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Fire Suppression Considerations for Storage Occupancies

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Introduction

The words "*Fully Sprinklered*" do not mean "*Adequately Protected*." There are many factors that have a direct effect on the suitability of fire suppression systems ability to control a fire. None more so than those found in a warehouse occupancy. What is being stored? How is it being stored? How high is it being stored? How tall is the building? Is there an adequate water supply? Change any one of these items and it will change the required level of fire protection. Unfortunately, over time and without realizing it, these factors change. Metal parts are now made from lighter, but just as strong, plastic; Stockpile storage is converted to pallet racks; a new forklift allows materials to be stored higher; a neighborhood develops and the city can no longer provide as much water. This paper will walk through these basic factors to help you draw some conclusions for your own facility.

What is Being Stored?

What is being stored? The National Fire Protection Association (NFPA) has provided some general definitions to classify a wide variety of goods. These definitions are based on the general combustibility of the item. The commodity classifications range from Class I – non combustible up to Plastics – very combustible. There are a few special classes of an extreme hazardous nature such as flammable liquids or rubber tire storage. We will focus on the five basic commodities classes in this introduction.

CLASS I
A Class I commodity is a non-combustible product placed directly on a pallet or in a single layer corrugated carton. Very simply stated, it is a product that won't burn and there are little or no packaging materials.

Some examples are: metal file cabinets, canned foods, electric motors, glass bottles, etc.

CLASS II
A Class II commodity is a non-combustible product in slatted. wood-crated, solid wood boxes, or multiple-layer corrugated boxes. These products still won't burn but the packaging certainly will.

Some examples are: baked goods, waxed paper containers, sugar, flour, book signatures, solid pile lumber, dry cell batteries, frozen foods in waxed cartons. etc.

CLASS III
A Class II commodity is a product made from wood, paper, natural fibers, or Group C plastics. They can contain up to 5% of Group B or A plastics. Again the fuel load is increasing. The product can burn and the packaging can burn.

Some examples are: bread, cheese, chewing gum, coffee, wood furniture, books, magazines, natural textiles, doors, wood cabinets, cotton diapers, roofing shingles, glass figurines packed in shipping peanuts, etc.

CLASS IV
A Class IV commodity is a product partially made up of Group B plastics, free flowing Group A plastics, or contains 15% by weight or 25% by volume Group A plastic. The product is not yet 100% plastic. But has a lot more plastic than a Class III product. But from the definition, once the product composition is greater than 25% by volume, will need to protect it as if it were entirely of plastic.

Some Examples are: Disposable diapers in cartons, Liquor 100 proof or less. Synthetic textiles, vinyl floor tiles, TV's, laptop computers, most small consumer electronics, wire on plastic spools, a snow blower, etc.

PLASTICS, ELASTOMERS and RUBBER
Plastics are classified as A, B or C, with 'A' plastic having the highest combustibility and 'C' plastic having the least. These products are mostly comprised of a plastic material.

Group A plastics are: polystyrene, polypropylene, polyurethane, and acrylics.
Group B plastics are: natural rubber, cellulosics, fluoroplastics, and nylon.
Group C plastics are: phenolics, melamines, polyvinyl chloride, and urea.

Some examples are: cottage cheese containers, paint containers, desk chairs, computer keyboards, plasma TV's, milk crates, empty soda bottles, laundry baskets, etc.

MIXED COMMODITIES
A brief discussion about mixed commodities. Most warehouses contain a wide variety of products. Seldom is a warehouse so specialized that it contains just one product (as in rubber tire or roll paper storage). There can be Class I through Class IV and Plastics stored. So what classification to choose? The level of fire protection is not provided to the warehouse based on the 'mix' of products within. Fire protection is based on the highest level of hazard present. If the overall mix of a warehouse is 20% Class IV and 60 % Class II and the remainder is a mix of Class I and III, the fire protection required would be based on the Class IV commodity. The highest fuel load present. It would not be based on the Class II product that makes up the majority of the storage. There are specific rules governing 'how much is too much".

How Is the Product Being Stored?

Now that we know *what* is being stored, our attention needs to look at *how* it is being stored. The simplest storage arrangement is stock pile. Just stack the pallet loads of goods on top of one another and side by side. This works very well for uniform loads and uniform product. It makes it easy to pack and stack. But, if the parts are small or of non-uniform shape, then maybe shelves are required. Trays can be used to contain the small parts. The shelves can be adjusted to handle a variety of package sizes.

For higher storage density, pallet racks can be utilized. These racks can be single row – accessible from either side; double row – two single row racks back to back; or multiple row – four or more single row racks back to back to back. It is apparent that the more product that can be packed into a given area, the more the fuel load increases. Along with this fuel load there is the creation of chimney like spaces between the racks. These spaces are called flues. These flues are between the racks and between the pallets loads. They channel the heat of a fire upwards like a chimney which speeds up the flame front. This phenomenon promotes flame spread, entrains air to the fire and creates a much hotter, fiercer fire to extinguish.

How High Is the Product Being Stored?

Stockpiles are self limiting. Stack product too high, and the lower boxes crush under the weight. Or stack product too high and the loads may become unstable and topple. The answer to this dilemma is to install pallet racking. An open metal frame that allows product to be stored up to one hundred feet high! Pallet racking is limited in height by the clear heights (floor to ceiling joists) of the building. Storage heights are also limited by the industrial lift trucks lifting capacity. A fork lift that can lift twenty feet, cannot fill a pallet rack at twenty four feet. Again, the thought of storage height is to determine how much fuel is available. The higher the storage the more the fuel.

