PRE-INCIDENT PLANNING FOR FIRE EMERGENCIES INVOLVING STORAGE IN RACKS AT HEIGHTS OF 25 ft (7.6 m) OR GREATER

INTRODUCTION

As a result of test work and actual loss experience, it is generally recognized that specialized automatic fire protection is required for combustible storage in racks because the open configuration of combustibles enhances rapid fire development. Of comparable importance, however, to this need for fixed protection are procedures and capabilities for achieving final extinguishment and prompt salvage. Thorough and detailed pre-fire planning is essential. This guideline focuses on racks above 25 ft (7.6 m) since racks at this height usually have narrower aisles, typically 4 ft (1.2 m) due to the use of stacker cranes or retrievers. Nevertheless, many of the following considerations apply equally to all rack configurations.

Many large scale fire tests established the type and degree of sprinkler protection needed to achieve fire control in various heights, arrangements, and classes of storage. Other information has also been developed from this program which is of great significance in estimating the overall loss potential and evaluating the effectiveness of the facility's emergency response team members (plant emergency organization) and fire department activities.

Despite the presence of properly designed sprinkler systems for the storage occupancy, complete extinguishment requires the use of multiple hose streams. It should be recognized that it is quite impossible for a firefighter to stand on the floor in a narrow aisle and completely extinguish residual fires in the upper levels of a high rack structure. In every large scale fire test, it was necessary to elevate one or more firefighters by some means in order to secure extinguishment through close-proximity, direct application of small hose streams. As rack heights exceed 25 ft (7.6 m) and aisle widths narrow down to 4 ft (1.2 m) or less, initial and final firefighting efforts become more difficult. A capability for applying hose streams to the upper portions of the rack must be available. Methods will have to be developed for each case to accomplish this necessary objective. It is very evident that total reliance must be placed upon the sprinkler system to bring a fire under control. Should a sprinkler system be out of service or the water supplies fail to function properly, a fire of disastrous proportion can be expected.

Stock in and around the fire area is likely to fall from the racks, constituting a safety hazard to firefighting personnel. This potential will exist even after the fire is controlled because it results from three possible actions:

- Fire damage to containers, wrappings, fastenings, pallets, or rack members;
- Absorption of water by the commodity, causing overloading of containers, pallets, or rack members;

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- Actual water-softening of cartons or wrappings so that contents are able to spill forth.

Before final hand extinguishment can be achieved, other steps are required:

- Operation of sprinklers for a time period after fire control to reduce environmental temperature to a point that would permit firefighters to operate in the area.
- Application of smoke venting procedures to produce needed visibility for firefighters.
- Removal of debris and stock which has fallen into aisles from overhead racks.

Even if all sprinkler systems, water supplies, emergency response team members and public firefighters perform with 100% effectiveness, the normal loss expectancy may be out of proportion with that normally associated with a "protected property." The property damage loss can be broken down as follows:

- **Fire damage to stock**: Following establishment of value of stock per square foot or square meter of floor area, an area of racks is assumed to be damaged by fire and appropriate salvage is credited. The floor area can be assumed to be in the magnitude of 1500 ft^2 (140 m^2).
- **Water damage to stock**: Take an additional area for water damage twice that damaged by fire.
- **Smoke, heat, and high humidity damage to stock**: Include those goods outside of the fire and water damage areas. Base the loss on degree of susceptibility of the commodity and packing methods. The loss can range from very minimal, as would be expected for metal parts, to 100% when associated with food products or pharmaceuticals.
- **Building and equipment damage**: Includes cleaning and repainting of the structure, as well as possible damage to the material handling system, i.e., retriever, stacker, racks.

POSITION

As can be seen from the following fire chronology, the time available for manual firefighting efforts in the initial stages of the fire is extremely limited. Accordingly, prompt and well-organized response from the emergency response team or fire department is essential. A well developed and clearly-defined pre-emergency plan of action should be developed, preceding the actual emergency.

Discovery

Upon discovery by the means of either a waterflow alarm, visual detection by an employee; or by a smoke detection system (products of combustion, rate-of- rise, or infrared), the alarm should summon the public fire department and the emergency response team and initiate evacuation of all personnel from the area except for firefighters. The material-handling equipment should be removed to a location remote from the fire. All equipment and any associated conveyors should be shut down.

