Placement & Maintenance of Fixed-Point Gas Monitoring Systems

By Matt Thiel

Protecting workers and equipment from gas hazards is a major concern for companies. One method of doing this is by installing and maintaining a fixed-point gas detection system. A fixed-point gas detection system consists of sensors (typically electrochemical, infrared, or catalytic bead) that respond to specific gases. These sensors are placed throughout the facility. The gas readings from the sensors are transmitted from all over the facility, back to a single or multiple monitoring station(s). These signals can consist of anything from analog 4-20 mA signals, high speed digital signals, or even a wireless data transmission. There are even a few products on the market today that offer both analog and digital interfaces as well as seamless integration with wireless telemetry products. Once the signal is received, the controller processes the gas readings and responds to any alarm condition that might be present by turning on strobe lights, sirens, actuating a valve, or starting/stopping a process. This is a complex system of highly integrated components, with a gas detector being the crucial component.

If the fixed-point gas detector is not positioned or maintained properly, the system may not respond to gas hazards as necessary. It is critical to have the proper sensors placed in the appropriate areas to detect potential leaks. When laying out fixed-point gas detection systems certain considerations should be made for placement of sensors.

Identify the Hazards: Fixed-point gas detection systems are used in a variety of ways to protect workers and assets. One application in which they are used is to monitor for gas releases as part of an industrial process. Process gases can be released from a number of different areas such as valves, weld joints, seals, flanges, or gaskets. Shipping routes or storage areas should also be considered as release points as well. When released, these gases could be explosive or extremely toxic. Identifying that a release occurred is critical to the safety of the workers or the process.

Once released, the gases are free to move around the atmosphere. Areas where gases can accumulate or be collected should be identified as potential areas to monitor. Collection points may or may not be close to possible release points, but these are areas that gases can migrate to and collect in. Some examples include confined spaces, wells, ditches, vaults, vessels, or any other areas that plant personnel may inhabit. Monitoring these areas protects workers that may inadvertently enter without other methods of personal protection. If a potential release point is large enough and identified as being extremely toxic or hazardous, perimeter monitoring of entire facilities or buildings within a facility may be required. This may be the case for large storage facilities or tank storage areas where large concentrations of hazardous or combustible liquids or gases are stored. Detectors are placed around a building, tank storage, or even the entire facility to detect if hazardous gases are leaving particular areas or the plant. This type of system can be used to protect workers as well as members of the neighboring communities from hazardous leaks. Measures such as these can also be taken to protect workers from hazards that may occur at adjacent facilities. Perimeter monitoring systems such as these are available that will transmit the gas readings wirelessly to a central controller, making the system easier and more economical to install.

Locate the Sensor Appropriately: After potential hazards and release/collection points are identified, placement of the gas detector is crucial. If placed in the wrong area, a gas release may occur, and the sensor may never see it. Knowing the environment (physical location as well as environment) and gases being detected is a major consideration in the placement of the detection devices. Certain gases such as methane or hydrogen are lighter than air. When released, these gases will rise above the ambient oxygen in the atmosphere. The sensors should be placed above the release points. In areas that are enclosed, the monitors should be placed at or near the ceiling. These areas are where lighter-than-air gases will accumulate.

Heavier-than-air gases such as hydrogen sulfide will sink to the ground collecting in low-lying areas of the facility such as ditches or vaults. Sensors for these types of gases should be placed closer to the ground, or below the release points. Caution must be taken. Placing these sensors too low to the ground may cause maintenance or performance issues. Sensors should be mounted 18-24 inches above the ground, keeping them free from dirt, debris, water, or other forms of contamination.

Gases that have similar weight as air should be monitored in the breathing zone. These sensors should be mounted five to eight feet above the ground. Care should be taken when placing sensors by any potential release points which may skew the readings. The sensors should be mounted between one and five feet from the potential leak source to provide adequate coverage while keeping the sensors away from high pressure or temperature gas streams.

For indoor environments as well as outdoor environments, airflow direction and velocity can also affect the placement of sensors. Areas where airflow will push or draw gases away from the sensor will hinder the performance. Direction and flow should be taken advantage of to enhance the performance of the system instead of hindering it. Sensors should be placed upstream where the maximum concentrations of gases will exist. Thought should be taken in placement of sensors near ventilation systems. These systems could push gases away from the sensors (such as a forced air heating vent). Ventilation systems may also be beneficial by drawing samples to the sensor (for example an exhaust fan may be used to pull gases towards a sensor). Consideration should be made for placement of sensors outdoors. If the wind consistently blows in a certain direction, sensors should be placed such that the wind will direct gas towards them. In an outdoor environment, more sensors may be required to obtain adequate coverage for particular areas such as fence line or building perimeter monitoring.

With all these variables affecting placement of sensors, detectors that offer the most flexibility should be considered. Certain products are able to detect two gases instead of one, allowing for multiple gases or multiple sensors to be placed in one particular area. The ability to place the sensors remotely from the main display and user-interface is also a huge benefit. This allows the sensors to be placed almost anywhere: in the breathing zone, towards the ceiling, or lower towards the ground based on leak points and the weights of the gases, while the main display and electronics are mounted in a clearly visible location. If single sensor units are initially installed, a second sensor can easily and very cost effectively be added to the system at a later time, making the system expandable.

Once sensors are all placed, they are typically wired into a control system. This is done with either an analog (typically 4-20 mA) or digital signal. There are many digital protocols available today such as Modbus, Profibus, or Fieldbus. The signal (either analog or digital) will transmit the gas readings from the sensors to the controller, where it will be monitored. When wiring the devices (for power or to the control device), the appropriate electric codes for that location should be followed.

System Maintenance: Gas detectors are typically exposed to some of the harshest conditions. They are placed in areas where they are exposed to extreme weather, dust, dirt, oil, and debris. These products are designed to operate in these conditions, but the instruments should be inspected on a regular basis. Filter elements used to keep dirt and water off and away from the sensors can become dirty and blocked over time. Once blocked, gas diffusion to the sensor can

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become hindered or stopped. If the gas cannot diffuse to the sensor the detector will no longer respond properly to leaks. Visual inspection does not always catch blocked or dirty filters. This is why routine function testing of instrumentation is recommended. A function test consists of applying a known concentration of gas to the sensor to ensure that the sensor's response exceeds the lowest alarm set-point. If the sensor does not respond properly, the filter may be blocked by dirt or debris, or the sensor needs to be calibrated. Along with function testing, calibrations should also be performed routinely on the instruments. A sensor calibration makes adjustments to the instrument based on the sensor's response to a known concentration of gas. This process ensures that the sensor and instrument are accurately responding to gas. If the sensor fails calibration, then it should be replaced.

Proper planning and placement of sensors is the first step in protecting workers and assets from gas hazards within any facility. If there are questions as to placement of products or classification of products for specific areas, plant safety officers or plant managers should be contacted. For questions concerning installation, operation, and application recommendations, equipment manufacturers should be contacted. Manufacturers are the experts on how their products work in a variety of applications. Once the equipment is placed and operational, continuous and proper maintenance of the products will help ensure worker and plant safety. Routine testing and calibration of the equipment ensures that it will continue to respond properly and accurately to gas exposures while providing a safe working environment.

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