

VERTICAL AUTOMATED STORAGE SYSTEMS

ALLIANZ RISK CONSULTING



Vertical automated storage system (VASS) installed in a warehouse

This Tech Talk discusses the fire hazards and business interruption exposure of vertical automated storage systems (VASS) and Allianz Risk Consulting (ARC) recommendations.

AT-A-GLANCE

- The frequency of fires involving VASS is low, but the loss consequences can be very high.
- Manual fire-fighting inside these storage units is very difficult if not adequately planned.
- Fire extinguishing systems inside the unit are not always adequate or reliable. The type of system selected to protect the unit should be carefully considered with ARC's involvement.

INTRODUCTION

Vertical automated storage systems (VASS), sometimes called vertically enclosed storage units, are usually installed in production or storage areas. They are often used for the storage of spare parts, production goods or small finished products, but could be used for an array of product storage. The benefits are obvious as they enhance and optimize the use of floor space.

Vertical storage units come in a number of different types: paternoster, buffer, lift/shuttle or carousel types. These units are very common in the manufacturing and warehousing industries, from automotive to pharmaceutical.

The unit is enclosed and equipped with a control panel and electrical motors that are used to store, locate and pick products as requested. There are several ignition sources present in this type of storage unit, with the most common being:

- Motors, wiring, electrical components or connections
- Control or electric panels
- Bearings or other components of the extractor

The combustible loading depends on the product being stored, the packaging material and the construction of the bins or boxes used.

Thus, there is a mix of ignition sources and combustible loads. Loss history shows that a fire starting in a vertical storage unit is rare, but can cause significant damage to the products and equipment being stored in and adjacent to the unit. There are several reasons this:

- The combustible loading inside the storage unit can be higher than what the ceiling sprinkler system was originally designed to control.
- The top and sides of the storage unit can prevent ceiling level sprinkler water and hose streams from reaching the fire.
- Collapse of the vertical storage unit can spread the fire to adjacent areas and lead to an uncontrolled fire.



VASS in a maintenance department

Many times, high value or business critical parts are stored inside these units, such that a large loss can be expected, even if the fire is controlled inside the storage unit. Because of the combustible loading and ignition sources inside these storage units, adequate fire detection and protection should be considered.

FIRE DETECTION AND PROTECTION

Fire detection systems (heat or smoke) or fire extinguishing systems (gaseous or chemical) have been proposed as an option by the suppliers, but without performance based fire testing. As a result, several entities, including government and manufacturers, have conducted fire tests to prove the reliability of fire extinguishing systems inside these types of storage units.

For example,

- A division of the British Ministry of Defence – MOD Defence Estates – approached Tyco Fire and Integrated Solutions to assess the effectiveness of various fire protection systems for VASS.
- IKEA Services AB has performed a series of fire tests with Viking and the Swedish SP Technical Research Institute for VASS.



VASS configuration during a test performed for IKEA Services AB

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These fire tests showed:

- Water mist systems failed to control the fire
- Gaseous extinguishing systems:
 - Carbon dioxide (CO₂) systems successfully extinguished fires originating from motors and control panels, but failed to control a fire involving the stored products.
 - Inert gas systems with a specific design extinguished fires in all cases.
- Sprinkler systems:
 - Sprinklers located at the top of storage units up to 7.5 m (25 ft.) in height controlled the fire.
 - Intermediate sprinklers may be needed once the storage units are above 7.5 m (25 ft.) in height.

ARC RECOMMENDATIONS

The following recommendations are based on best engineering practices and should be considered after a hazard analysis is completed based on the potential loss for each storage unit. The level of fire protection is dependent on the loss exposure, similar to any other storage arrangement. Please contact your local ARC representative to discuss a pragmatic approach.

STORAGE UNIT

- Metallic trays and boxes are preferred when possible.
- Reduce the combustible packaging as much as possible.
- Prohibit the use of storage systems made of combustible panels unless approved/listed by a nationally recognized testing laboratory.
- Ensure adequate anchoring and bracing of all units to prevent any collapse. Take into account additional structural issues that may be needed, such as for earthquakes.
- Keep the storage units at least 1.2 m (4 ft.) away from any critical machinery or unprotected areas.

The recommendations below apply only to storage units that contain combustible commodities (products or packaging) or combustible containers. If the parts being stored are noncombustible and the containers are noncombustible, then additional protection measures are probably not needed even if the products are high valued.

MAINTENANCE

- Perform infrared inspections (thermography) of the electrical installation at least annually.
- Inspect, test and maintain the fire detection and fire protection systems in accordance with applicable NFPA codes and standards.

FIRE DETECTION

- Install a high sensitivity smoke detection system inside the storage unit.
- The fire detection system should signal to a 24/7 attended location.
- Interlock the power to shut down upon activation of the fire detection system.

MANUAL FIRE-FIGHTING

- Update the fire emergency plan in order to guide the fire brigade. A list of stored materials and their reaction to fire / water / extinguishing system agent should be included.
- Advise the fire brigade that they may have to drill small holes to allow the introduction of water hoses inside the storage unit. The unit should never be opened during a fire to prevent spreading.
- Ensure there is clear access for the fire brigade to the storage unit for manual fire-fighting.
- Advise the fire brigade they may have to use infrared equipment (thermography) to locate the fire.
- Use only water to fight the fire if appropriate for the stored product.
- Provide adequate hose stream allowance (950 l/min or 250 gpm) near the storage unit and keep in mind that manual fire-fighting is likely needed to control a fire.

AUTOMATIC FIRE PROTECTION

Depending on the VASS configuration and contents, either a gaseous extinguishing system or automatic sprinkler protection or both may be considered.

High-value or business critical goods:

Install an inert gas extinguishing system. The proposed installation and design calculations should be conducted by an approved third party and reviewed by ARC prior to installation. Keep in mind that the storage unit should be designed to maintain an inert gas concentration level, which may influence the construction of the unit for air tightness.

High loss exposure, storage height, and combustibility of the commodities:

- Install automatic sprinkler protection designed in accordance with FM Global Data Sheet 8-34, *Protection for Automatic Storage and Retrieval Systems*. Alternative sprinkler designs may be considered based on ARC's review of successful fullscale fire testing conducted by an internationally recognized laboratory, such as UL, VdS or SP.

- The design drawings and hydraulic calculations should be completed by a recognized supplier and reviewed by ARC prior to installation.
- Arrange the storage trays to drain sprinkler water to the sides and consider the additional weight of water in the open-top containers.

REFERENCES

- *Experience from sprinkler tests in a shuttle storage system*, Magnus Arvidson, SP Technical Research Institute of Sweden
- FM Global Data Sheet 8-34, *Protection for Automatic Storage and Retrieval Systems*

QUESTIONS OR COMMENTS?

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