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Example[1] Root Cause Analysis Report

Focal Point: Two Fatalities

Report Number: CSB: No. 2011-4-I-TN
Report Date: 01/10/2012

Problem Statement

Focal Point 2 Fatalities

When
Date: 01/31/2011
Time: 5:00 a.m.
Unique Timing: After requesting that a motor be restarted

Where

Facility:	Hoeganaes Corporation: Gallatin, TN
Component/System:	Bucket elevator #12 and motor
Materials:	Iron dust - 45 to 150 microns

Impact

Safety:	2 Fatalities; potential, multiple fatalities and injuries
Revenue:	Unknown, but likely substantial
Cost:	Unknown, but likely substantial
Publicity:	Severe negative impact
Frequency:	Multiple flash fires occurred in the history of the plant, but none were fatal until 1/31/2011

Cause and Effect Summary

On January 31, 2011 at around 5:00 a.m., the company experienced an incident that led to two fatalities. Two employees were severely burned in an iron dust fire. The employees were wearing fire protective clothing, however this was not adequate protection due to the temperature of the fire, the contact time with the fire, and the proximity of the employees to the fire.

The two employees had been sent to repair a conveyer belt motor that had tripped. Upon examination of the system, the employees did not find an obvious problem. One employee radioed the control room to attempt to restart the motor. This triggered an iron dust fire that immediately engulfed the two workers.

[1] Note: This is an example only! The sole source of information for this report is the CSB report number No. 2011-4-I-TN and the accompanying video *Iron in the Fire*. Both are located on the CSB website: www.csb.gov

When the motor was restarted, it caused vibration in the surrounding equipment. This vibration mobilized a large amount of iron dust that had settled on the equipment and surrounding structures into the air. This dust encountered an ignition source - likely exposed wiring for the motor - and immediately ignited. It is unknown why the wiring had been left exposed. The team also discovered that the motor was not grounded properly, which could have contributed to the ignition.

Tons of iron dust is deposited throughout the entire facility. The facility was not designed according to dust management best practices and therefore has many flat surfaces that can gather dust in areas where cleaning is difficult.

The iron dust comes primarily from multiple sources in the dust handling system that are not completely sealed. Also, dust comes from open conveyor systems. The dust collection system is down frequently due to mechanical failures.

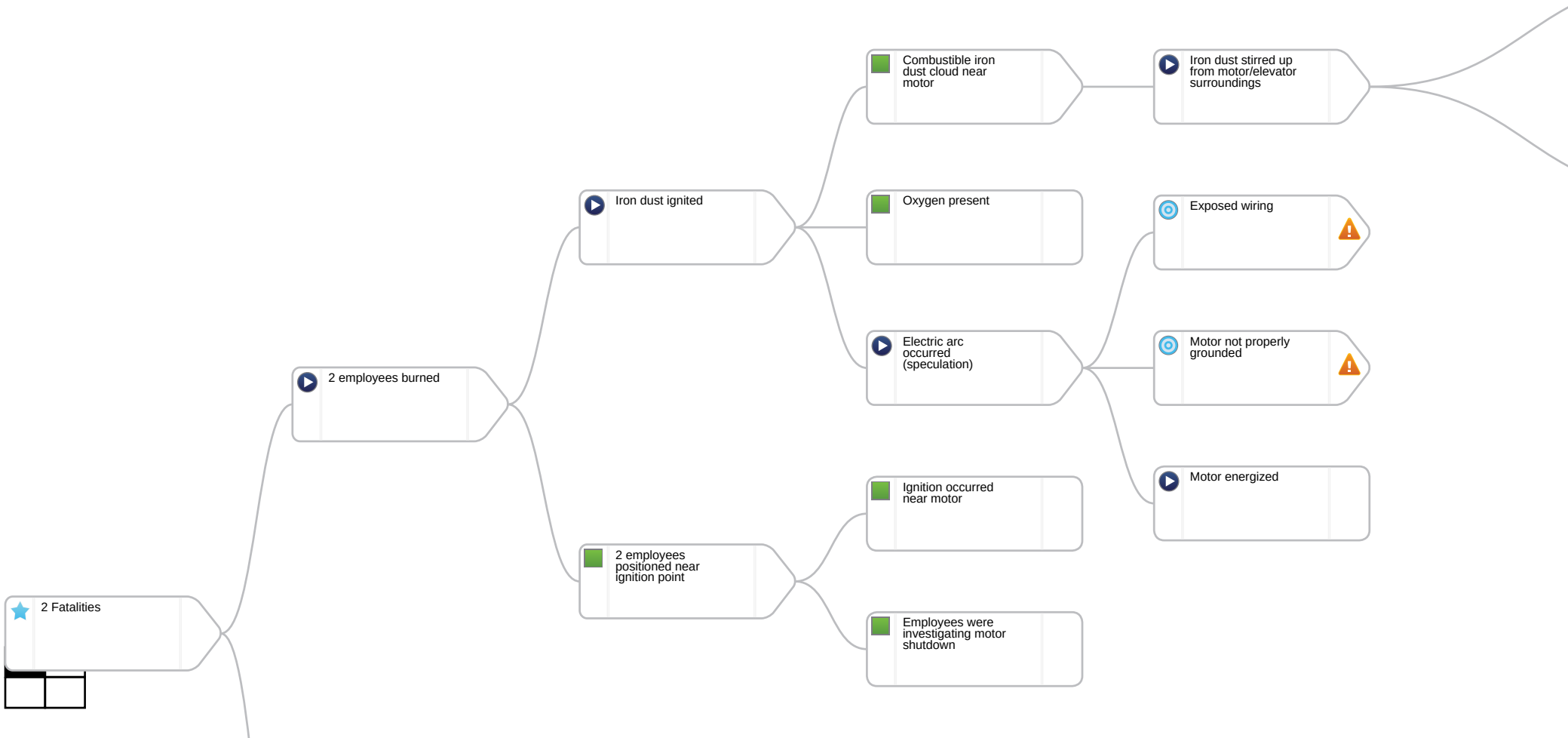
There are regulatory gaps and loopholes that prevent oversight of this type of production facility. OSHA is in the process of writing standards for combustible dust, but they have not been finalized or released yet.

