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Software Solutions

Damage Limiting Construction – Part 2 Damage Limiting Construction

Damage Limiting Construction- Part 2. HCI Systems, Inc.

This article continues with the topic of damage limiting construction (DLC). If you missed Part 1, please go to my LinkedIn page to view. So the photos above show the finished project. On the left, is a view where the duct collectors at exposed to the outside and the building relief (aka, blow-off) panels which cannot be distinguished from normal stationary panels. Also one can see that an emergency escape system was installed. On the right is a shot of the blow-off panel from the inside. The panels are installed in sections and tethered to building steel. The panel sections are connected to the building steel by way of shear bolts designed to break at a predetermined force. The number and capacity of the shear bolts relate back to the design building internal pressure that we are trying not to exceed. The next variable is how much area (SF) of relief panels do we need? This is where it gets tricky.

Technical Stuff

This section is going to be technical. So unless you are using this article for PDUs or in case your boss quizzes you on this, skip to the next section. Here we go.... Combustible dusts, vapors and gases combust or burn a rate called the fundamental burning velocity (FBV). The FBV tends to increase with increasing concentrations (up to the UEL) and deceasing particle size (or liquid droplet size or hydrocarbon molecule size). Now this combustion releases energy that translates into higher temperatures in the dust, vapor or gas "cloud". This thermal expansion produces a pressure pulse or wave and expands the

volume of the cloud. It is important to note that this pressure wave is traveling at the speed of sound. This will become useful and discussed on a later article. Another term that is used is Deflagration, a "slow" moving fire ball, which is what a combusting dust, vapor or gas cloud normally is. Also when you confine a deflagration and that containment fails, we call that a physical explosion.

For a stationary observer watching an unconfined combustion event, it will appear to that observer that the flame front is accelerating. This is due to the thermal expansion effect stated earlier. This flame speed is called the apparent flame speed (AFS). This stationary observer will also feel the pressure wave which is dissipating inversely proportional to the distance from the source. So what are we saying here? We are saying even with a building which is 99% open to the atmosphere, that 1% remaining will be exposed to this unconfined pressure wave. And, if not designed to take the pressure, it will fail. Unfortunately, this is the case for many material handling systems and structures. These are called low strength structures. Please refer to NFPA 68 for more on this topic.

Back to Normal Stuff

So getting back to the relief panel area question, unless your structure is a bomb shelter, you need to come to terms that your structure is at risk of coming apart. So what do you do?

- Design your structure as a "bomb shelter"? Not cost effective unless it is intended to be a high strength structure.
- Build the structure with no exterior walls? OK, but what if you live where it gets cold.
- Move your hazardous systems to a "bomb shelter" room. Possibly. As can be seen from this article's left photo, that is kind of what was done there and then the exterior walls were removed.
- Design as much as possible the exterior walls as relief panels. That is, in many cases, the best that can be done.

Now the answers to the questions from Part1.....

1. *So what do you think happened to the stuff attached to the siding?*

It generally goes bye-bye with the panels. Unfortunately, this is usually electrical conduit and wiring to electrical equipment and controls. Be prepared to re-wire your affected panels. If you saw the photo from Part 1, this was a major issue in bringing that building back to service.

1. *If the structure was constructed of masonry or brick, would that have made the event worse?*

This was a trick question. Although masonry or brick construction may or may not have a higher strength value than panels, it will still fail. The windows will go first followed by any relief panels. Then the building will come apart. So protect any nearby critical equipment from potential falling bricks like transformers.

Damage Limiting Construction Part 3 will address pressure wave conduits, i.e., construction that actually allows the transmission of a fire ball to another part of the plant.

Questions or comments? Contact me at richgehse@hcisoftware.biz