MSA Gas Detection:
Layered Gas & Flame Monitoring

General Monitors

Gas and flame detection is a challenge; serious explosions and fires still occur, despite safety practices and existing equipment. According to the Center for Effective Government, more than 430 chemical releases or explosions have occurred in the U.S. since President Obama's 2013 Executive Order 13650, "*Improving Chemical Facility Safety and Security*" that is intended to help improve petrochemical safety policies.* Fortunately, the latest generation of gas and flame detection systems employs a more comprehensive and layered *human sensory* approach that can save lives, reduce risk and lower overall cost through reducing shutdown incidents.

Challenges of Facility Protection

Large indoor and outdoor areas of petrochemical plants present a congested array of complex equipment, such as tanks, pumps, pipelines, and valves. Gas leaks are affected based upon density, ambient temperature, nearby air flow including wind, and other factors. Despite the number of fixed gas and flame detectors installed within a given system, a leak or flame can still go undetected if it doesn't reach a gas sensor or can't be seen by a flame sensor. (Fig. 1)

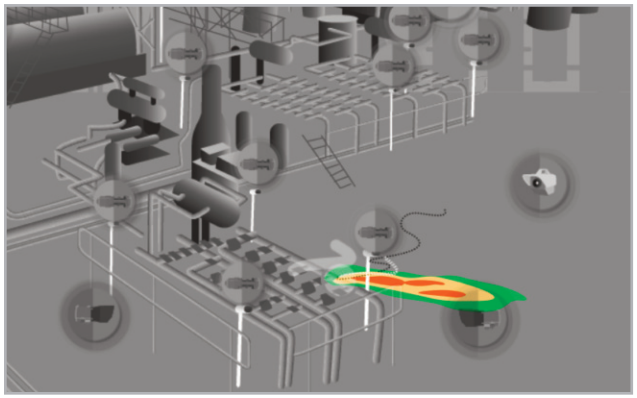

Figure 1

Generally, well-known sensing technologies are employed for gas and flame detection within petrochemical plants, including catalytic bead, point infrared (IR), open path IR, ultrasonic, and optical. All provide specific advantages depending upon application environments and all have limitations. Wind can blow gas leaks away from traditional catalytic bead sensors. IR detectors cannot detect hydrogen gas, as hydrogen doesn't absorb IR energy. A pressurized pipe gas leak can create ultrasonic noise; however other equipment can also trigger ultrasonic detectors. Optical flame detectors can be fooled by heat rising from tanks and from reflective surfaces on hot days.

Each sensor type is susceptible to false alarms under certain conditions, as no single gas and flame detection method is foolproof. False alarms can result in unnecessary process or plant shutdowns, reduced production and time-consuming reviews, and over time can provide employees with a false sense of security.

Human Sensory Model

Given the difficulties faced by the best sensing technologies, a new strategy in gas and flame protection has emerged for use within petrochemical and other industrial plants. Consider a system that combines and layers all gas and flame detection technologies to provide the best, most reliable protection within each unique plant layout.

Gas and flame detection sensing technologies mimic the senses of their inventors. Catalytic bead detectors "sniff" gases, infrared and optical type sensors "see" gases and flames and ultrasonic sensors "hear" gases. If detectors react in ways that resemble those of humans, that is, based upon intelligence and retained past memories, then layering sensor technologies throughout the plant can achieve a sensory chain of defense against hazardous gases and flames (Fig. 2).

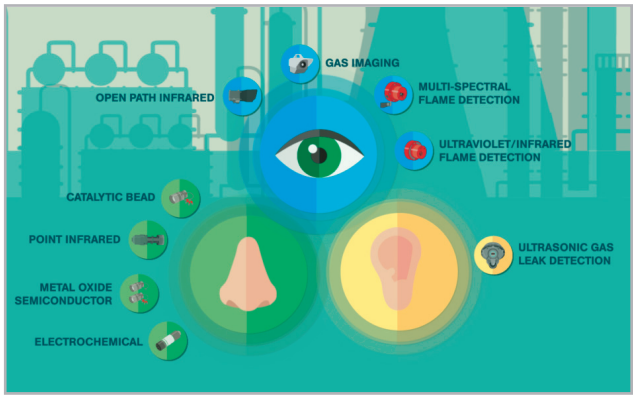

Figure 2

This paper discusses sensing technology types, their operation and the application of *neural network technology* as applied to advanced gas and flame detection systems.

