Helideck Flame Detection

Civil Aviation Authority CAA demand **higher levels** of **safety** for helicopter operations on Normally Unattended Installations (NUIs).

Introduction

Normally Unattended Installations present a wide range of safety issues; one being the use of rudimentary firefighting equipment. Edition 7 of CAP 437 sets out to address the issues faced with the hazardous operation of helicopters landing on NUIs.

The CAA amended CAP 437 to require that new build Normally Unattended Installations (NUIs) be built with deck integrated fire fighting systems and that existing NUIs should be retro-fitted with an alternative automatically activated fire fighting system. A means of automatically activating the DIFFS or FMS should be through the use of flame detection, however, not using the correct type of detector could result in catastrophic failures if not specified correctly. This application note investigates the different types of flame detection available and the strengths and limitations of installing them on a helideck.

Helideck Flame Detection

As with all applications for flame detection within the oil and gas industry, there are strengths and limitations associated with the various technologies. The application of flame detection on a helideck is a particularly challenging environment for flame detection to operate correctly and safely. If for example a false alarm were to be generated when a helicopter was approaching to land, the false activation of the foam monitors or DIFFs could be potentially catastrophic, or merely a costly clean up exercise.

There are two very distinct flame detection families that are used within the Oil and Gas Industry:

1. Radiation Flame Detectors

Consisting of; Ultraviolet, Single Frequency Infrared, Combination UV/IR, and Multiple Frequency Infrared.

Radiation-type flame detectors collect radiation from the area under surveillance; sum the total radiation within the field of view; analysing the total intensity of the radiation and any flicker frequency that exists.

2. Visual Flame Detectors

Consisting of; Visual Flame

Visual Flame Detectors are based on a near IR CCTV camera with flame detection recognition algorithms built into the detector. This type of detector is spatially aware; in that it analyses each area of interest within the field of view and determines if each area meets the criteria for fire. The visible radiation from each potential fire source is analysed individually.

Ultraviolet Flame Detection

Ultraviolet (UV) detectors are good general-purpose fire detectors as virtually all fires emit UV radiation. However, UV flame detection is well known for its false alarm susceptibility to arc welding, X-raying and lightning. Due to the open nature of a helideck, UV flame detection would be subject to all elements of the weather therefore if the detector was subjected to lightning from a nearby storm, even a few miles away, a false alarm could be generated and potentially activate the FMS or DIFFs.

Single Frequency Infrared

Infrared (IR) detectors operate by detecting the heat element of a fire; analysing amplitude and flicker frequency of the flame. IR flame detectors are not affected by hydrocarbon films, however, black body radiation does cause false alarms and water on the optical surface, attenuates the heat energy from a fire resulting in decreased sensitivity of the device. The vast majority of IR devices are designed to detect the product of combustion from a hydrocarbon fire—hot CO_2 emissions. The blackbody radiation emitted from the body and engine of the helicopter, modulated by the chopping motion of the propellers is enough for an IR detector to recognise that as a false positive. As with UV detection, the open nature of helidecks are subject to all elements of weather and droplets of rain on the lens of the detector will rendering it blind to any fire.

Multi Frequency Infrared IR3

With the advent of Multi-Frequency detectors, guard bands were added to the 4.4µm IR sensor to reduce false alarms and increase the sensitivity. The signals from the sensors are correlated at either two or three optical wavelengths.

These devices may be less prone to spurious alarm from black body radiation although the sensitivity of this type of detector is also reduced, sometimes by a large amount, in the presence of blackbody radiation. In a helideck application where a helicopter is landing, an IR3 detector could potentially be blinded by heat radiation emitted by the body and engine of the detector.

As with all IR based flame detection, this technology is monitoring for modulated IR radiation from a fire at 4.4µm. This wavelength is associated with the product of combustion—hot carbon dioxide—from a hydrocarbon fire. The exhaust emissions from a helicopter are of course hot CO_2 therefore in the event of a helicopter landing, an IR3 detector will be activated falsely.

Visual Flame Detectors

Visual Flame Detectors, employ a video imaging based technique, utilising CCTV and advanced flame detection algorithms. The advanced algorithms process the live video image from the CCTV array and interpret flame characteristics.