Building Height?

Storage height leads directly into the height of the building. At one time the typical industrial building was sixteen feet high. This didn't allow for storage much beyond twelve feet. But buildings are now being built thirty five and forty feet high. This allows for a maximum storage height of thirty to thirty five feet. But what if the fork lift is the limiting factor? If the storage is only twenty feet high and the roof deck is at forty feet, this leaves twenty feet of space between the top of storage and the sprinklers. If this space is too large, then the effectiveness of the fire protection system diminishes greatly. On the flip side, should the building be too short and the storage too high, then the sprinklers will be obstructed and once again become impaired. But this leads to another question – if the building has thirty five feet available for storage, but the current storage arrangements are planned for twenty feet, what height of storage should the sprinklers system be designed? If anything has been learned so far, things change. Sooner or later that unused space will be filled. If the system was designed for twenty foot high storage, it will be over taxed when the storage heights increase.

Is There Water?

Unless the system has its own tank or reservoir, the water supply for the fire protection systems is probably out of the hands of the building owner.. Many systems have a booster pump to augment the water pressure provided by the municipality. Booster pumps require weekly operation and annual testing. Annual testing will help to determine the water supply adequacy for the building. Over time, as new neighbors move in to adjacent buildings, as cities grow and there is a greater demand on the water supply, city water pressures usually decrease. A sprinkler system properly installed twenty years ago, can actually be inadequate today because of a weakened water supply. Your sprinkler contractor and insurance company loss control can assist in this determination.

The "Brick"

Imagine that a company manufactures bricks. A brick will not burn so it is a CLASS I commodity. These bricks are being shipped to customers but there is a high level of breakage in transit. The company decides to ship the bricks in double thick corrugated boxes. They pack the bricks in the boxes and put them on a pallet. Without knowing it, they have just taken the Class I commodity and have now created a Class II commodity. The boxes were a good idea but the bricks are still being received broken and chipped. So management makes the decision to wrap the bricks in heavy kraft paper and put fewer bricks in the boxes. Once again the commodity class has jumped up to a Class III. These bricks are still being warehoused in the same place. But no one has considered the increase in fuel load on the sprinkler systems. Fewer bricks are being broken now but the amount of breakage is still unacceptable. So they abandon the kraft paper and use blister pack and styrene peanuts. What was once a Class I product is now a Class IV !!! The moral here is that the 'product" isn't just what you are making. It is the packaging as well. In this example the protection requirements aren't based on the original product (the brick), but the overall product on the pallet. Namely the brick, the double thick box and all the plastic dunnage.

A Company's Evolution

Over time as a business grows, the amount of raw material needed grows. The amount work in process grows. And the amount of finished goods grows. This material takes up space and needs to be put somewhere. Maybe the building can be expanded to meet this growth. If there is no land for a planned expansion, or money for an addition, then more material will have to be stored in the same amount of floor space. The only way to do that is to store higher and deeper. Pallet racks replace shelves, flow through racks replace single row racking and multiple row racks provide the highest storage density. The result is that storage heights start reaching the ceiling and aisle spaces shrink. But what hasn't grown? What hasn't expanded to meet the newest challenge? - The fire suppression systems. The sprinklers that were installed when the building was built.

A sprinkler system that was originally designed for stock pile storage of a particular product will be incapable of adequately protecting rack storage of the same product. A sprinkler system originally designed for twenty foot high rack storage of a product will not adequately protect rack storage to twenty four feet in height. A sprinkler system designed for twenty foot rack storage of Class II commodity will not be able to protect similar twenty foot rack storage of Class III commodity. As plastic pallets replace wood pallets, sprinkler system demands will also be increased. So as any company grows and the eventual variety of internal changes occur, the overlooked effects of these changes on fire protection could be devastating in the event of a fire loss.

Without giving it a thought, the day to day changes put increasingly greater demands on a safety system. Risk managers and company safety committees look for machine guards and unsafe act and conditions. But they have neither the training nor the understanding of how a fire sprinkler system functions and protects lives and property.

Conclusion

What to do? Where to go? The first thing to do would be to gather some data and look at the storage arrangements then (when the building was built) and now (after years of alterations). Have the storage arrangements changed? How have they changed? Was it stockpile? Were solid shelves installed? Did the storage get higher? Make note of the changes in arrangements. Now address the product. Has the commodity changed? Did the manufacturing expand to include both metal and plastic processing? What once was paper is now plastic? Has the packaging changed? Again make note of the composition of the product and its packaging. These basic questions will be needed to assess the adequacy of protection. Who will make that assessment? Time to get help.

Help comes in many forms, but the most available would be your sprinkler contractor. This is the company you have on contract to test the systems quarterly. The sprinkler contractor will be able to compare the current level of fire protection and the current storage arrangements and make some conclusions on the suitability of the fire protection. In fact, this is something sprinkler contractors do all the time. Another great resource of help is your property insurance company. Many insurance companies have a loss control department. These loss control representatives are normally trained in fire prevention and risk management. They will also be able to assist in determining the adequacy of a suppression system. Let's not discount your own insurance agent. Many insurance agencies also have loss control personnel. They will be able to assess and direct a company for additional assistance.

As can be seen, many things have a direct impact on fire protection. The product, the packaging, even the storage arrangements. They are all intertwined. So much so that a building that is “Fully Sprinklered” truly does not mean that it is “Adequately Protected.”