A blueprint for disaster

Justin Clift of Hazard Control Technologies and John Astad, Head of the Combustible Dust Policy Institute in Texas, on why complacency is not an option with dust.

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The Combustible Dust Policy Institute has reported that after researching media accounts in 2008, over 150 combustible dust-related fires and explosions occurred in the manufacturing, non-manufacturing and utility sectors in the US alone. In addition, many of those incidents were repeat fire incidents that eventually took the form of combustible dust explosions.

OSHA accident data from 1980-2005 included 350 combustible dust-related explosions or fires, and the Chemical Safety Board (CSB) concluded after looking through limited data, that there had been "197 serious industrial incidents in the US involving dust since 1980".

These are hazardous and damaging events that are generally acknowledged as being dangerously underreported.

OSHA's involvement is dependant on injury or death resulting from the incident. In addition, the utilities sector downplays explosions or near-miss events by labeling them as "puffs" – a more attractive term. On October 18, 2007, OHSA issued the Combustible Dust National Emphasis Program (NEP), revised on March 11, 2008. In April 2008, the US House of Representatives passed a Combustible Dust Bill that never made it to the Senate.

On February 4, 2009 US Rep. George Miller (D-CA), Rep John Barrow (D-GA) and Rep Lynn Woolsey (D-CA) reintroduced legislation to prevent workplace explosions. The Workers Protection Against Combustible Dust Explosions and Fires Act (HR 849) would require OSHA to issue rules regulating combustible dusts.

It is unfortunate that it takes an incident like the Imperial Sugar Explosion to address combustible dusts in the workplace. The latest combustible dust explosion incident happened this past February at a Major Utility in Oak Creek, Wisconsin; nearly one year after the Imperial Sugar tragedy.

Combustible dust poses a severe hazard to the coal power industry. Coal handling systems produce two types of dust: fugitive dust and float dust. Fugitive dust is defined as the larger coal dust particles that accumulate from leaks or spillage in and around material-handling equipment such as conveyors, transfer chutes, and unloading apparatus. Fugitive dust is often found to be the cause of a fire or an explosion when ignited through frictional heat or equipment failure. Float dust is the finer dust particles that collect on elevated horizontal surfaces. When Float dust is dispersed in the air at the minimum explosive concentration (MEC), and an ignition source is present, a deflagration will occur

First responders must be educated on combustible dust hazards. Top right: combustible dust poses a severe hazard to the coal power industry.

L-beams and coveyors belts are areas where dust collection can result in potential hazards.

that – with the right conditions – can destroy a plant, as the combustion zone propagates through the system.

It is important to understand that the "Kst" value, or deflagration index, of coal dust can increase significantly depending on the coal handling system's condition and design. Each transfer point is an impact zone for the coal, continually causing a degradation of the coal particles. The increase in surface area with the smaller particle size increases the potential for oxidation which could result in spontaneous combustion. In addition, as particle size decreases, the Kst and Pmax (maximum explosive pressure) value of the coal dust increases, while the MEC (minimum explosive concentration) and MIE (minimum ignition energy) decrease. As the coal travels further through the handling system, finer coal dust particles are produced and the likelihood for an explosion, as well as the potential magnitude, can increase substantially.

The terms and equations associated with combustible dust hazards are important for understanding explosion ventilation, magnitude, severity, and likelihood. While they are inherent to providing an overall engineering-based evaluation of the hazard, when training fire departments and emergency responders there is no need to focus on such detail. Of most importance is understanding that if you are handling a material that produces combustible dust and you do not have an adequate housekeeping program, a path of footprints may be common to everyday plant operations.

However, these are "the footprints to disaster". You may be incident-free this week, or for the month, or during a particular year, but eventually this abundance of fuel accumulating around the plant is going to lead to a major fire or explosion. It is not a matter of "if" you will have a fire or explosion, but "when".

Failure to recognize or respect potential hazards is a major problem in the power industry: plant employees become complacent with their environment – and rightfully so – but letting your guard down can be extremely costly. Allowing dust deposits to accumulate on I-beams or under conveyor belts is the equivalent of leaving gasoline in close proximity to ignition sources. Any combustible dust deposit greater than 1/32 inch needs to be cleaned up immediately in accordance with OSHA's NEP. Failure to address near miss warning events is another unfortunate problem. Often times, the plant culture reduces the seriousness of a near miss event and a whistle blower may be criticized for speaking up and seeking action.

POWER SECTOR: WHY DUST EXPLOSIONS OCCUR

– *Failure to respect potential hazards*

- Failure to address near miss warning events ("puffs")
- Failure to maintain safety systems
- Lack of maintenance of production systems
- Lack of Housekeeping Procedures
- Complacently leads to human error

– *Lack of proper engineering and design*

- Lack of technical expertise
- Failure to comply with NFPA standards
- Lack of documentation, hazard analysis or review on design modifications

– *Lack of preparedness*

- Lack of procedures or training for abnormal operations
- Failure to plan for emergency response
- Failure to prepare community for emergency (FD)
- Common sense is not that common

Proactive plants learn from their near miss events, as well as from others reported in the industry, and take appropriate corrective action. Reactive plants make the minimal adjustments to their operating systems, hesitate to share hazard reports with employees, and fail to educate workers and subcontractors on safety and preventative measures. Plant officials must decide to take conscientious action, and remedy their combustible dust hazards with appropriate equipment and training, directed at fire suppression, detection and prevention systems. First Responders must be educated on combustible dust hazards, including the use of proper suppression techniques and equipment, to safely deal with fires in the coal handling system. Fire detection equipment such as CO monitors and smoke/heat detectors should be placed throughout the coal handling system, silos/bunkers and dust collectors. Officials must commit to an ongoing training regime, so that employees are fully aware of housekeeping and hazard prevention methods, and how to recognize potential threats.

