Digitisation of gas detection

Enabling remote monitoring safety

By Stephen B. Harrison, sbh4 consulting

Industrial, medical, and food-grade gases touch our lives in many ways. Carbon dioxide (CO_2) cylinders are ubiquitous – we use them under our sink to carbonate tap water, they are present in fast-food restaurant chains for soft drinks dispense and there will inevitably be a few cylinders in the cellar of your favourite sports bar or pub to put bubbles in your beer.

Food or beverage-grade carbon dioxide is produced to be safe for human consumption. But, if one of those gas cylinders should develop a leak, or the gas supply hose were to rupture there would be an excess of carbon dioxide gas released into an indoor space. Carbon dioxide in high concentrations is not safe to breathe – so we must permanently monitor for gas leaks to ensure the safety of the staff and public. Gas detection close to where the gas is being used is the answer.

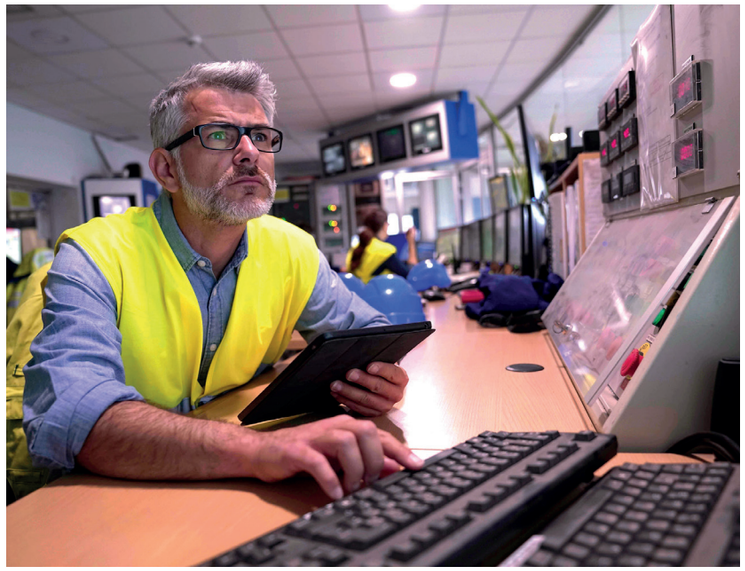
Medical oxygen is also stored in bulk tanks as a cryogenic liquid at just about every hospital. Oxygen also presents hazards which must be monitored. Too much oxygen in the air causes a combustion hazard and a leak of oxygen is a warning that the gas storage installation requires maintenance.

LPG filling stations for cars and trucks also have bulk liquified gas storage. In this case, a flammable gas which could ignite and explode if a leak were to go un-noticed. As the hydrogen economy develops, hydrogen – a flammable energy gas – will penetrate deeper into our urban and industrial infrastructure. Just like carbon dioxide and oxygen, gas detection can raise the alarm in the event of a gas leak. That can trigger experts to arrive on the scene and put things right before the situation escalates to an emergency.

Distributed applications call for digitised remote monitoring

"Imagine how many fast-food restaurants, pubs, and bars there are in the world with carbon dioxide cylinders. Thousands, hundreds of thousands, perhaps millions. Even if we focus on a single country location such as France, the number is still likely to register in the thousands."

That is the scale of the gas detection challenge, as explained by Martin Robbins, Global Business Development Manager at Teledyne Gas and Flame Detection. "Put on top of that the number of factories with nitrogen tanks, hospitals with oxygen storage, and garages with LPG. Add to that hundreds of containerised hydrogen electrolyser systems that will emerge in the coming decades. The complexity of the gas detection monitoring network for a gas supplier is increasing year-on-year."



It is often the case that industrial gas operators share the responsibility for gas storage and supply system safety with the operator or gas customer. Generally, the gas cylinder or bulk storage tank will remain the property of the industrial gases supplier so, they have a duty of care around that system, and they have the appropriate expertise to maintain it.

Digitally enabled, remote monitoring of bulk tank contents has been in place for several decades as standard practice in the industrial gases sector. The next wave of the digital revolution will be remote gas detection for system integrity monitoring and safety. When there are some many sites that require gas detection, digitalisation and the Industrial Internet of Things (IIoT) is most likely to be the most cost-effective solution to support the data processing.

Robbins comments that, "Industrial gases companies have been using IIoT based solutions for several years to enable communication between their local gas production operating plants and regional centres of excellence – remote operating centres. The flow of data is like an avalanche of information, endlessly streaming down the mountain."

