Reliability of Gas and Flame Detectors on Offshore Platform

by Ir. Gan Chun Chet

INTRODUCTION

Infra red gas detectors are used on offshore platforms to detect gas leakage from hydrocarbon inventory inside pressure containing equipment such as vessels and pipelines. It is located near dangerous places at the workplace, especially in the process areas, complying with the hazardous area classification as stipulated in IEC 60079.

[1]. Infra red flame detectors and infra red gas detectors are installed on the platform to detect methane flame, serving the same purpose, to shut down the platform during a catastrophe due to a leakage. If this happens and shutdown occurs, the hydrocarbon inventory will be isolated from coming out of containment.

Another method of detecting fire on offshore platforms is by using fusible tubes, complying with API RP 14C.

[2]. Pressurised pneumatic air, with melting elements connected along and at the end of the tubing routes in the process area will depressurised when the surrounding temperature reaches approximately 71 degrees Celsius. When the pressure is depressurised off the fusible tubes, low pressure detected inside the pneumatic tube by a pressure switch will signify a fire in the protection area.

INFRA RED GAS DETECTORS SINGLE AND PAIR ARRANGEMENT

On offshore platforms, the gas detectors (normally infra red type due to hydrocarbon inventory) are arranged in pairs. This is to achieve a reliable *confirmed detection* in the protection area, for immediate shutdown. So when one detector fails in a particular area, it is very critical. The situation is not performing as intended and the second detector will function as an alarm in the same area of detection. It should be noted that the protection area has been minimised to a certain extent temporarily until the fault is removed, i.e. the faulty detector replaced with another healthy detector.

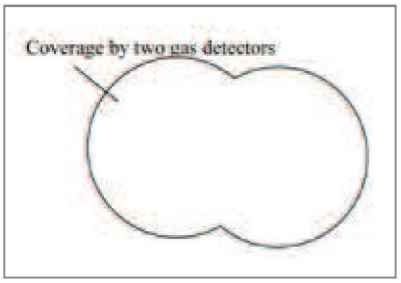

Figure 1a: Detectors in Pair Arrangement

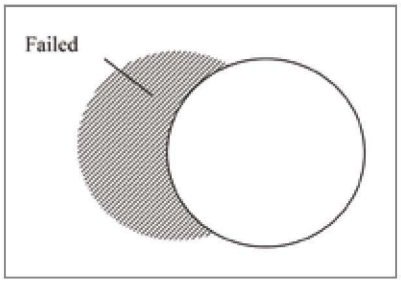

Figure 1b: The reduced coverage area due to a failure of pair arrangement

EXAMPLE OF NON-CONFORMANCE

Deriving a reliability figure which signifies certainty of detection in required in assuring the users. However there are situations where non-conformance occurs. An example is given here. By calculating the number of gas detector failures on an offshore platform, the following gives an approximate figure of the actual matter. With 24 detectors in operation and 7 returned to the supplier during a 4-year period, the average failure rate was 7.3% per annum.

This shows the number of operating gas detectors on this platform to be approximately 92.7% a year, based on this set of formulation as tabulated below, deriving these figures in an actual application. A chart that depicts this case is as shown in Diagram 1.

Table 1: Failure Occurrence of Gas Detector on An Offshore Platform

No. / Percentage	Description
24 qty	The total number of gas detectors purchased
7 qty	Replace after check by supplier during 4 years operation years
29.2%	Failures, in total, for 4 operating years
7.3%	Failure per year on average (of this period)

From the calculation and illustration above, spare detectors are required to be kept in stock to immediately replace any faulty detector returned to the suppliers. This is to ensure that the detection coverage is maintained at the optimum level although there will be some periods where there will only be one detector instead of the intended two. Having spare detectors will increase the operational hours of the detectors slightly as there would not be the need to wait for a replacement.

In operating hours, the calculation is as below:

7 failures in 3.5×10^4 hours (4 years x 365 days x 24 hours)

2×10^{-4} failure in 1 hour

This shows that the quality of these detectors not meeting the specification requirement is low instead of 99.99% availability (approximately 1.1×10^{-5} failure in 1 hour).

INFRA RED FLAME DETECTOR CONE OF VISION

This type of flame detector detects a possible fire by having a clear vision of the target area without compromising the sensing distance (or cone of vision), and alerts the inhabitants to the danger.

There are various sensing distances, usually 30 metres or 60 metres, depending on vendor standards. On offshore platforms where there are flanges throughout the process areas, it is a matter of chance whether the detectors would be able to sense the possible fire source. In practice, the flame detectors are targetted at these areas, with a reliable flame detector as the vital requirement to ensure optimum performance of the flame detection system.

