Airplane Hangars

WHITE PAPER

1. Abstract

Airplane Hangars are a well-known application of flame detectors. Airplane hangars are a versatile and demanding application. Due to its dimensions, the maintenance activities taking place and objects which may cause obscuration of the flame detector and possibly friendly fires. Correct positioning of the detectors is from utmost importance, to monitor every potential fire risk. The Sense-WARE IR3 and UV/IR flame detectors are suitable for this application, with a good sensitivity, a fast response and good false alarm immunity.

In this white paper fire protection in airplane hangars with help of flame detectors is worked out.

2. Problem Statement

Airplane Hangars are a well-known application of flame detectors. Airplane hangars are a versatile and demanding application. They strongly vary in size (500 m^2 - 20,000 m^2) and in application. There are several potential false alarm sources. The response, when there occurs a real fire, must be fast, to enable a quick extinguishing action when needed, to protect lives and assets. On the other hand, an undesired extinguishing action in costly and should be avoided with help of flame detectors with a good false alarm immunity.

3. Background

3.1 introduction

Airplane hangars are large, open floor areas with tall roof decks and tall doors, to house high-value airplanes. In many hangars the airplanes are not just stored but maintenance activities are taking place. Maintenance-activities automatically means that personnel are at work in the hangars. Their lives should be protected, next to the assets like the airplane(s) and the hangar and adjacent buildings. The Hangar and adjacent buildings are already costly, but the airplanes, stored in hangars are significantly more costly.

Hangar design is featured by a multiple of parameters:

- The floor area strongly varies from 500 m^2 for hangars for small airplanes to 20,000 m^2 for the biggest commercial airplanes.
- Airplane areas may be designed for individual or multiple airplanes per fire compartment.
- Just storage or maintenance activities (regular maintenance, repair, refurbishment, or complete overhaul of airplanes).
- Unfueled or fueled airplanes (unfueled highly limits impact of a fire; often airplanes are fueled, for operations reasons).
- Commercial airplanes, military airplane. And from Airbus or Boeing to Cessna.
- Variation in door heights.

In the following sections specific aspects of flame detection are discussed:

3.2 Standards and regulation

The American NFPA 409:2016 Standard on Airplane Hangars is worldwide accepted as standard for fire detection and suppression in airplane hangars, often combined with additional local legislation. The NFPA divides airplane hangars into groups and subgroups, each with its own door height and floor area and for every of these

3.3 Fire risk

The typical type of fire to be expected is a quickly expanding flaming spill fire. The value of the airplane(s) will exceed the value of the hangar significantly. Fast response of flame detectors in combination with foam extinguishing must protect the airplane(s).

The fire risks may well differ:

- If only defueled airplanes are allowed the risks are lower, then if also fueled airplanes are allowed. In the latter case, large quantities of fuel or may be present.
- If the airplane is only stored, but no maintenance is taking place, the risk is lower than if also maintenance is taking place. Airplane maintenance activities include potential ignition sources; spray painting, during refueling, grinding, or welding, an electrical fire, static discharge, or a heater.
- If multiple airplanes are stored the consequences are more severe. In this case may be chosen for compartmentation of the hangar.
- The combustibles to be expected are typically hydrocarbons; jet fuel (for example JP5), kerosene, lubricants, solvents, paints, hydraulic fuels. The flaming fires hereof can be detected with help of IR3 or UV/IR flame detectors.

3.4 Obscuration

Flame detectors need a free sight. A hangar is an application with several potential obscuration sources. Obscuration effects must be limited to avoid delay in response, after a fire.

The sources of obscuration may be:

- The airplane to be protected: the wing, the fuselage.
- Mobile obscuration sources: counterbalanced lift trucks, scissors lifts, vertical lifts, tow equipment. scaffolding, ladders, maintenance platforms, mobile passenger boarding stairs, work benches, tooling trolleys, hoisting equipment.
- Tools and materials used for service, maintenance, repair, or outfit airplanes.
- Mezzanine floors.

3.5 False alarm suppression

False alarm suppression has two factors:

- the resistance of the detectors against false alarms caused by sunlight or by heat sources
- the quality of the positioning of the flame detectors in a way, that they will not see friendly fires
  A friendly fire may be observed by one or more flame detectors if the tall doors of a hangar are open and an afterburner of a military airplane or an Auxiliary Power Unit (APU) is visible for the detector(s).