"The complexity of the gas detection monitoring network for a gas supplier is increasing..."

Digitalisation is the only realistic way to deal with such high data volumes flowing from plants that are separated by large distances. The case for remote monitoring of gas detection systems is similar. In this instance each location is only reporting a small number of data points, but the number of locations is high, and this is the reason that IIoT is favoured.

To support industrial gases operating companies with this data management challenge, Teledyne Gas and Flame Detection can work with operators to implement IIoT solutions for complex, multi-site gas detection networks. "We have partnered with a PaaS provider for

ISO 22734-1

Hydrogen gas detection requirements are written into ISO 22734-1

our cloud services to ensure the ability to work with all major PaaS providers through either open API integration or by providing standard protocols like MQTT from our Edge devices."

What that means is that Teledyne's digital data-management technology can plug directly into the systems that most major corporate companies, midsized operators and independent gas companies are using. By electing to leverage the default IIoT solution, Teledyne can accelerate the implementation of gas-detection networks for their customers.

Leveraging top-tier safety practices

The nuclear power generation sector operates at a safety standard that is unparalleled in other industrial and consumer applications. It is one of the few applications where Safety Integrity Level 4 (SIL 4) is in place for multiple systems. For most industries, operating at SIL 2 or 3 is common. Safety functions in the nuclear sector are implemented at one or two orders of magnitude lower risk.

"Implementing a SIL 4 system in a fast-food restaurant would be possible, but it would be like using a sledgehammer to crack a nut," says Salvator La Piana, Application Engineering Manager for the EMEA region at Teledyne. "There is a limited quantity of gas that can be released, the building can be easily evacuated, ventilation is possible and carbon dioxide is not extremely toxic in the same way that a gas such as phosgene is." For these reasons, a gas detection system rated at SIL 1 or SIL 2 would be fit for purpose.

> "...we will engineer a solution to fit the needs of the hydrogen economy"

La Piana says that, "The level of safety that we apply to each scenario depends on the situation. What people can count on when they come to Teledyne is that we have been working with safety systems in the French nuclear power sector for decades. This is one of the most safety-conscious industries in the world. We do not always need to apply similar systems in other applications, but we can leverage the depth of expertise that we have built up in the nuclear sector to keep other industries safe."

One of the hazards that gas detection mitigates in the nuclear sector is hydrogen gas leaks. Hydrogen can be produced within the nuclear reactor under abnormal operation. Detection of a hydrogen will trigger an alarm that points to the problem which must be addressed with urgency. Hydrogen is also intentionally used in pressurised water nuclear reactors. A gas distribution pipe brings pure hydrogen into the nuclear auxiliary rooms where it is injected into the primary circuit to limit corrosion of the pipework that is in contact with the water.

For hydrogen gas leak detection, Teledyne uses a catalytic-bead type of gas detector. When these are used in the nuclear sector, they must be certified to be compatible with high temperatures, vibration, seismic activity, and radiation. "We also use catalytic-bead and electrochemical cell hydrogen gas detectors for everyday applications," adds La Piana. For example, in modern containerised hydrogen electrolyser systems, there will typically be two hydrogen gas detectors fitted in carefully selected locations within the container.

In the hydrogen electrolyser application, the gas sensing technology is the same as the nuclear plant, but the gas detection system will be engineered without the nuclear sector 'bells and whistles'. La Piana says, "That helps to keep costs under control for our industrial customers and simultaneously means that they can be sure the system is based on the most solid foundation of safety that is possible to imagine."

Hydrogen gas detection requirements are written into ISO 22734-1: Hydrogen generators using water electrolysis process – industrial, commercial, and residential applications. As an example, it specifies that: *The hydrogen gas detector(s) shall be installed in optimum location(s) to provide the earliest detection of hydrogen gas, such that their protective function can be proven.*

La Piana closes by saying that, "Our job in the Teledyne Gas and Flame Detection Applications Engineering team is to interpret the requirements of our customers and the relevant safety standards. We design cost-effective systems that conform to those requirements."

"If that means SIL 4 for nuclear safety, we can do what is required there. If it means implementing ISO 22734-1 in a cost-effective way in thousands of stand-alone remote hydrogen electrolysers, we will engineer a solution to fit the needs of the hydrogen economy." gw

ABOUT THE AUTHOR

Stephen B. Harrison is Managing Director of sbh4 consulting. Harrison has over 30 years' experience of the industrial and specialty gases business.