Catalytic Bead (CB)

Catalytic bead gas detectors employ catalytic bead combustion to measure combustible gases in air at low concentrations. As combustible gas oxidizes in the presence of a catalyst, heat is produced; sensors convert temperature rise to a change in electrical resistance that is linearly proportional to gas concentration. A standard Wheatstone bridge circuit converts raw temperature change to a sensor signal.

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The Safety Company

*Center for Effective Government, July 30, 2015

Point Infrared (PIR)

Infrared gas detectors use two wavelengths, one at the gas-absorbing *active* wavelength and the other at a *reference* wavelength not absorbed by gas; neither wavelength is absorbed by common atmospheric components such as water vapor, nitrogen, oxygen, or carbon dioxide. Point IR detectors measure hydrocarbon gas concentration via infrared absorption of an optical *active beam*. A second *reference* optical beam follows the same optical path but contains radiation at a wavelength not absorbed by gas.

Open Path Infrared (OPIR)

OPIR detection path of an IR beam is expanded from fewer than 10 centimeters, typical of point IR detectors, to greater than 100 meters. These devices can use a retro-reflector or separate IR transmitters and receivers housed within different enclosures. OPIR detectors are available that monitor both LEL-m and ppm-m ranges to detect small and large leaks. OPIR detectors cover large open areas along a line of several potential leak sources, such as a row of valves or pumps, as well as leak perimeter monitoring.

Ultrasonic (UGLD)

Ultrasonic gas leak detectors with **neural network technology** (see below) include *pattern recognition capability* that responds to ultrasonic noise created by pressurized gas leaks. Ultrasonic noise provides measurement of leak rate and establishes warning and alarm thresholds. Gas does not need to reach the sensing element, as the detector "hears" the gas leak. These detectors are best suited for outdoor installations and indoor spaces with high ventilation rates.

Ultraviolet/Infrared (UV/IR)

By integrating a UV optical sensor with an infrared (IR) sensor, a dual-band flame detector emerges that is sensitive to UV and IR radiation emitted by flame. UV/IR flame detectors offer increased immunity as compared to UV-only detectors, function at moderate response speeds and are suited for both indoor and outdoor use.

Multispectral Infrared (MSIR)

Advanced multispectral infrared (MSIR) flame detectors combine multiple IR sensing arrays with neural network intelligence. These detectors provide pattern recognition capabilities that can differentiate between real threats and normal events, thus reducing false alarms. MSIR technology allows area coverage that is up to six times greater than that of conventional IR flame detectors.

Neural Network Technology (NNT)

Figure 3

Neural network technology is based upon the human brain (Fig. 3); this technology is now applied to gas and flame detection. Detectors equipped with NNT intelligence provide reliable solutions, as they can eliminate many false alarm sources while improving overall detection. A key advantage of this technology is its ability to learn; NNT intelligence can recognize gas leaks or flames based upon stored data, even if that exact pattern has not been previously observed.

Optimal Site Coverage

Design and installation of a layered gas and flame detection system for process industry facilities begins with choosing correct instrumentation for your specific potential hazards, as well as determining sensor detection range, mounting and positioning, field of view, knowledge of lines of sight, and blind spots. A technical assessment of your facility is necessary, and can be followed by employing mapping software to provide metrics calculation based upon the technical report's findings. Use of mapping software aids not only in assessing optimal sensor placement; it is highly useful in determining the location and scope of gaps in coverage targets in order to eliminate those gaps. Coverage calculations provide a quantitative measure of gas detection needs that compliment conventional methods.

Conclusion

Applying a human sensory model builds layers of protection within (Fig. 5) petrochemical and other industrial plants that increase overall system reliability. Decades of safety monitoring design and experience are built into these highly intelligent devices. When assessing your plant's safety requirements, consider a layered strategy to design the most comprehensive gas and flame detection system for your facility.

