



Early Warning Fire Detection

REFRIGERATED STORAGES

Design Guide

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1 Introduction

Warehouses and storage facilities are historically one of the key infrastructure buildings that attract significant new constructions to meet increasing demands from urban population growth, change in consumers' behaviour and innovative goods and service fulfilment. With the rapidly growing e-commerce and digitisation of warehousing operations, emerging market demands drive purpose-built warehouses, such as refrigerated (cold) storages to cater for increasing preferences for fresh and frozen perishable goods, pre-packed or grocery shopping, pharmaceuticals, biologic components and high value electronic goods. Compound with current rate of online grocery shopping remains low at around 3% to reach 20% by 2025, the global cold storage market is anticipated to reach US\$ 212.54 bn in the same period. Since 2000, the U.S. cold storage warehouse industry has experienced a 43% increase in capacity, largely due to investment in larger scale facilities exceeding 70'800 m³ (2.75 m ft³) of space [1].

Refrigerated Storages, logistics & distribution industry

Racking systems (e.g. high-bay racking, block storage, bulk goods storage) are designed for maximum storage capacity per square meter/foot. As such, a higher roof and a narrower aisle width are desirable from a business profitability perspective. As the level of refrigerated storage automation increases, very high rack configurations and very narrow aisles become possible to further maximise total storage volume on the same footprint. A typical new built warehouse height is 11.5-12 m (30-40 ft) – from older warehouses of only 7-8 m (23-26 ft) – to accommodate various racking systems and forklift movement.

Bigger, taller warehouses with narrower aisles rely more on robotics and automation

Nowadays, the logistics operation from leading specialist cold chain service providers is moving towards fewer but larger regional distribution centres or a single national distribution centre to reach a scale of regional or even global distribution with flexible ongoing OPEX¹, rather than upfront CAPEX investment. This results in typically 25'000-40'000 m² (269'100-430'600 ft²) size buildings or even larger buildings of up to 80'000 m² (861'100 ft²). In large cold stores, storage can be routinely placed on racks 30.5-40 m (100-130 ft) high, while some go up to 60 m (200 ft) above the floor where AS-RS² equipment is installed [2], [3], [4]. On the other hand, small or modular refrigerated storages where perishable goods must be stored before they are sold, delivered or dispensed to the customers are very important business assets to safeguard uninterrupted and smooth operation.

Cold storages vary in size, depending on where they are in the distribution chain

Persistently, fire risks and a high percentage of total loss due to fires in industrial and warehouse/storage type occupancies remain high. Storage fires in the USA in the 5-year period of 2013 to 2017 accounted for almost 30% of total fires reported, 46% of total civilian deaths and almost 25% of total property loss. In Germany, the German Insurers' Association's GDV³ fire statistics from 2001 to 2016 show a total of over 76'000 risks and approximately 7'000 claims from warehouses during this period, with almost 60% of average claims for damages exceeding € 500'000 [5], [6], [7]. Historically, from a fire in an abandoned cold storage warehouse in Worcester, Massachusetts that, killed six firefighters in December 1999, to a US\$ 100 m claim for a distribution centre of a retail chain in the USA, harden the desire for businesses to adopt rigid risk management regimes and for the insurers to manage risks through the recommendation of best practices in fire safety and protection.

Risk management and business continuity is paramount to operation

Over 25% of fires in storage warehousing facilities originated from electrical distribution, lighting equipment or heating equipment. While sprinklers are deemed as standard fire protection for storages, only about 30% of the warehouses from which fires were reported, were actually equipped with sprinklers in the USA. Of these, 12% were deemed as failure to operate or to operate ineffectively [8], [9].

Electrical equipment is the prime cause for fires

¹ OPEX: operating expenditure, CAPEX: capital expenditure

² AS-RS: Automatic Storage and Retrieval Systems

³ GDV: Gesamtverband der Deutschen Versicherungswirtschaft e.V.