Normally, there will be 2 flame detectors located in an area to cover the target area with a 50:50 chance of a likely fire detected by a single detector. This is illustrated in Diagram 2.

Each of the detectors in this arrangement will be able to detect only one side of the vessel if a fire occurs. Therefore if one detector is faulty, only one will be left operational. Thus, it is always advisable to utilise fusible plugs which are located above the vessels or above pipe flanges.

It is still a reliable method in fire detection, although this method may be slow in sensing. With this, it will ascertain the situation, promising greater safety in the workplace.

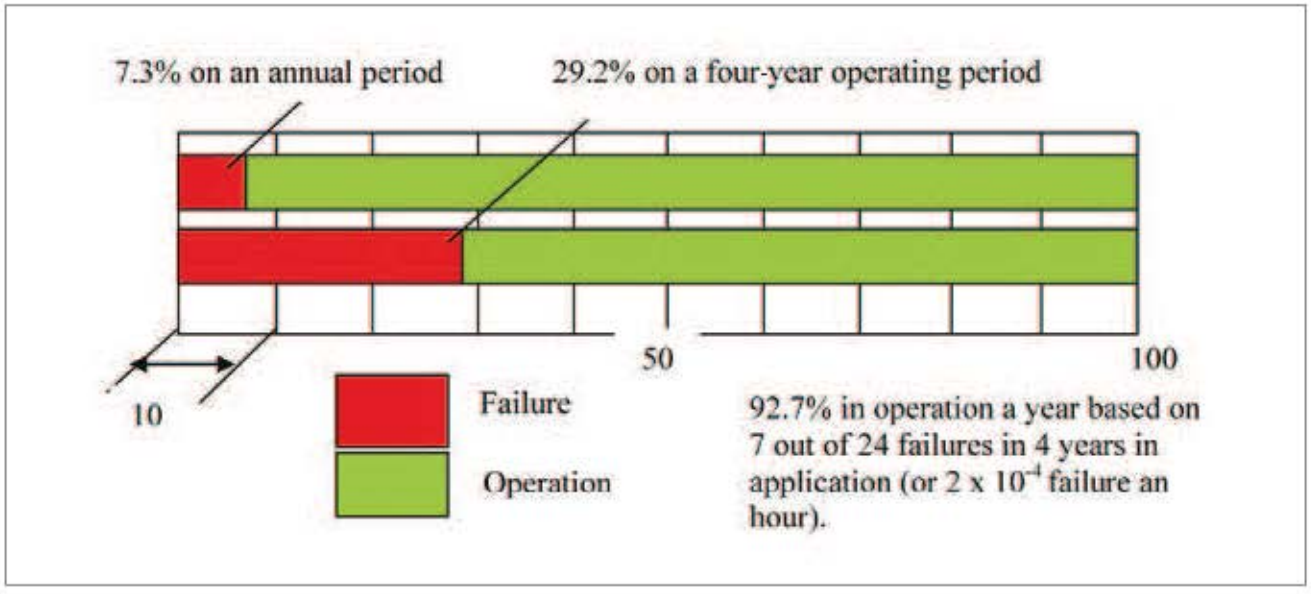

Diagram 1: Gas Detectors Failure and Operation

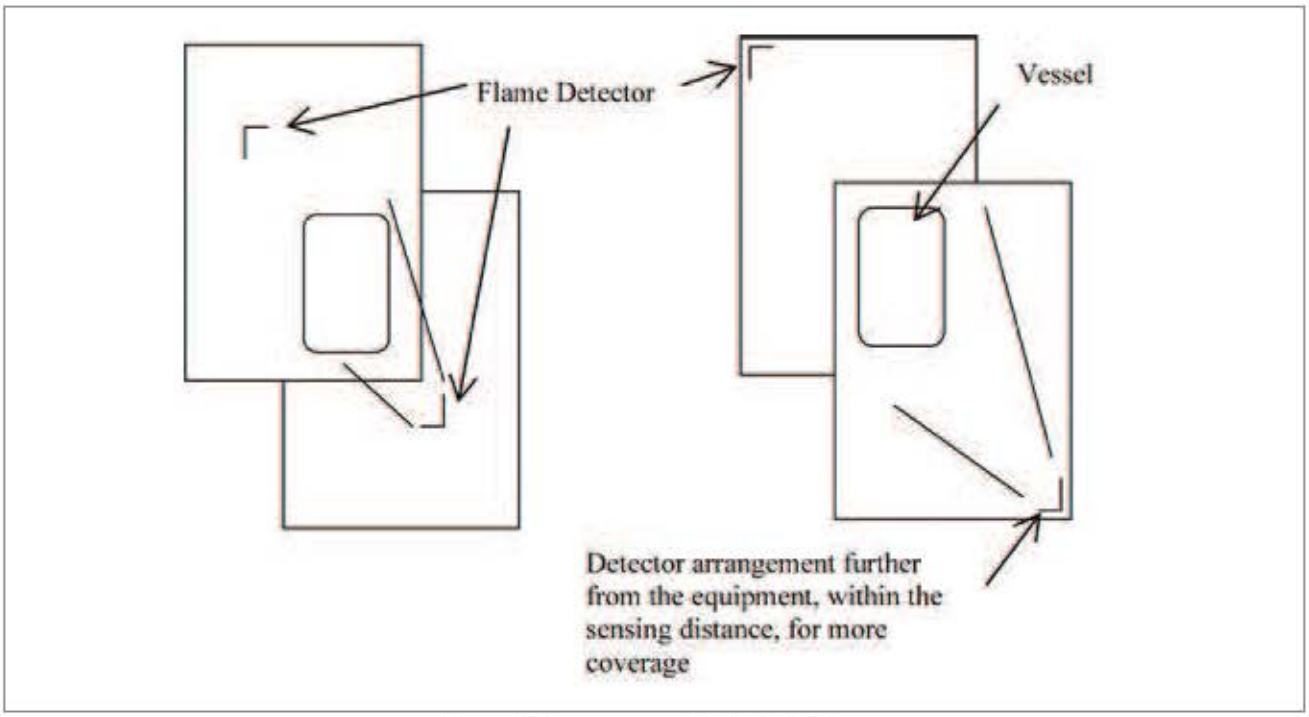

Diagram 2: Coverage area, within viewing distance

CERTAINTY IN DETECTION

Sometimes, different area sizes need to be calculated for fire protection. This is based on governing coverage area of a flame detector for a fixed area, depending on the distance of the detection area from the detector. When it comes to variations in distances, the situation is solved by the positioning of the flame detectors and the number