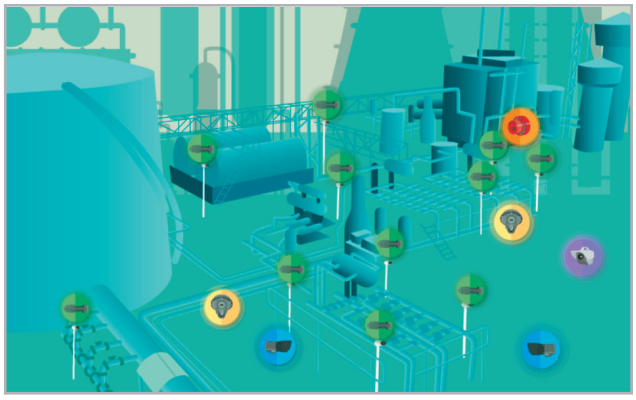

Figure 5

SENSOR TECHNOLOGY							
MSA FGFD Product	**Catalytic Bead (CB)**	**Point Infrared (PIR)**	**Open Path Infrared (OPIR)**	**Ultrasonic (UGLD)**	**Ultraviolet/ Infrared (UV/IR)**	**Multispectral Infrared (MSIR)**	**Neural Network Technology (NNT)**
ULTIMA® X SERIES GAS MONITORS	■	■					
ULTIMA XIR GAS DETECTOR		■					
ULTIMA OPIR-5 OPEN PATH INFRARED DETECTOR			■				
ULTRASONIC™ IS-5 GAS LEAK DETECTOR				■			
OBSERVER-I ULTRASONIC GAS LEAK DETECTOR				■			
FLAMEGARD® 5 UV/IR-H2 FLAME DETECTOR					■		
FLAMEGARD 5 UV/IR FLAME DETECTOR					■		
FLAMEGARD 5 MSIR FLAME DETECTOR						■	
FLAMEGARD 5 MSIR FLAME DETECTOR						■	■

For additional information concerning fixed gas and flame detection products, contact MSA Customer Service at 1-800-MSA-INST or visit www.MSAgasdetection.com.

View the video MSA's Gas Sensing Technologies.

Author Ardem Antabian, MSA OGP Marketing Manager for Fixed Gas and Flame Detection, holds dual bachelor of science degrees in chemical engineering and chemistry. He started his career in the fixed gas and flame detection industry in 1999 and was involved in the development of the company's new point infrared (IR) gas detector, open path IR gas detector and multi-spectral IR flame detector.

General Monitors—**by MSA**

Almost 100 years of experience and capability in comprehensive safety solutions have made MSA a modern and forward-looking company for the protection of people, facilities and the environment. MSA is one of the few suppliers of fixed gas and flame detection (FGFD) measurement technology that develops and manufactures a complete range of products and integrates them into safety solutions.

With the acquisition of General Monitors in September 2010, the MSA FGFD product portfolio expanded even further. As two unmatched experts in gas and flame detection joined forces, we are proving that the right mix of durable products and innovative technology can increase safety while driving operational efficiency.

Together MSA and General Monitors have the widest range of sensing technologies for gas and flame detection. We can create solutions that will not only provide worker safety and protect facilities, but will also decrease overall cost of ownership. While our customers still have access to the great products and service that they have come to rely on in the past, they now have access to so much more: superior service, improved support, a wider range of technology, and unique solutions enhanced by the combined strength of MSA and General Monitors.

Our Mission

MSA's mission is to see to it that men and women may work in safety and that they, their families and their communities may live in health throughout the world.

MSA: Because every life has a purpose.

Note: This Bulletin contains only a general description of the products shown. While uses and performance capabilities are described, under no circumstances shall the products be used by untrained or unqualified individuals and not until the product instructions including any warnings or cautions provided have been thoroughly read and understood. Only they contain the complete and detailed information concerning proper use and care of these products. Specifications subject to change without notice.

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