Inherent Safer Design DuPont Incident

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24th November, 2015

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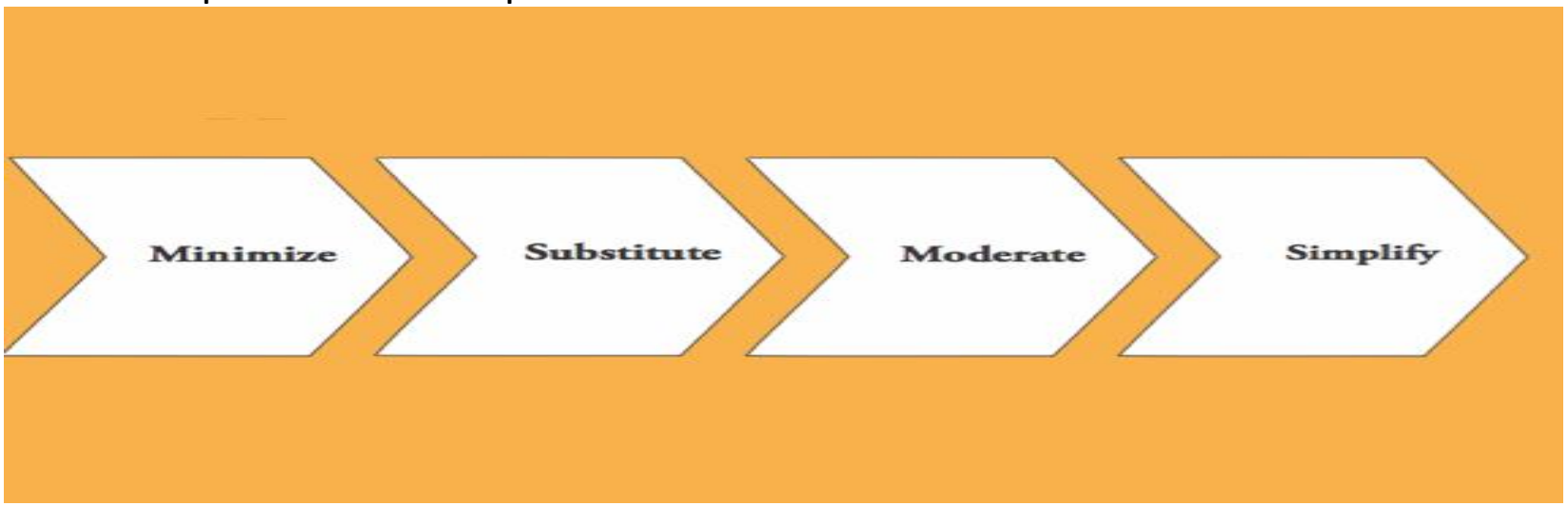
WHAT IS INHERENT SAFER DESIGN (ISD)

Inherent safer Design (ISD)

"An **inherently safer design** is one that avoids hazards instead of controlling them, particularly by reducing the amount of hazardous material and the number of hazardous operations in the plant.



The goal is to encourage minimization or substition of hazardous chemicals as well as simplification of complex industrial processes that use hazardous chemicals.

DUPONT SAFETY ORIGINS

Process Safety was born on the banks of the Brandywine River in the early days of the 19th century at the E. I. du Pont black powder works 1803-1921. Recognizing that even a small incident could precipitate considerable damage and loss of life, du Pont directed the works to be built and operated under very specific safety conditions. That success resulted directly from the firm's pioneering use of gunpowder processing machinery driven by water wheels and water turbines

Black Powder is a chemical explosive—the earliest known. It is a mixture of sulfur, charcoal, and potassium nitrate (saltpeter).

Du Pont instituted management practices that established safety practices and ensured high-quality production.

DUPONT RECENT INCIDENTS

- "world class safety leader" and the original promoters of a so-called "zero injury culture.“
- The Delaware-based corporation claimed to have no workplace accidents in its plants, employing 2,000 workers, from 1994 to 2004 - and has profited by selling its safety programs to other employers.
- Recorded 34 accidents involving toxic releases and at least eight fatalities at DuPont plants nationwide since 2007,

DuPont: A Safety Legacy in Doubt

DUPONT RECENT INCIDENTS

1. Belle
- In 2010, phosgene release resulted in 1 fatality
- Three releases in two days , methyl chloride, oleum and phosgene

(Fareed Ali – ALM (July,2012)