The lack of following-through on proper engineering and design of the explosion ventilation, fire detection and suppression system is risky business: the low bid is typically not the best system solution, and could be an indication that the contractor has little or limited knowledge concerning coal handling hazards. A contractor

that designs and installs fire suppression and detection systems in commercial buildings is not necessarily qualified to design and install a system capable of addressing the hazards inherent in a coal handling system. The last thing you want is a fire system that does not detect or extinguish fires, because it was poorly designed, installed, and maintained.

An example of poor design adaptation would be a closed head, dry system. It is the most common yet least preferred; even though NFPA 850 allows either open or closed types to be installed. The problem is that these systems activate upon detecting a temperature increase, and the first thing out of the nozzle is a release of pressurised air followed by water or a proportioned suppression solution. Before the agent reaches the nozzle the pressurised air will have dispersed combustible float dust particles from the nozzle and surrounding pipe surface into the air. When teamed with the heat source that triggered the alarm, an explosion occurs immediately following activation. Spot thermal detection is not effective as a stand-alone detection method and only appropriate when coupled with CO monitors, linear heat detection or infrared detection technology. Some coal handling systems may not even have fire suppression or detection systems in place in the transfer points where conditions are constantly suitable to produce fires.

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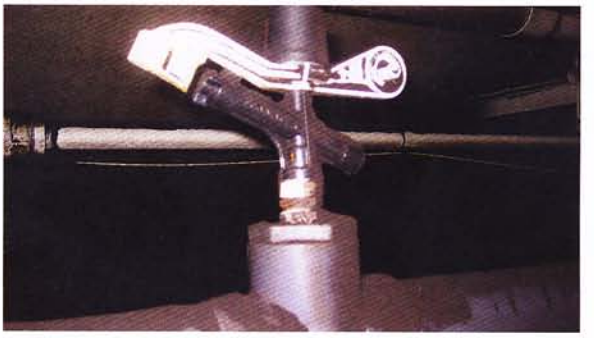
The lack of preparedness is the biggest contributor to the occurrence of dust explosions. Plants may purchase the best detection equipment on the market and have the specified fire suppression agent on hand, but ignore the need for professional training of key personnel on combustible dust hazards. Often times when a fire is detected, emergency response procedures (if they exist) are left on the bookshelf, or marginally applied. This increases the chance that human error will adversely contribute to an explosive event. Due to high turn-over or an aging work force, new-hires and newly-promoted employees replace seasoned veterans, and without training and work instructions, most of that experience is lost forever. The new, inexperienced employees may not be aware of the potential hazards, nor appreciate the devastating results that ignoring such hazards could produce.

Old school thinking dictates that each generation must learn from its own mistakes, but there is no room for error with combustible dust. To prevent events from occurring, plant officials must educate new employees on every aspect of combustible dust biannually. It is the responsibly of the plant's safety officials to seek professional outside training and to provide a library of information on facility procedures, potential hazards, and previous incidents in both the plant as well as the industry. This approach may be the best prevention and preparedness technique available.

Many power plants rely on an internal fire brigade, supported by a municipal fire department. While these fire departments acknowledge these coal burning plants in their responding area, many times they don't have adequate training for responding to events involving combustible dust. While having the fire department visit the plant for a BBQ and a tour can be an effective team-building exercise, it does not replace thorough awareness and training on specific and unique threats to safety. Power plants can be very confusing and disorienting to someone that does not frequent them, there are a multitude of stairways and ladders, and the equipment is not always where it's supposed to be located. The fire department needs to conduct high speed training and



Combustible dust deposits on an in-house washdown system. The PVC piping means that any slight movement could cause a cloud of combustible dust.

coordinated action plans with the plant on a regular basis. It is relying on a false sense of security for plant officials to depend on the local fire department to extinguish a fire they know little about, in an environment with numerous, undisclosed hazards, and with minimal assistance from safety personnel. This is exactly what happened last year in Stockton, CA, when a silo fire led to a dust explosion that injured six fire fighters.

Even with a thorough understanding of what leads to a combustible dust explosion, and in how to prevent, suppress, and detect an oncoming hazard, is not going to eliminate the occurrence of such events. Plant officials have been aware of the hazards for over 30 years. However, it is in the proactive sharing of experiences, incidents and information with employees, contractors, and the local fire departments that best serves to prevent an event from occurring at your plant. The industry itself operates in a unique manner, often times an explosion may go unnoticed by many, even with employees in the same company. This regrettably, prohibits other utilities from learning about previous mistakes, and in adopting best practices as a result.

The fact that over 150 dust explosions or fires occurred in 2008 is an unacceptable statistic contributing to a dangerous trend. The information and technologies to prevent these events is readily available from knowledgeable vendors and experienced consultants. As technology advances and older plants venture into the 21st century, plant upgrades are essential. These upgrades must be included in the plant training regimen, fire suppression capabilities, and fire/hazard detection equipment. It is recommended that plants seek professional assistance in preventing such incidents, obtain a hazard analysis report, install the new detection equipment that may have inadvertently been assigned a lower priority, and educate all employees along with the local fire department. Understand what your plant might lack or need to improve and see what you need to do to ensure the earliest possible detection of potential hazards. As knowledge and technologies advance, plants need to keep current, so that their employees are as safe as possible. Because, complacency as a cost all of its own.

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