H2scan®
Advanced Hydrogen Sensing

Hydrogen Sensor Monitoring Prevents False Carbon Monoxide Alarms at Major Auto Manufacturing Facility

CASE STUDY

Challenge

A major auto manufacturer in the eastern United States faced a critical challenge after purchasing a fleet of hydrogen fuel cell-powered forklifts to facilitate its manufacturing process. Despite careful design and maintenance procedures, hydrogen fuel cell vehicles pose a risk of leaks from both fuel cells and fueling stations. During recent inspections, using standard handheld gas detection equipment, the local fire department raised concerns about potentially dangerous carbon monoxide (CO) exposure levels, triggering a safety investigation.

The investigation revealed a significant technical issue: carbon monoxide and hydrogen are small molecules with similar chemical properties, making it difficult for standard CO detectors to distinguish between them. Both molecules can interact with the metal oxide semiconductor (MOS) sensors in CO detectors, causing a change in electrical resistance that registers as a false positive reading. This cross-sensitivity was causing the fire department's CO detection equipment to mistakenly indicate elevated CO levels when, in actuality, hydrogen gas was present. An elevated level of either gas could pose dangers to the staff and facility alike.

Background

The auto manufacturer had strategically positioned numerous active hydrogen fueling stations along its assembly line to support its fleet of electric forklifts powered by hydrogen fuel cells. This implementation was part of a broader sustainability initiative that took advantage of the many benefits of hydrogen-powered equipment:

Longer operating times without the need for recharging

- ***Longer operating times without the need for recharging***
- ***Significantly faster refueling compared to battery recharging (minutes versus hours)***
- ***Reduced energy costs***
- ***Eligibility for government sustainability incentives***

The facility's operations were subject to strict regulatory frameworks, including standards such as IEC 62282-4-101 (safety of fuel cell power systems for industrial trucks), UL 2267, NFPA 505 and ANSI/ITSDF B56.1. These regulations address the unique safety considerations of hydrogen, which has a Lower Explosive Limit (LEL) of 4% and an Upper Explosive Limit (UEL) of 75.6% in air — a substantial explosive range requiring careful monitoring.

However, even with well-trained operators, unintentional hydrogen releases can occasionally occur during refueling operations. These releases created not only potential safety concerns but also triggered cross-sensitivity issues with other gas detection systems in the facility. The situation was complicated by the fact that NFPA 72, NFPA 720, the International Building Code 915 and the International Fire Code 1103.9 all regulate CO levels in commercial facilities, requiring monitoring that was being compromised by the hydrogen cross-sensitivity issue.

Solution: Implementing Targeted Hydrogen Detection

The facility had its own fixed carbon monoxide detection system as required by NFPA 72 and building codes, which had been experiencing similar false positive readings in areas near hydrogen fueling stations.

While some CO detectors employ filtering techniques to mitigate cross-sensitivity (including catalytic filters, selectively permeable membranes and chemical absorbent filters), these have proven insufficient in the hydrogen-rich environment of the manufacturing facility.

To resolve this issue and provide definitive proof to the fire department, the facility implemented H2scan® hydrogen sensors. These self-calibrating, solid-state sensors were specifically designed to:

- ***Detect hydrogen without cross-sensitivity to other gases, including CO***
- ***Provide accurate data to address the fire department's safety concerns***
- ***Supply continuous data without requiring manual calibration or oversight due to auto-calibration***
- ***Integrate with existing building management systems***
- ***Operate maintenance-free for 10-15 years even in demanding industrial environments***

The engineering team conducted a comprehensive hazardous mitigation analysis to:

1. **Early detection capability, providing a timely warning**
2. **Continuous, real-time data monitoring**
3. **Accuracy in harsh environmental conditions, including corrosive saline atmospheres**
4. **Cost-effectiveness, priced significantly lower than competitors' options**
5. **Ease of deployment, making it ideal for widespread use across multiple transformers**

The implementation included analyzing the 4-20 mA signaling from the hydrogen sensors to the PLC controls, which were used to manage air handler responses based on detected hydrogen levels. This enabled a structured response plan that automatically adjusted ventilation based on varying H2 concentrations, with specific response thresholds aligned with safety standards.