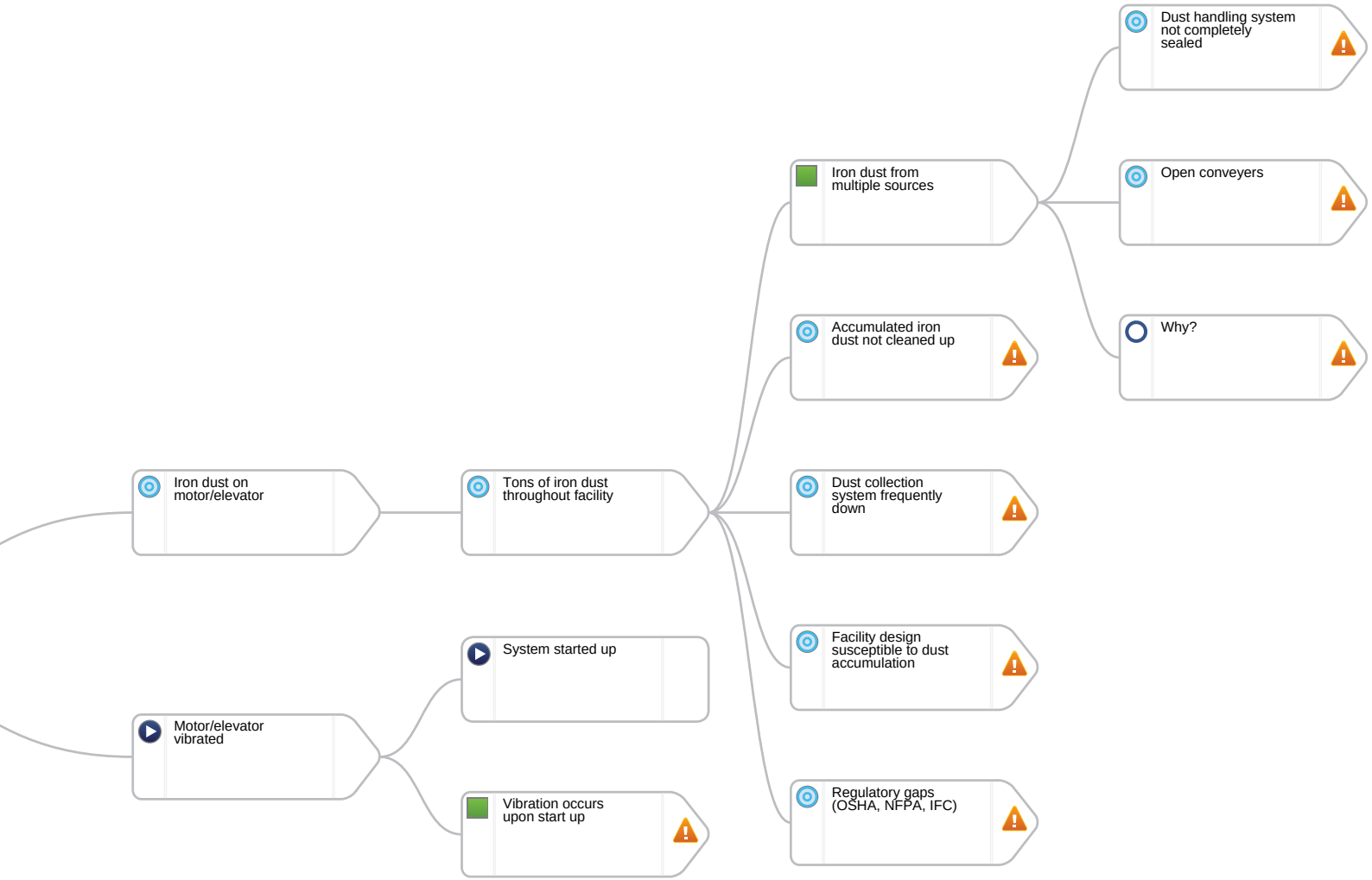
Solutions

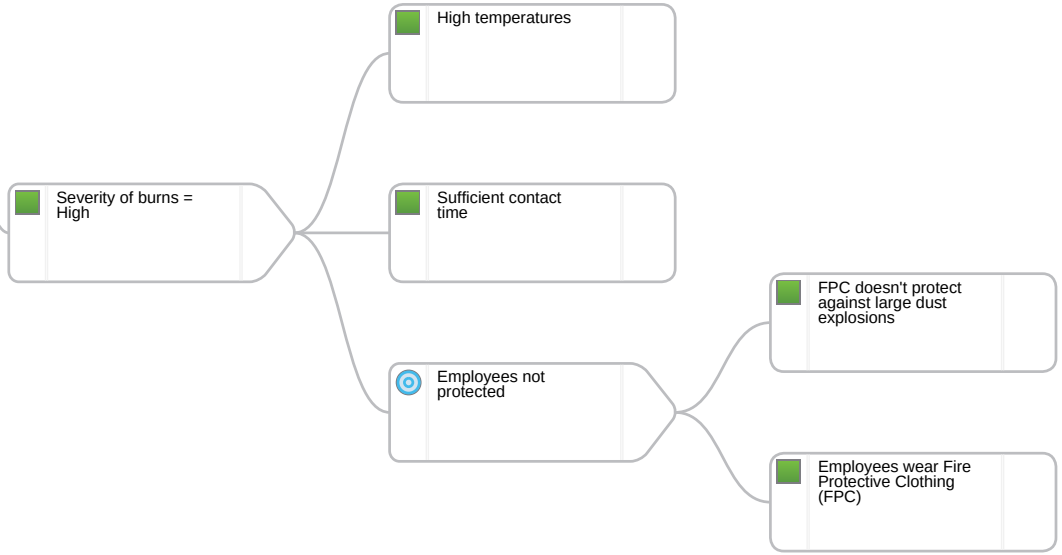
ID	Label	Detail
1	**Cause:**	Dust handling system not completely sealed
	Solution:	Identify and seal leaks in dust handling system.
	Assigned:	Hoeganaes Corporation: Gallatin, TN
	Due:	No due date assigned – example only!
	Term:	Medium
	Notes:	If the sources of the dust are identified and mitigated, less dust will escape. Recommend accounting for the primary contributors, ranking them from largest to smallest, and then getting to work sealing up the largest contributors.
	Est. Cost:	No estimated cost available – example only!
2	**Cause:**	Open conveyers
	Solution:	Replace with closed conveyers, or modify existing so they are enclosed
	Assigned:	Hoeganaes Corporation: Gallatin, TN
	Due:	No due date assigned – example only!
	Term:	Medium
	Notes:	This solution works in conjunction with #1 above. Open conveyors will likely be one of the largest contributors of dust.
	Est. Cost:	No estimated cost available – example only!
3	**Cause:**	Accumulated iron dust not cleaned up
	Solution:	Implement housekeeping practices and standards
	Assigned:	Hoeganaes Corporation: Gallatin, TN
	Due:	No due date assigned – example only!

