Grain Handling Fire & Explosion Hazards For Control Engineers

Grain Handling Fire & Explosion Hazards

Review For Controls Engineers

As I find myself doing more grain elevator controls and working on adding sensors to notify the operators and shutdown equipment in order to avoid potentially hazardous situations, I thought it good to research and review the regulations and concerns surrounding grain elevator fire and explosion hazards. References are noted at the end of this article.

Grain elevator fires and explosions are fairly well documented.

Dust explosions require 5 elements to exist simultaneously to trigger a fire and/or explosion. These are:

Elements Needed for a Fire (the familiar "Fire Triangle"):

1. Combustible dust (fuel);
2. Ignition source (heat); and,
3. Oxygen in air (oxidizer).

Additional Elements Needed for a Combustible Dust Explosion:

4. Dispersion of dust particles in sufficient quantity and concentration; and,
5. Confinement of the dust cloud.

"OSHA 29 CFR 1910.272 simply titled "Grain Handling Facilities" is the primary document regulating practices in these types of facilities.

The primary controls and sensors that are being added to reduce the risk of explosions and fires are:

1. Key bearing temperature monitoring

This is noted in OSHA Standard 29 CFR 1910.272 (q)(4)(ii) where it states: "Provide vibration monitoring, temperature monitoring, or other means to monitor the condition of those bearings mounted inside or partially inside the leg casing".

2. Belt alignment sensors (or belt rub blocks with temperature monitoring)

This is noted in OSHA Standard 29 CFR 1910.272 (q)(6)(i) where it states: "The employer shall: Equip bucket elevators with a belt alignment monitoring device which will initiate an alarm to employees when the belt is not tracking properly; or, Provide a means to keep the belt tracking properly, such as a system that provides constant alignment adjustment of belts".

3. Conveyor slow down sensors.

This is noted in OSHA Standard 29 CFR 1910.272 (q)(5) where it states: "The employer shall equip bucket elevators with a motion detection device which will shut-down the bucket elevator when the belt speed is reduced by no more than 20% of the normal operating speed".

Section (q) applies to "Inside bucket elevators" which are defined as …a bucket elevator that has the boot and more than 20 percent of the total leg height (above grade or ground level) inside the grain elevator structure. Bucket elevators with leg casings that are inside (and pass through the roofs) of rail or truck dump sheds with the remainder of the leg outside of the grain elevator structure, are not considered inside bucket elevators".

Another point worth noting is that OSHA (in section (q)(4) does not require bearing temperature monitoring if the bearing is not mounted "inside the leg casing". All of the bucket and belt conveyors I've worked with had the bearings outside of the conveyor casing or enclosure and yet they have bearing sensors installed in them. As for vibration monitoring in lieu of temperature monitoring, this is something I've not seen or heard about as something implemented. The reason is likely that temperature monitoring is probably more straight forward.

Many in the industry believe that OSHA will be strengthening these requirements to automatically shut down equipment not only if the speed of the bucket elevator slows down, but also if the bearing temperatures get to high or the belt goes out of alignment. Additionally these rules are also being applied to any type of belt conveyor. For drag conveyors only bearing temperatures are generally monitored. Alignment sensors and the slow down sensor are not seen as needed for drag conveyors since these are driven by a sprocket guided chain and have sensors to detect a chain break condition.

I was unable to find any information supporting the belief that OSHA will strengthen the existing requirements. I would invite the reader to comment with additional insight on this topic.

When considering the risk or fire or explosion, a big concern is secondary explosions that are caused by the dispersal of grain dust into the air from the first explosion that in many cases is more severe than the initial explosion.

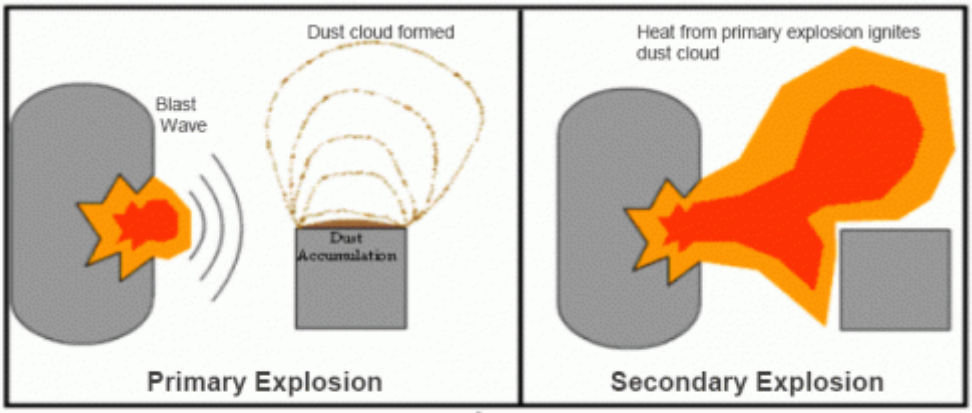

Figure 2

REFERENCES:

1. OSHA Standard 29 CFR 1910.272 (q)(4)(ii), (q)(5), (q)(6)
2. Regulatory Review Of OSHA's Grain Handling Facilities Standard [29 CFR 1910.272] http://www.osha.gov/dea/lookback/grainhandlingfinalreport.html
3. Grain Handling: http://www.osha.gov/SLTC/grainhandling/standards.html
4. Combustible Dust in Industry: Preventing and Mitigating the Effects of Fire and Explosions http://www.osha.gov/dts/shib/shib073105.html
5. NFPA 654, Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids

6. NFPA 61, Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities.

Source: http://hennulat.wordpress.com/2013/06/24/grain-handling-fire-explosion-hazards/