HCI Systems, Inc.
Software Solutions

Damage Limiting Construction – Part 5 The Effects of Airborne Objects

Damage Limiting Construction- Part 5. HCI Systems, Inc.

If you are just starting with this article on Damaging Limiting Construction, please go to my LinkedIn page and also read Parts 1 through 4. This Part 5 topic will discuss the effects of airborne objects.

So if you are following this series, you now see from the photo on the left that the fire ball that started in a different building made its way to the main building via the material handling conveyor system. There are many things to point out here, but I want to focus on the roof panels for now. These were pre-cast concrete slabs that weigh-in about 4000 LBS each. They are roughly 4 FT by 10 FT. In order to lift this panel off its support clips, the uplifting pressure had to be at least 1 PSIG. So where did they go?

It was said that witness testimony stated that the event sounded like "All Hell Was Breaking Loose". Considering the mass of these panels and the vertical drop distance of approximately 100 FT, well it must have sounded like bombs going off, about 100 or so, laying a path of destruction as they fell to earth. So the suggestion here is to consider uplift as part of the roof slab support system. The second thing is to create sections of less-dense roof panel material as relief panels to control the overpressure event. Yes, this is damage limiting construction.

The photo on the right shows that building siding became projectiles as well. And, in this event, landed on main and auxiliary transformers and shorted them out. The plant went "dark". Back-up battery systems were called to duty as essential service generator systems began to boot-up. But it was too late. Loss of seal oil on the generator released hydrogen which ignited blowing-out masonry walls at grade.

Now let's get to the fire protection system. With all this going on and numerous residual fires throughout the plant, the single gasoline engine driven fire pump rated at 1500 GPM did not have a chance. It was severely undersized. Fire fighting efforts were crippled due to the lack of water. Fire departments had to truck-in water and later drew suction from the cooling pond. So what size fire pump is needed? To answer that question, some background on the types of fire protection systems available will need to be explained.

- A wet pipe sprinkler system, as it suggests, is full or water. Used mostly for office buildings, hotels, commercial buildings, etc.
- A dry pipe system, as it suggests, is empty with no water. It may or may not have supervisory air pressure. Used mostly where wet pipe system would freeze.
- A pre-action system is like a dry pipe system but uses a fire detection system as the activating component.
- A water spray or deluge system uses spray nozzles or open sprinklers that discharge all at the same time. It uses a fire detection system as the activating component or via a manual activation system.

We will group our material handling system into three (3) categories:

1. Buildings
2. Material conveying systems
3. Material handling equipment

For buildings, wet, dry or pre-action type will work. For material conveyor systems, you have two (2) scenarios. One is an enclosed structure with open conveyors. the other is an open structure with hooded conveyors. If the structure is enclosed, use a pre-action system with sprinklers at the roof. If the conveyor is hooded, use a deluge system for the upper and return belts. Now the bad news, the ignition temperature (energy) for a dust cloud is generally not detectable by a thermal fire detection system. As this fact sinks-in, the real question should be "can your fire protection system make it through the fire ball event?"

The system must be designed to handle the "seismic" event. Minimize the use of friction beam clamps. Otherwise the blast, could cripple the fire protection system or rob water from the fire pump. Other suggestions:

1. Do not install your control valves in the hazard area it is intended to protect. No one is going to run into a burning structure to trip the valve. Use a valve house at least 50 FT from the building.
2. Avoid running your fire main piping for one area through another area.

3. Make sure you have fire hydrants and hose reels a safe distance outside the structure.
4. Include remote operation of all fire protection control valves from the central fire control station.
5. Consider the use of manual pull box stations throughout the system.

For material handling equipment such as dust collectors, hoppers, chutes, etc., I have seen all four (4) types used. But be careful, for dry, pre-action and deluge, the piping is full of air and only has one exit path, through the sprinkler head or spray nozzle. Introducing forced air in a enclosed container smoldering or on fire will agitate the environment and possibly cause a secondary fire ball event on its own.

For fire pump sizing, you should consider the possibility that more than one zone could be engulfed at the same time. And, the two (2) largest demanding adjacent zones should be your minimum GPM fire system flow rate. Add to this a 1000 GPM hose allowance for the fire fighters and you start to see what these numbers add up to be.

I have designed many fire pumps in my career. All of which were at least 4000 GPM and diesel driven. This is not where you want to pinch pennies.

The above is not intended to be an exhaustive set of recommendations on the topic of fire protection for material handling systems. But, it is a start. If you would like to learn more or would like to share a specific issue or experience, please contact me at richgehse@hcisoftware.biz