This is a technology that provides a control room operator or nearby mother platform in the case of a NUI with real time images of each detector's field of view, therefore allowing a potential incident to be assessed and controlled from a safe distance. This in turn reduces the risk to personnel and reduces the risk of unwanted activation of the DIFFs or FMS. The detector operates in the near Infrared and uses extensive signal processing to detect and annunciate fires while rejecting the common sources of false alarm found within a helideck application.

As we have discovered the emission of exhaust gases from a helicopter engine emit very strongly at 4.4µm; the prime detection wavelength for IR detectors; causing them to false alarm. As a visual flame detector is monitoring for bright burning fires visually, false alarm immunity is assured to hot CO_2 emissions.

Black body radiation, at certain high temperatures, emits strongly at 4.4µm, which we learned causes desensitisation or spurious alarms with IR flame detection. The flame detection algorithms, and the wavelength at which visual technology operates at, ensures that the detector completely ignores this source of radiation and will not false alarm.

MICROPACK FDS301 VISUAL FLAME DETECTOR

Flame Detection Design

To ensure complete coverage of the helideck a minimum of three visual flame detectors are recommended to be installed facing inwards at 120 degrees to each other. This will ensure complete coverage of the helideck and comply with a 2oo3 detector voting structure.

An example of this design can be seen in figure 2 and 4. This design using Micropack Visual Flame Detectors has already been implemented successfully on various NUIs in the UKCS. The added benefit of the live video signal from each detector could potentially be beamed to the mother platform via a microwave link, or video over IP system, allowing any potential incident to be monitored from a safe distance and recorded for analysis post fire. An example of the quality of video feed from the Micropack FDS301 is shown in figure 3.

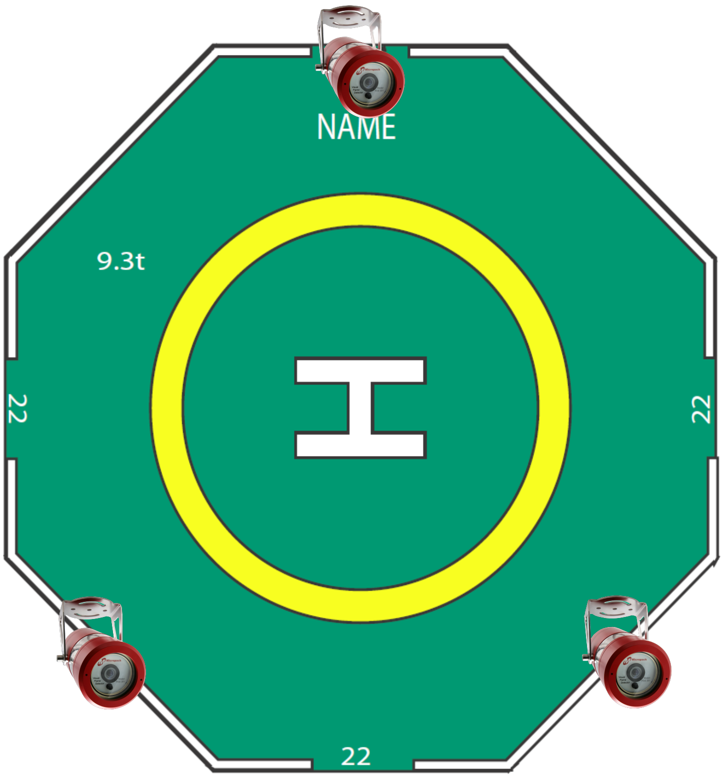

Figure 2 Example Helideck Flame Detection Design

Figure 3 Micropack FDS301 Video Output

Figure 4 Micropack FDS301 Helideck Installation

Conclusion

For a NUI, which is unmanned for at least the first and last flight of the day, an automatically activated DIFFS ideally with a passive fire-retarding surface is preferred since this solution provides for automatic fire suppression and active intervention in the event of a major fire situation occurring during a take-off or landing where all trained fire crews are otherwise located in the helicopter. Due to the false alarm sources associated with IR flame detection which are found in the helideck application—hot CO_2 emissions from helicopter turbines and black body radiation—the preferred method of flame detection shall be Visual. Coupled with the extreme exposed environment by which the flame detection is installed, we have learned that IR flame detection is severely desensitised by fog, rain and salt deposits on the lens, strengthening the case for Visual flame detection technology. Finally, the added benefit of a live video feed shown either locally on the platform, or beamed to the mother platform via microwave link or VOIP, adds an extra layer of safety to what is already an extremely hazardous operation.

References:

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