2. Yerkes
- In 2010 there was a hot work incident resulting in 1 fatality and 1 injury

3. La Porte
- In 2014, 24, 000lb highly toxic chemical released resulting in 4 fatalities
- During the CSB investigation there were additional smaller releases on site and at other Du pont Sites
- From 2007 to 2012, DuPont had reported at least three incidents involving toxic releases and non-fatal injuries at the La Porte plant

DUPONT RECENT INCIDENT – LA PORTE

November 15, 2014

- The system allowed the toxic chemical to migrate to a line used to vent unwanted gases. When workers tried to drain what they thought was water out of that line, something they did routinely, the chemical flowed into a building releasing 24,000lb of toxic methyl mercaptan released on and off site.

- All four employees who died were inside the building

- Two of the four fatalities occurred during rescue

- DuPont employed 300 personnel at the site

DUPONT RECENT INCIDENT – LA PORTE

Following Bhopal incident , DuPont modified its La Porte methyl isocyanate (MIC) process using inherently safer design (ISD)

–Open building structure

–Equipment to direct leaks to an incinerator for destruction of highly toxic chemicals

- Minimum in-process hold-up of MIC
- Minimum process piping runs and number of flanges
- Relief devices vented to an abatement device
- Use of an open building structure with potential leak sources vented to the incinerator
- Lethal service equipment and piping design
- Multi-layers of MIC destruction to ensure no MIC releases.
- Multi-layer interlock systems for fail safe operation.

These principles were, and are, the basis for the design. The sections that follow spell-out the design basis in more detail.

VIDEO OF INCIDENT– LA PORTE

Incident Animation of DuPont La Porte Gas Leak That Killed Four Workers.mp4

DUPONT RECENT INCIDENT – LA PORTE

Enclosed Building Hazards

- The portion of the process where the incident took place is enclosed within a building that has no documented design function and appears to serve no essential manufacturing purpose
- Housing the process equipment inside the enclosed manufacturing building introduces highly toxic chemical exposure and asphyxiation hazards to personnel that DuPont has not effectively identified or controlled

DUPONT RECENT INCIDENT – LA PORTE

Enclosed Building Hazards

- The DuPont manufacturing building design introduces all of the negative design features of a containment building, but offers none of the benefits through off-site risk reduction

–Vapors from highly toxic chemical leaks are trapped and concentrated inside the building, increasing risk to personnel

–The manufacturing building ventilation system will discharge these highly toxic chemical leaks to the outdoor surroundings

DUPONT RECENT INCIDENT – LA PORTE

The manufacturing building ventilation fans were classified as **“PSM Critical”** equipment by DuPont

–meaning their failure could result in a high consequence event

- Neither fan was in operation at the time of the incident
- Preliminary calculations indicate that even with both fans operating, ventilation would likely have been insufficient to avoid a lethal atmosphere inside the manufacturing building

DUPONT RECENT INCIDENT – LA PORTE

Building Ventilation Hazards

- At the time of the incident, the manufacturing building ventilation fan for the portion of the unit where the methyl mercaptan was released (wet end fan) was not operating despite an “urgent” work order written nearly a month earlier on October 20, 2014
- The breakdown of the ventilation fan did not result in any additional safety precautions, such as operational or emergency response requirements, worker access restrictions to the manufacturing building, or personal protective equipment (PPE) requirements

DUPONT RECENT INCIDENT – LA PORTE

The stairs that provide the primary means to access the equipment within the manufacturing building are designed for fire escape, and DuPont has not effectively evaluated entry or egress hazards in a toxic or inert gas atmosphere

–One victim was located in the stairway

•There is no ventilation provided in the stairways and internal doors to the process; furthermore, the internal doors do not provide an effective barrier to keep hazardous gases from entering the stairway

DUPONT RECENT INCIDENT – LA PORTE

Gas Detectors are Ineffective

- The design of the methyl mercaptan detection system does not effectively warn workers or protect the public from highly toxic chemical exposure
- The detector alarm point is above the permissible exposure limit for workers and the response to a detector alarm (administrative control) is not sufficient to protect the public

DUPONT RECENT INCIDENT – LA PORTE

Response to Detectors

- During the hours prior to the November 15, 2014 incident, multiple highly toxic chemical gas detectors alarmed (sounded)
- The DuPont emergency response team (ERT) was not notified, and the area was not cleared of personnel
- Methyl mercaptan releases on November 13 and 14, 2014, were picked up by methyl mercaptan detectors, but were never reported as releases nor investigated as serious process safety incidents

