TECHNOLOGY PROFILE

By Raymond MacLeod

All signs point to mapping

Safety standards shine light on gas, flame-detector coverage

Gas-leak monitoring and flame-detection technology are nothing new. Yet they are evolving, thus sparking the need for increased safety standards and requirements.

In an attempt to avoid loss of property and lives, safety engineers, application engineers and designers are now playing larger roles in how equipment is used and on what scale.

The use of the safety equipment is no longer solely based on an installer's experience alone, but also on data as well as codes and standards. The approach involves incorporating industry experience, existing standards and risk assessments with "mapping."

So what is mapping?

Mapping is best described as a graphical representation of where to best place gas detectors and the quantities required based on data from a detector's radius of coverage (field of view, in the case of flame detectors), characteristics of the fuel source and operating conditions.

For a particular application, however, detection-equipment users first need to know the following:

- Technology and choice in equipment
- Gas and potential fuel source
- Surrounding/operating conditions
- Size of the area to be monitored
- Location of blind spots, or obstruction between the detectors and fuel source
- Acceptable industry practices.

Point gas detectors typically fall in one of two categories, depending on the technology:

- Combustible (dual-beam infrared and catalytic-bead)
- Toxic (metal-oxide semiconductor and electrochemical)

Choosing the right detector depends on the application, the gas and how well the particular detector will function in the environment. In all cases, the end user has to know the detector's response time and other key specifications.

For example, some point detectors incorporate a flame arrestor separating the sensors element from the atmosphere — in which case the gas cloud has to first penetrate the material before reacting with the sensing element for a response to take place.

Infrared open-path (perimeter-gas) detector technology involves a continuous IR beam between the transmitter and receiver. This beam can be obstructed by solid objects cutting across its path.

These detectors are typically used as another line of defence in perimeter monitoring to compliment point detectors. They are often necessary in outdoor applications where gas clouds can be affected by erratic winds. In such cases, the detectors are mounted near the boundaries of coverage areas or zones. When the gas cloud crosses the infrared beam, an alarm condition is generated.

Ultrasonic pressurized gas-leak detectors are often used to compliment detection systems. These detectors will not distinguish the gases that are leaking, or pin-point the leak. They will, however, allow end users to respond quicker. Ultrasonic pressurized gas leak detectors do not need time for gases to penetrate sintered materials to react with sensing elements.

End users also need to understand the characteristics of the target gas. Under normal conditions, gases that are considered denser than air (heavier than air) and normally found at ground levels will become less dense when the temperatures increase, and eventually rise to the upper/roof levels (ceilings or near ceiling levels). Conversely, light gases will become heavier as temperatures decrease. These gases will now be suspended in air or slump to ground levels.

Wind draft (air movement) is one of the most influential factors that will affect where gas will end up and accumulate. This, again, is more evident in outdoor applications. In such applications, air movement can be erratic, making it difficult to predetermine where gases may accumulate.

In the end, no written rule exists in determining gas-detector placement and quantity. However, joint industry studies on the placement of gas detectors in off-shore applications suggest the minimum spacing for confined areas is a five-metre radius. Since gases may slump to low levels in cold conditions, the studies also determined that detectors should be mounted in 3-D patterns (three-dimensional arrangements) with some detectors positioned lower, some mid level and others high to detect lighter gases.

Recommendations for the installation, operation and maintenance of combustible gas detection may be found in ISA documentation: ISA-RP12.13, Part II-1987. In these instances, data generated by mapping software is supplemented by historical data and wind-pattern analysis.

Determining were to place flame detectors is less challenging because data — such as field of view, distance and response times associated with a particular flame source — is already known.

If the potential flame source is complex or involves a mixture of hydrocarbons, data associated with a representative (compound close in makeup and nature) may be used.

When positioning flame detectors and determining quantities, the challenge lies in determining full coverage.

Most flame detectors are similar. The differences are typically:

- The speed at which the detector will respond to a specific flame source
- The field of view (cone of vision) for each flame source
- The preferred detector technology for an application

While it is ideal to have data on field of view and response time, it is also practical to have some way of visually seeing the "angle of coverage" to aid in making assessments.

Alignment tools are often the most useful in these applications. They are typically fitted to the face of flame detectors and adjusted so their lasers are pointed a certain amount of degrees to the left, right, above and below the central axis, providing a clear visual and highlighting any obstruction in the detectors field of view.

Design software such as Solid Works and computer-aided design software (CAD) can provide a reasonable mapping of the area to be monitored. This would indicate the position of each detector, taking into account the potential leak source's location and ignition sources (in the case of gas detectors).

This would also help determine the positioning of flame detectors based on the flame source, required overlapping of the field of views and visual coverage indicated by alignment tools.

Raymond MacLeod is a technical product specialist with Emerson Process Management — Net Safety Monitoring with more than 16 years in the process and instrumentation industry.