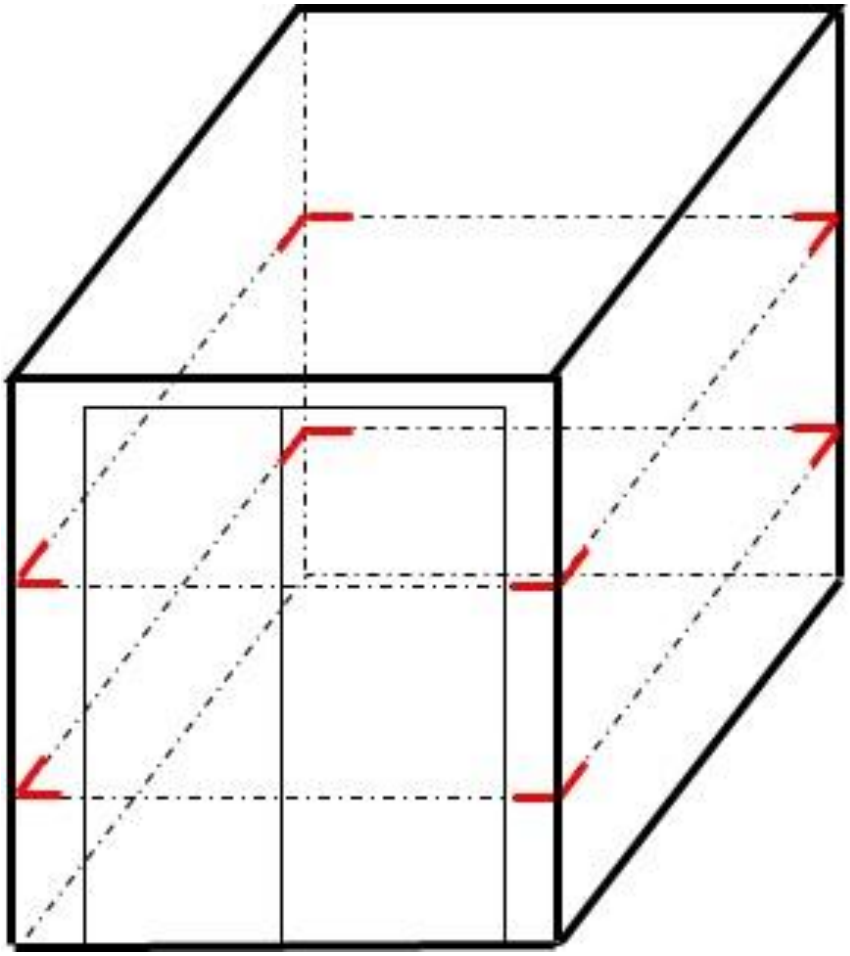
In hangars, false alarms must absolutely bey avoided; in hangars fire suppression by a sprinkler system or foam extinguishing system (high density AFFF foam is quite common. When a stationary fire extinguishing system is activated by a false alarm, extinguishing agent will be released; for example Aqueous Film Forming Foam (AFFF). The foam itself is already costly, but also removal and cleaning up and salvage of the airplane(s). may be costly as well. Therefore, a flame detector with a good false alarm resistance and a good positioning of the flame detectors to avoid visibility of friendly fires is from utmost importance. The unwanted alarm immunity claims of Sense-WARE flame detectors have been witnessed by FM approvals. See page 22 of the manual Manual_Flame-detectors_UV-UVIR-IR3.pdf.

To additionally suppress the probability of a false alarm a voting system may be applied: two detectors must be in alarm to activate the stationary extinguishing system. Be aware, however, that both detectors must be able to see the same flaming fire, otherwise the activation of the fire suppression system may be unnecessary late.

3.6 Project design

Correct positioning of the detectors is from utmost importance, to monitor every potential fire risk. A correct detector positioning reverts to sections 3.2 to and including 3.5 of this white paper.

- The project design must comply with NFPA409 and local regulation (see section 3.2)
- The fire risks must be considered (see section 3.3)
- Sufficient flame detectors must be placed to avoiding obscuration (see section 3.4)
- A combination of area monitoring and object monitoring is to be expected.
  For the area monitoring, typically, the positioning of the flame detectors should be for under the wing monitoring and above the wing monitoring in figure 1. You can see the typical basic monitoring configuration of flame detectors. Additional object monitoring may be needed
- Visibility of potential friendly fires must be avoided (see section 3.5)



Above the wings monitoring

Under the wings monitoring

Airplane hangars are a versatile and demanding application. Because of its dimensions, the maintenance activities taking place and objects which may cause obscuration of the flame detector and friendly fires. Correct positioning of the detectors is from utmost importance, to monitor every potential fire risk. The Sense-WARE IR3 and UV/IR flame detectors are suitable for this application, with a combination of a good sensitivity, a fast response and good false alarm immunity.

5. References

1. NFPA 409:2016 Standard on Airplane Hangars.
2. NIST Analysis of High Bay Hangar Facilities for Fire Detector Sensitivity and Placement; 1997.
3. NFPA 11:2016 Standard for Low-, Medium-, and High-Expansion Foam.
4. F.J. Tanis Jr. Life Safety and Fire Analysis Airplane Hangar, California Polytechnic State University, 2018.
5. Manual of Fire Protecting Engineering 2016 (MFPE), Ch 13, Airplane Hangars, Australian Government.
6. Manual of Sense-WARE IR3, UV/IR and UV flame detectors: Manual_Flame-detectors_UV-UVIR-IR3.pdf. Page 19.