DUPONT RECENT INCIDENT – LA PORTE

Process Hazard Analysis

- Process hazard analyses (PHAs) and relief system design scenarios do not effectively consider hazards from nonroutine operations, such as aligning the liquid methyl mercaptan piping to the vapor waste gas vent header
- Along the liquid methyl mercaptan feed line there were three locations where it was connected by valves to a waste gas vent header
- At the time of the incident one of these valves weres fully open and a second valve was slightly open

DUPONT RECENT INCIDENT – LA PORTE

PHAs performed on the insecticide manufacturing process did not sufficiently identify and control process hazards

- Post-incident, DuPont has conducted a new baseline PHA for two of its 15 Insecticide Business Unit (IBU) PHAs
- These new post-incident PHA teams are applying a more robust methodology resulting in hundreds of new action items
- However, DuPont is not completing its other 13 PHAs prior to resuming production

DUPONT RECENT INCIDENT – LA PORTE

Ventilation Evaluation

- The manufacturing building air dilution ventilation system has never been evaluated by a PHA or engineering study
- DuPont had scheduled such a review for 2017

DUPONT RECENT INCIDENT – LA PORTE

Ventilation Evaluation

- The area of the manufacturing building where the largest methyl mercaptan release occurred during the incident has never been tested for ventilation flow rate or effective distribution of dilution air
- Prior to receiving a draft of these CSB proposed recommendations, DuPont management stated they were not going to perform an engineering study to ensure the dilution air ventilation system is effective to protect workers from highly toxic chemical exposure or asphyxiation hazards

DUPONT RECENT INCIDENT – LA PORTE

Building Safeguards

- DuPont's process analyzer houses are infrequently entered, but they are equipped with more robust safeguards (detectors and alarms) than the normally occupied manufacturing building
- The manufacturing building has significantly larger inventories of hazardous chemicals, but has unventilated areas and is regularly occupied by workers

DUPONT RECENT INCIDENT – LA PORTE

Pressure Relief Systems

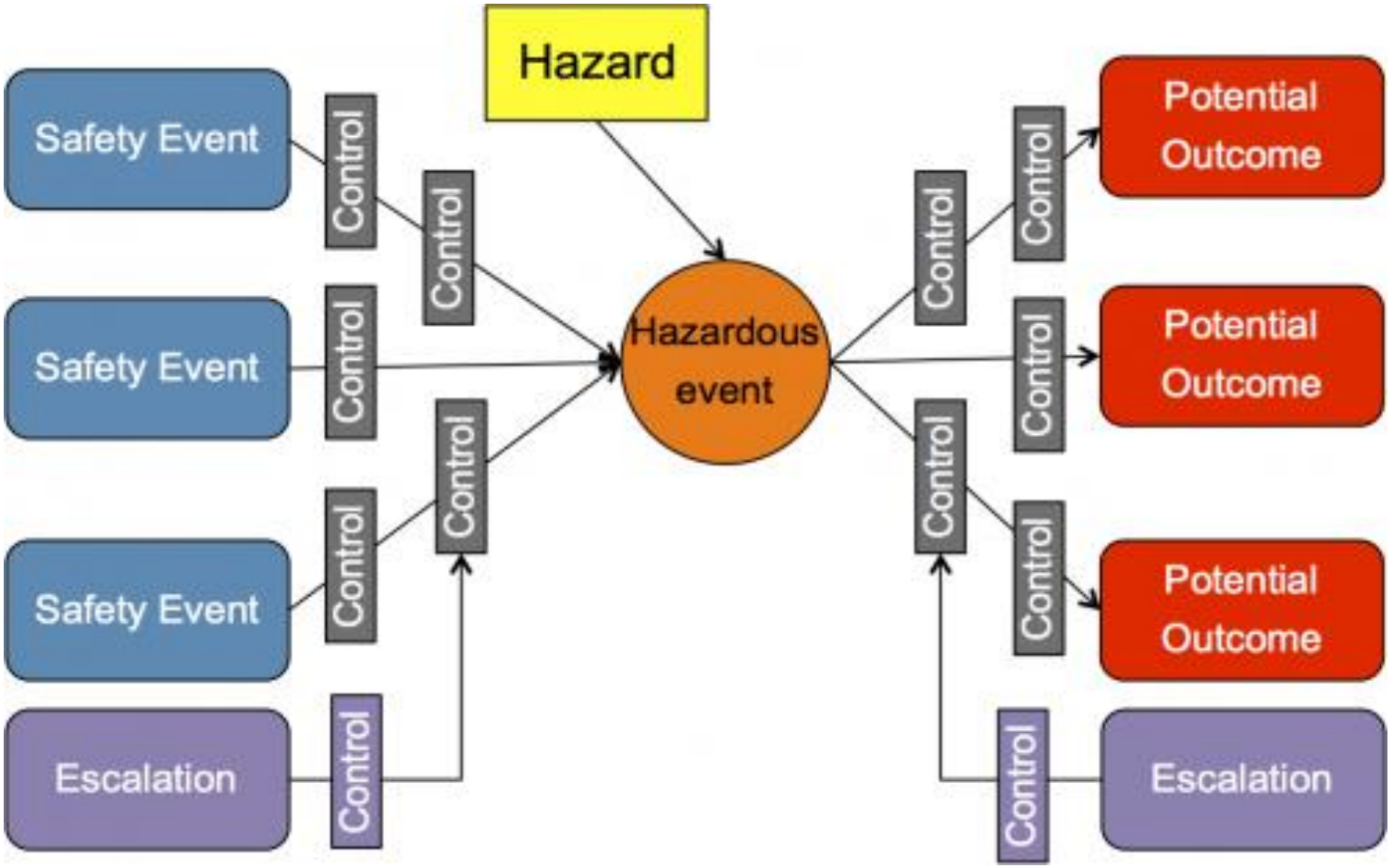
- There are pressure relief systems in the insecticide manufacturing process that are improperly designed and do not effectively ensure that highly toxic, highly flammable, and asphyxiating chemicals are discharged to safe locations as required by industry codes and standards

