senscient ELDS detectors are designed with Class 1 eye safe lasers that penetrate thick fog, heavy rain and snow beyond the capability of traditional open path infrared (OPIR) detectors. With their automated SimuGas™ safety integrity self-check, there is no need for the typical OPIR sensor gas checks and recalibrations requiring field technician time to address.

Senscient ELDS detectors are also virtually maintenance-free in terms of their construction. They have no consumable parts or gas cells to replace. Their harmonic fingerprint detection method eliminates calibration drift, which eliminates technician manual checks and adjustments, offering significantly lower lifecycle costs.

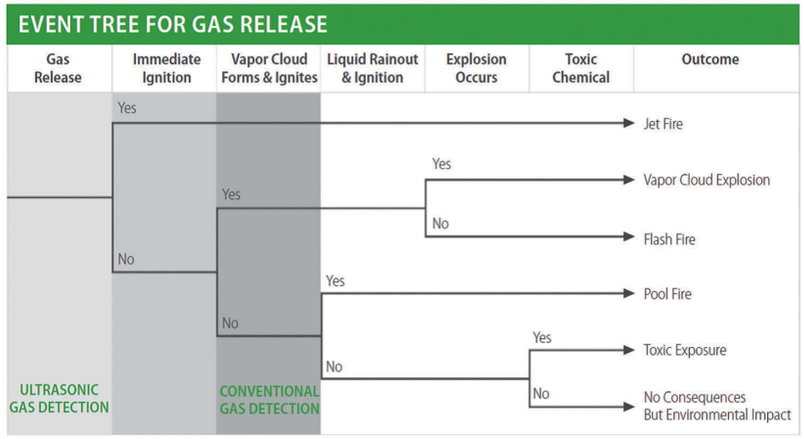

Fig 3. Gas Event Tree Table

Conclusions

The future of gas detection is a layered strategy that takes advantages of multiple sensing technologies: catalytic bead, electrochemical cell, point infrared, ultrasonic and laser optical detection. Point fixed gas detectors are the first line of defense placed near potential leak sources such as pipes, valves, pumps, compressors, tanks and other equipment. By choosing the right combination of traditional point detection, along with the new UGLD and ELDS detector technologies, a much higher level of safety can be obtained to protect people, equipment and facilities.

*Notes: * Health & Safety Executive Report Offshore Hydrocarbon Releases Statistics and Analysis 2002*

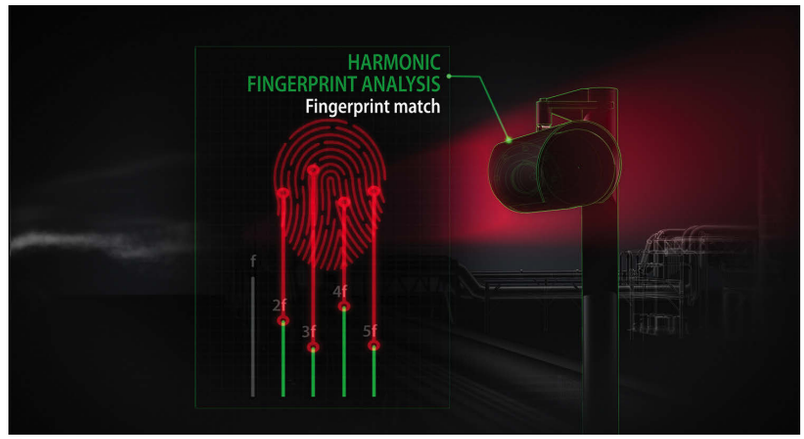

Fig 4. ELDS Gas Detector

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