required. The flame detectors located in the hazardous area must be certified to the application, in this case near the leakage source if the governing distance is short for close monitoring, i.e. specific to the target only.

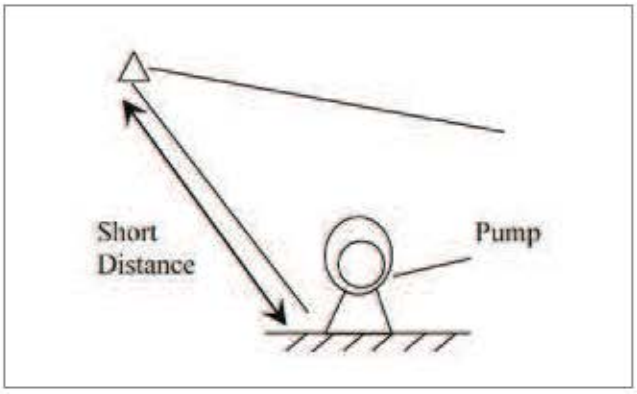

Figure 2a: Locating A Flame Detector Near a Pump

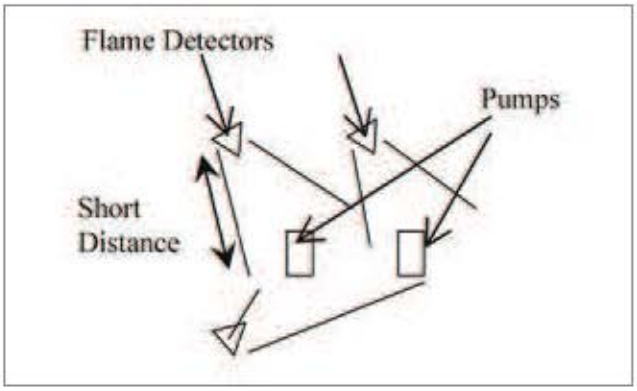

Figure 2b: Locating A Few Flame Detectors in a Pump Area

CONCLUSION

It is important to note that flame and gas detectors may fail due to faults. During the replacement period, there is a certain timeframe when the platform detection system will not be performing at optimum requirements. Keeping operational spares of fire and gas detectors to ensure safety is a must. For fire detection, it is always advisable to have fusible plug accompany the design, although it is slow in detecting a fire. ■

REFERENCES

[1] IEC 600 79, Published standards by International Electrotechnical Commission on Explosive Atmospheres.

[2] API RP 14C, American Petroleum Institute, Recommended Practice for Analysis, Design, Installation and Testing of Basic Surface Safety Systems for Offshore Production Platforms.

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