

# Effective Safety Monitoring in LPG Storage and Filling Plants

## Application

What is LPG (liquefied petroleum gas)? LPG is a mixture of propane, butane, and other organic gases that are used as an efficient form of energy. When stored under pressure, LPG becomes a dense liquid allowing large quantities of gas to be stored in a small space. If the pressure is released, the liquid evaporates. LPG has to be compressed above its vapor pressure at a certain ambient temperature to maintain it in liquid form and facilitate its transport and storage.

LPG can be delivered to distribution facilities via pipeline, train, or trucks. Nevertheless, delivery by road tankers remains the most common transport method in many countries. These countries often have distribution depots with storage vessels with capacities of 20,000–30,000 gallons each. As needed, LPG is pumped to fill small trucks of about 3,000 gallons for road delivery to big industrial and commercial consumers or to fill small containers at rates of 5,000 cylinders a day or more depending on the plant capacity.

## Challenges

LPG is non-toxic but at very high concentrations in air, LPG vapor acts as an anesthetic and subsequently as an asphyxiate by diluting or decreasing the available oxygen. When LPG is mixed with air, a highly flammable mixture is produced. The flammability range is between 2 % to 10 % by volume of gas to air. LPG vapor is also heavier than air, therefore any release will migrate to the lowest point where it will concentrate and form a highly flammable mixture.

Filling small LPG cylinders is still a manual process in locations that use either mass flow metering technologies for dispensing the liquid or basic scales to account for the mass by weight. These filling/bottling areas typically require numerous personnel, sometimes more than 50 staff members, to complete tasks such as filling and transporting cylinders, and performing tests on reusable cylinders and systems within the plant. During these processes even small gas releases may result in fires and detonations.



LPG Cylinders

## Solution

For the area of large pressurized vessels a sound safety monitoring strategy can be achieved through the installation of UV/IR optical flame detectors and fixed gas detectors. Flame detectors must be in sufficient number to make sure that their field of view covers the entire area of the vessels to be monitored. Adopting a voting logic may be a good idea to avoid false trips. Despite flame detectors immunity to sunlight and exposure, reflected radiation from metallic surfaces can produce unexpected frequencies that may affect the performance of some flame detectors. Gas detectors should be placed close to the inlet/outlet piping line of tanks and must be mounted at an appropriate height to account for the possible path of a heavy gas in event of leakage.

The area of the pumps must also be protected with the use of optical flame detectors and gas detectors to monitor any potential leak coming from leaking valves, flanges, or mechanical seals of pumps.

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The bottling/filling area is normally left open (no walls) to create natural ventilation. Because of presence of gas in this area on a consistent basis, catalytic bead sensor technology should be avoided, since this constant exposure will compromise the sensor life. However, IR technology can be effectively utilized to provide alarm for the presence of high concentrations of gas in each filling line and cylinder storage areas for potential leaks in cylinder valves. The use of an optical flame detector is highly recommended in the filling area because of the presiding explosive conditions.

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### UV/IRS Flame Detector

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### References

- Plant Engineer's Handbook By R Keith Mobley
- World LP Gas Association website ([www.worldlpgas.com](http://www.worldlpgas.com))

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