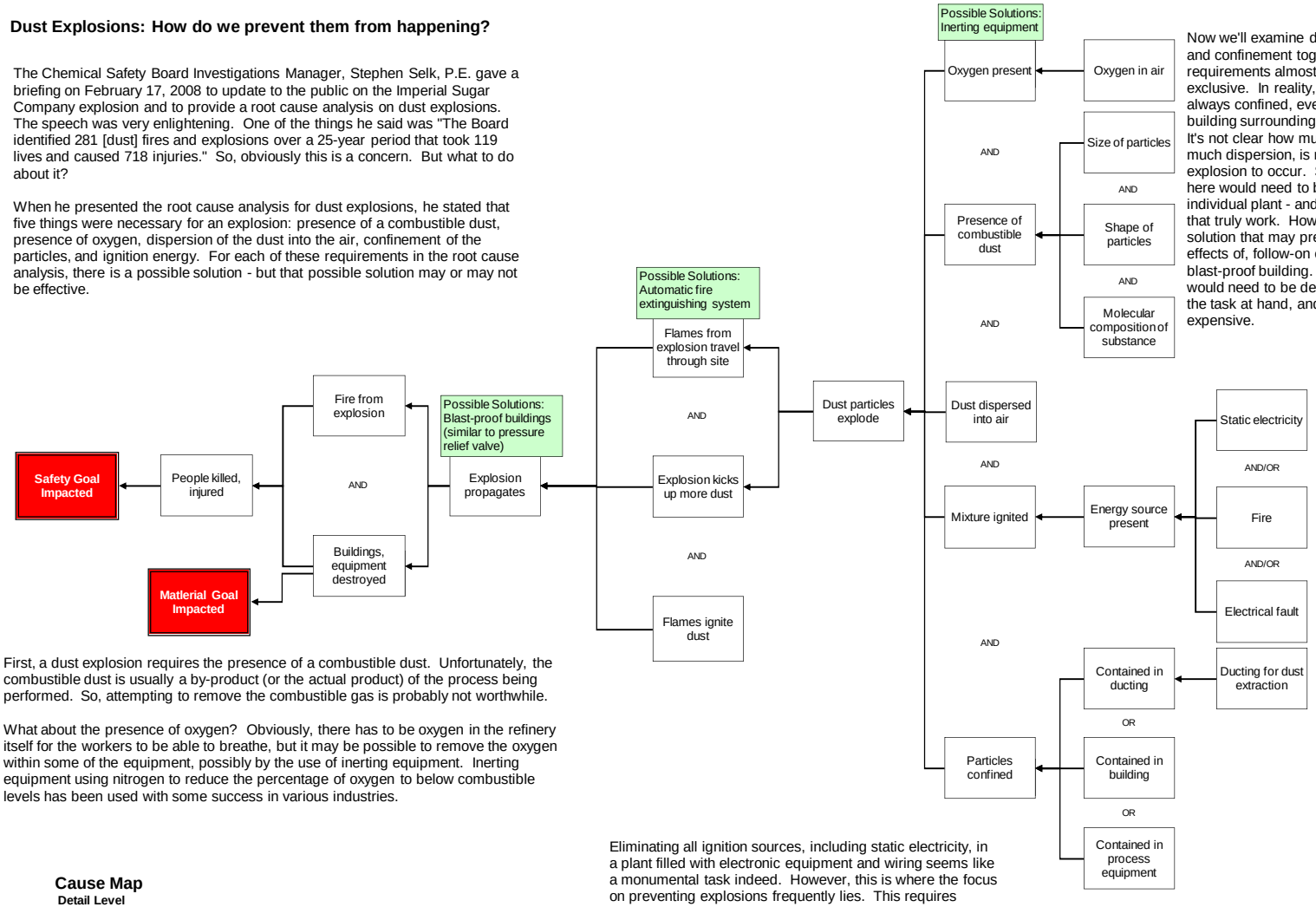
Dust Explosions: How do we prevent them from happening?

The Chemical Safety Board Investigations Manager, Stephen Selk, P.E. gave a briefing on February 17, 2008 to update to the public on the Imperial Sugar Company explosion and to provide a root cause analysis on dust explosions. The speech was very enlightening. One of the things he said was "The Board identified 281 [dust] fires and explosions over a 25-year period that took 119 lives and caused 718 injuries." So, obviously this is a concern. But what to do about it?

When he presented the root cause analysis for dust explosions, he stated that five things were necessary for an explosion: presence of a combustible dust, presence of oxygen, dispersion of the dust into the air, confinement of the particles, and ignition energy. For each of these requirements in the root cause analysis, there is a possible solution - but that possible solution may or may not be effective.



First, a dust explosion requires the presence of a combustible dust. Unfortunately, the combustible dust is usually a by-product (or the actual product) of the process being performed. So, attempting to remove the combustible gas is probably not worthwhile.

What about the presence of oxygen? Obviously, there has to be oxygen in the refinery itself for the workers to be able to breathe, but it may be possible to remove the oxygen within some of the equipment, possibly by the use of inerting equipment. Inerting equipment using nitrogen to reduce the percentage of oxygen to below combustible levels has been used with some success in various industries.

Eliminating all ignition sources, including static electricity, in a plant filled with electronic equipment and wiring seems like a monumental task indeed. However, this is where the focus on preventing explosions frequently lies. This requires constant and careful inspection of all wiring and potential power sources. Another consideration is that fire is a potential ignition source. If preventing ignition is to be the primary way to avoid dust explosions, automatic fire extinguishing systems should be considered.

Now we'll examine dispersion of the dust and confinement together. These two requirements almost seem to be mutually exclusive. In reality, the particles are always confined, even if it is only by the building surrounding the processing plant. It's not clear how much confinement, or how much dispersion, is required for an explosion to occur. So, specific solutions here would need to be tailored for each individual plant - and there may not be any that truly work. However, there is one solution that may prevent, or lessen the effects of, follow-on explosions. That is a blast-proof building. This solution, too, would need to be designed specifically for the task at hand, and may be prohibitively expensive.

Preventing dust explosions is a daunting task. But we see as we examine the statistics - 281 fires and explosions over 25 years, many of them destroying lives and buildings - it is something that must be done. Once we have completed the root cause analysis, we can look for solutions and then set about implementing them.

Cause Map
Detail Level

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Why?

Effect ← Cause

NOTE: Read the Cause Map from left to right with the phrase "Was Caused By" in place of each arrow.