CSB RECOMMENDATIONS– LA PORTE

Proposed Recommendations for DuPont Crop Protection Unit

- R1: Conduct and implement a comprehensive inherently safer design review
- R2: Conduct a PHA and Engineering Evaluation of the building design and ventilation system
- R3: Perform a site-wide pressure relief study to ensure compliance with codes and standards
- R4: Develop an expedited schedule for robust more detailed PHAs

IDENTIFYING AND CONTROLLING PS EVENTS



PROCESS SAFETY DEFINITION

“Process Safety is everything we do as a team to prevent catastrophic accidents, particularly fires, explosions, and toxic releases on our site.”

RUDYARD KIPLING “THE SECRET OF MACHINE”

We were taken from the ore-bed and the mine,
We were melted in the furnace and the pit—
We were cast and wrought and hammered to design,
We were cut and filed and tooled and gauged to fit.
Some water, coal, and oil is all we ask,
And a thousandth of an inch to give us play:
And now, if you will set us to our task,
We will serve you four and twenty hours a day!

We can pull and haul and push and lift and drive,
We can print and plough and weave and heat and light,
We can run and race and swim and fly and dive,
We can see and hear and count and read and write!

Would you call a friend from half across the world?
If you’ll let us have his name and town and state,
You shall see and hear your crackling question hurled
Across the arch of heaven while you wait.
Has he answered? Does he need you at his side?
You can start this very evening if you choose,
And take the Western Ocean in the stride
Of seventy thousand horses and some screws!

The boat-express is waiting your command!
You will find the *Mauretania* at the quay,
Till her captain turns the lever ’neath his hand,
And the monstrous nine-decked city goes to sea.

Do you wish to make the mountains bare their head
And lay their new-cut forests at your feet?
Do you want to turn a river in its bed,
Or plant a barren wilderness with wheat?
Shall we pipe aloft and bring you water down
From the never-failing cisterns of the snows,
To work the mills and tramways in your town,
And irrigate your orchards as it flows?

It is easy! Give us dynamite and drills!
Watch the iron-shouldered rocks lie down and quake
As the thirsty desert-level floods and fills,
And the valley we have dammed becomes a lake.

But remember, please, the Law by which we live,
We are not built to comprehend a lie,
We can neither love nor pity nor forgive.
If you make a slip in handling us you die!
We are greater than the Peoples or the Kings—
Be humble, as you crawl beneath our rods!-
Our touch can alter all created things,
We are everything on earth—except The Gods!

Though our smoke may hide the Heavens from your eyes,
It will vanish and the stars will shine again,
Because, for all our power and weight and size,
We are nothing more than children of your brain!

QUESTIONS ??

Take a look at your Process Safety Role and Make it count