ID	Label	Detail
	Term:	Short
	Notes:	This solution works in conjunction with #8 below.
	Est. Cost:	No estimated cost available – example only!
4	**Cause:**	Dust collection system frequently out of service
	Solution:	Conduct dynamic analysis into dust collection system outages
	Assigned:	Hoeganaes Corporation: Gallatin, TN
	Due:	No due date assigned – example only!
	Term:	Short
	Notes:	This is not a solution per se, however a dynamic analysis to identify common causes of dust collection system outages would provide a roadmap for how to address the reliability issues the system is currently experiencing.
	Est. Cost:	No estimated cost available – example only!
5	**Cause:**	Facility design susceptible to dust accumulation
	Solution:	Develop a plan to improve the dust accumulation properties of the plant design
	Assigned:	Hoeganaes Corporation: Gallatin, TN
	Due:	No due date assigned – example only!
	Term:	Medium
	Notes:	The CSB report notes that this facility is 30 years old and was not designed with dust handling best practices in mind. Identifying opportunities to reduce the susceptibility of the facility to accumulate dust.
	Est. Cost:	No estimated cost available – example only!
6	**Cause:**	Facility design susceptible to dust accumulation
	Solution:	Consider building a new facility
	Assigned:	Hoeganaes Corporation: Gallatin, TN
	Due:	No due date assigned – example only!
	Term:	Long
	Notes:	This is obviously a long-term solution, and may not be applicable to this plant if solution #5 above is successful. However, future plant designs should take dust management into account and be built to the latest standards.
	Est. Cost:	No estimated cost available – example only!
7	**Cause:**	Regulatory gaps (OSHA, NFPA, IFC).
	Solution:	Don't wait for regulatory agencies. Develop and apply standards internally.
	Assigned:	Hoeganaes Corporation: Gallatin, TN
	Due:	No due date assigned – example only!
	Term:	Short
	Notes:	These standards make sense. Industries that take the initiative to self-regulate are likely to find less actual regulation over time.

ID	Label	Detail
	Est. Cost:	No estimated cost available – example only!
8	**Cause:**	Tons of iron dust accumulated throughout facility
	Solution:	Completely clean the facility from top to bottom.
	Assigned:	Hoeganaes Corporation: Gallatin, TN
	Due:	No due date assigned – example only!
	Term:	Short
	Notes:	Pictures of the site clearly show dust everywhere. Not only is this a fire hazard, but it also must be an inhalation hazard as well. A single massive clean-up, coupled with solution #3 above, should create a safer environment while the engineering solutions are put in place.
	Est. Cost:	No estimated cost available – example only!
9	**Cause:**	Iron dust on motor/elevator
	Solution:	Clean up area before beginning work
	Assigned:	Hoeganaes Corporation: Gallatin, TN
	Due:	No due date assigned – example only!
	Term:	Short
	Notes:	This solution goes along with good housekeeping, and best maintenance and safety practices. Before beginning work, mechanics should ensure the area is clean and safe.
	Est. Cost:	No estimated cost available – example only!
10	**Cause:**	Exposed wiring
	Solution:	Inspect the site for wiring hazards and fix.
	Assigned:	Hoeganaes Corporation: Gallatin, TN
	Due:	No due date assigned – example only!
	Term:	Short
	Notes:	This solution goes along with solution #11 below. Identify all exposed wiring hazards and fix them immediately.
	Est. Cost:	No estimated cost available – example only!
11	**Cause:**	Motor not properly grounded
	Solution:	Complete an audit of the facility to identify improper grounding. Ensure everything is properly grounded.
	Assigned:	Hoeganaes Corporation: Gallatin, TN
	Due:	No due date assigned – example only!
	Term:	Short
	Notes:	This solution goes along with solution #10. All equipment needs to be properly grounded.
	Est. Cost:	No estimated cost available – example only!


2 Fatalities
2 employees burned
Iron dust ignited
Combustible iron dust cloud near motor
Iron dust stirred up from motor/elevator surroundings
Oxygen present
Exposed wiring
Electric arc occurred (speculation)
Motor not properly grounded
Motor energized
2 employees positioned near ignition point
Ignition occurred near motor
Employees were investigating motor shutdown


Dust handling system not completely sealed
Iron dust from multiple sources
Open conveyers
Accumulated iron dust not cleaned up
Why?
Iron dust on motor/elevator
Tons of iron dust throughout facility
Dust collection system frequently down
System started up
Facility design susceptible to dust accumulation
Motor/elevator vibrated
Vibration occurs upon start up
Regulatory gaps (OSHA, NFPA, IFC)


High temperatures
Severity of burns = High
Sufficient contact time
FPC doesn't protect against large dust explosions
Employees not protected
Employees wear Fire Protective Clothing (FPC)