Initial Fire Progress

As the fire growth progresses, the emergency response team has some responsibilities and actions they should follow. These responsibilities should be preassigned to specific individuals and include the following:

- Closing fire doors to adjacent building areas.
- Verify that sprinkler and water supply valves are open.
- Verify all fire pumps are in satisfactory operation, and maintain surveillance in pump room.
- Shut down natural gas or fuel oil supplies to fire-involved area.
- Send an electrician to the substation to deactivate breakers, without interrupting power to the fire pumps.

The emergency response team's action could include:

- Laying out hose and applying hose streams to attack the fire. (Note: Hand extinguishers become ineffective once the fire involves stock in racks.)
- Removing combustible and hazardous materials from adjacent building or yard areas.

Control Established

With correct sprinkler design and operation, control probably can be made within 30 min. Through visual or other positive means of identification, it must be established that fire progress has been arrested before final extinguishing actions can be taken. Even then, sprinklers should be retained in operation for an additional 30 min period. During this waiting period, public and private personnel and equipment should be marshalled and coordinated for effective action in final extinguishment and salvage phases. This would include items, such as additional hose streams, ladders, forklift trucks, and dump trucks for hauling away debris.

Final Extinguishment

Several hours may be needed for this phase. When ready to proceed with final extinguishment, the following steps should be initiated:

- Effect maximum ventilation.
- Send in a two-man or larger team with self-contained breathing apparatus for final verification that fire is under control.
- Shut off overhead sprinklers, but retain in-rack sprinklers, if provided, in operation. Station personnel at all closed sprinkler valves, so sprinklers may be quickly reactivated should flare-ups occur.
- Employ hose streams or other means to extinguish residual fire.
- Remove debris from aisles and from rack as necessary to achieve effective overhaul.

Salvage

It must be anticipated that all stock in the fire area has been damaged. Initial salvage operations should be concentrated on stock primarily subject to water, smoke, heat or humidity damage. Prompt handling, repackaging, and deodorizing of this stock offers the greatest possibility of salvage.

DISCUSSION

The complex problems involved with fires in high rack storage require the creation of a well-defined emergency program and realistic drilling of emergency response team members. For instance, in the initial stages of fire development after discovery, it is likely that there will be only 10 min – 15 min during which manual firefighting can take place. With this fact in mind, it is obvious that interior hose connections must be readily available and response time to a fire alarm practiced until maximum results are achieved. A realistic goal would be the application of at least two 1½ in. (40 mm) hose streams to any fire location within 5 min from the time the alarm is received.

The actions to be taken after fire control has been achieved are equally important. As noted, extinguishment by sprinkler operation alone cannot be expected. Manual overhaul is a necessity. Plans must include arrangements for safely and effectively overhauling stock in high racks. Hose streams applied from the floor will not be sufficient. Sole reliance for stock removal should not be placed on operation of the stacker crane or retriever. This may be rendered inoperative by fire or water damage to the unit or its wiring, by rack and rail distortion or by blockage of aisles from collapsed loads. Forklift trucks, on the other hand, cannot operate effectively in the narrow aisles that are often encountered. In some instances, it may be necessary to utilize timbers to span aisles and form supports for extension ladders. In other arrangements, the use of equipment with articulated booms or “cherry-pickers” may be feasible if sufficiently wide cross aisles are available. Small, hand-held, high expansion foam generators may be effective in extinguishing residual fires in flue spaces and ensuring safety of personnel from sudden fire outbreak during removal of burned pallet loads.

It is not possible to delineate specific equipment or arrangements needed for all rack storage facilities. The firefighting and salvage problems must first be recognized by plant and fire department personnel. Once this is achieved, then a joint planning committee can tailor their program and equipment needs to the physical configuration of the building, the class of storage involved, and their own inherent capabilities. Beyond the basic protection of sprinklers and hose streams, there is room for ingenuity and original thinking. Make maximum use of the talents of the facility's engineering and mechanical staffs in arriving at new approaches. Unique or unusual solutions should be passed along to AXA XL Risk Consulting for review and comments.

Effective salvage techniques will also be governed by the amount of planning given to the particular stock involved; its susceptibility to heat, water, or smoke damage; the best means for recovery; availability of equipment and materials needed; and the education of personnel in the best methods of salvage.