Success Factors

The solution's success hinged on several key factors:

1. **Accurate detection:** The H2scan sensors provided reliable, continuous monitoring that clearly distinguished between hydrogen and carbon monoxide.
2. **Regulatory compliance:** The implementation met all safety regulations, including maintaining hydrogen levels below 1% of room volume or 25% of the lower explosive limit (LEL) as required by codes and standards.
3. **Collaborative approach:** The engineering team worked closely with the fire department to demonstrate the actual conditions and provide evidence-based safety assurances.
4. **Preventative monitoring:** An ongoing monitoring program was established to continuously distinguish between CO and H2 levels, ensuring operational safety and addressing potential risks before they became serious issues.

Broader Impact

This customer experience highlights the importance of proper gas detection and monitoring, particularly when considering cross-sensitivities, in industrial settings that utilize hydrogen sensor technologies. The auto manufacturer's experience highlights several industry-wide considerations:

1. The growing transition from traditional battery-powered to hydrogen fuel cell-powered equipment, such as hydrogen fuel cell forklifts, in manufacturing environments
2. The need for precise monitoring systems that can differentiate between similar gases to prevent false alarms and ensure accurate safety assessments
3. The challenge of cross-sensitivity between hydrogen and carbon monoxide in sensor technology, which is particularly relevant as more facilities adopt hydrogen technologies
4. The critical importance of complying with multiple regulatory frameworks simultaneously, including both hydrogen safety standards (IEC 62282-4) and carbon monoxide monitoring requirements (NFPA 72, International Building Code 915)
5. The importance of collaboration between engineering teams and emergency services when implementing new energy technologies

Key Benefits of H2scan's Hydrogen Sensor Solution

H2scan hydrogen sensors provided several critical advantages:

- **Auto-calibration:** Self-calibrating solid-state sensors that require no maintenance
- **Longevity:** 10-15 years operational life (for the sensor) in industrial environments
- **Seamless integration:** Compatible with existing systems through various communication options including 4-20 mA analog over RS-485, Modbus RTU and Dry Contact
- **Reliability:** Continuous operation without false alarms or cross-sensitivity issues
- **Regulatory compliance:** Helped meet all safety codes and requirements

Safety, Reliability and Future Planning

Based on the success of this implementation, the auto manufacturer plans to conduct future hazardous mitigation analysis for other areas within the manufacturing process. The goal is to replicate the success of the current configuration across the entire plant, reinforcing the company's commitment to safe and sustainable manufacturing practices.

As manufacturing facilities increasingly transition to sustainable energy alternatives, such as hydrogen forklifts, cases like this highlight the importance of proper monitoring technologies that can accurately distinguish between gases. H2scan's hydrogen-specific sensors provide the accuracy and reliability needed to support this transition safely and effectively, enabling the industry to move forward with confidence in hydrogen-powered solutions.

The Solution to Eliminating False Alarms

For facilities facing similar challenges with hydrogen fuel cell forklifts and cross-sensitivity issues, H2scan's HY-ALERTA® 5021 solid-state area hydrogen monitor eliminates false carbon monoxide alarms while maintaining safety standards. The HY-ALERTA 5021 utilizes patented hydrogen-specific sensor technology, which exhibits no cross-sensitivity to other gases. It detects hydrogen from 4000 ppm to 5% (10% to 125% of hydrogen's lower explosive limit) with maintenance-free operation throughout its service life of over 10 years.

The HY-ALERTA 5021 provides several critical advantages in similar hydrogen fuel cell equipment environments beyond forklift operations, including other vehicle fleets operating, stored or refueling in maintenance facilities, parking garages, warehouses or even maritime applications, offering:

- ***Maintenance-free operation via auto-calibration technology***
- ***Enables timely response to hydrogen detection due to continuous monitoring***
- ***Extended 10+ year sensor life cycle***
- ***Integrates with existing building management systems***
- ***Multiple mounting options for installation flexibility***

About H2scan

H2scan is a leading developer and manufacturer of high-performance hydrogen sensor solutions, dedicated to delivering the most reliable industrialized sensing solutions to OEM partners, distributors and end customers globally.

The company's latest Gen 5 solutions offer unparalleled accuracy, maintenance-free operation and cost-effectiveness in hydrogen sensing. Trusted by industry giants across multiple sectors, its products are integral in shaping the new Hydrogen Economy for a clean, secure and affordable energy future.

H2scan products are used by utilities for transformer fleet asset management, by the chemical industry to optimize hydrogen processes and for safety monitoring in enclosed areas susceptible to hydrogen leaks, energy storage charging out-gassing and other similar hydrogen sources.

Built on solid-state technology pioneered at Sandia National Laboratories and the U.S. Department of Energy, H2scan boasts 44 patents covering its core technology, software and product innovations.

Learn more at www.h2scan.com.