



CSB Public Meeting

DuPont Toxic Chemical Release
November 15, 2014

La Porte, Texas

Interim Recommendations

September 30, 2015



Speakers from the DuPont Investigation Team

Dan Tillema

Tamara Qureshi

Steve Cutchen



Agenda

Video Animation of November 15, 2014 Incident

Recent CSB Investigations of DuPont Incidents

Investigation Activities Through June 12, 2015

Investigation Interrupted – August 2015 Start-up

Key Findings and Pre-Startup Recommendations

Potential Investigation Pathways

Board Questions

Public Comment Period

Board Vote on Interim Document and Recommendations



Animation

Animation DuPont La Porte





Recent CSB Investigations of DuPont Incidents

Belle, West Virginia – January 22 and 23, 2010

Three release incidents in two days:
methyl chloride, oleum, and phosgene.

The phosgene release resulted in one fatality.

Buffalo, New York – November 9, 2010

A hot work incident resulted in one fatality and one injury.

La Porte, Texas – November 15, 2014

A release of 24,000 lb of methyl mercaptan resulted in four fatalities.

During investigation, there have been other smaller toxic releases



Recent CSB Investigations of DuPont Incidents

Deployment decision to La Porte based on:

- seriousness of the incident.

- third fatality incident at a different DuPont facility – a first in CSB history.

Personal Safety versus Process Safety

CSB has advocated for a separate focus on process safety since the BP Texas City Investigation in 2005.

DuPont has had good personal safety performance.

These incidents reflect a poor process safety performance.

CSB is concerned about DuPont's process safety performance.



Investigation Activities Through June 12, 2015

Deployed November 16, 2014

8 investigators, D.C. and Denver

Coordination with OSHA

Currently 3 investigators

Weekly meetings: DuPont & Union
leadership

More than 100 interviews

More than 1,100 document requests

More than 140,000 pages

Equipment testing

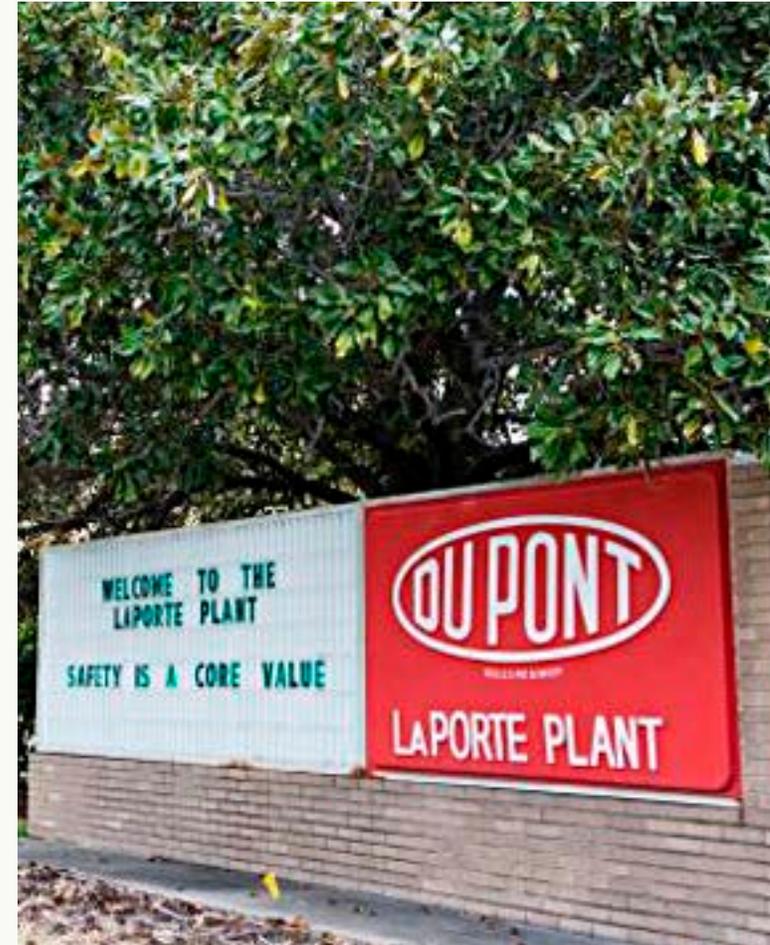


Photo Credit: Houston Chronicle, Marie D. De Jesus



Investigation Interrupted– August 2015 Start-up

CSB had been communicating key findings and associated corrective actions to DuPont throughout the investigation.

Many DuPont employees communicated about pre-startup activities and restart dates.

CSB concluded that key findings would not be resolved before August start-up.

CSB interrupted the investigation to formally prepare pre-startup recommendations.



Photo Credit: U.S. Chemical Safety Board



Key Findings Require Pre-Startup Mitigation

Inherently Safer Design of
Manufacturing Processes and Facilities

Worker Safety in the Manufacturing Building

Public and Worker Safety from Emergency Relief Systems

Robust Process Hazard Analysis

Active Workforce Participation

Public Transparency and Accountability



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Inherently Safer Design of Manufacturing Processes and Facilities

Bhopal, India, December 1984: Methyl Isocyanate (MIC)

Inherently Safer Design (ISD) eliminates or reduces hazards to avoid or reduce the consequences of incidents.

DuPont Modifies its La Porte MIC Process using Inherently Safer Design

- 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.



Inherently Safer Design of Manufacturing Processes and Facilities

New MIC Unit included

- Open building structure

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

DuPont's adoption of Inherently
Safer Design is acknowledged
by the CSB



Photo Credit: U.S. Chemical Safety Board

Inherently Safer Design of Manufacturing Processes and Facilities

In addition to MIC, the Insecticide Business Unit (IBU) manufacturing processes and facilities contain other highly toxic chemicals:

Chlorine

Methyl mercaptan

DuPont did not effectively apply similar ISD to other IBU processes and facilities.

Enclosed manufacturing building



Photo Credit: U.S. Chemical Safety Board



Inherently Safer Design of Manufacturing Processes and Facilities

DuPont did not effectively apply similar
ISD to other IBU processes and facilities.

Pressure relief systems

e.g. Methyl mercaptan storage tank

Methyl mercaptan feed pump discharge



Photo Credits: U.S. Chemical Safety Board





Inherently Safer Design of Manufacturing Processes and Facilities

The CSB is making Recommendation R1 to DuPont to conduct an inherently safer design review prior to resuming IBU manufacturing, to evaluate

- the manufacturing building, and

- the discharge of pressure relief systems with toxic chemical scenarios.

Implement inherently safer design principles to the greatest extent feasible.

Details of the recommendations are found in the document.



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Worker Safety in the Manufacturing Building

Areas of focus include:

The Manufacturing Building itself

The Stairways

The Ventilation System

The Air Monitoring System



Worker Safety in the Manufacturing Building

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The Manufacturing Building

The Stairways

The Ventilation System

The Air Monitoring System



Enclosed Building Hazards

The Manufacturing Building

has no documented design function.

serves no apparent essential manufacturing purpose.

is not a containment building.

introduces increased worker hazards of a containment building.

Toxic leaks are trapped and concentrated inside.

Not designed to route toxic vapors to a destruction device.

does not provide risk reduction to the public of a containment building.

If collected, toxic leaks are discharged from the roof to the atmosphere.



Worker Safety in the Manufacturing Building

Areas of focus include:

The Manufacturing Building

The Stairways

The Ventilation System

The Air Monitoring System



Worker Hazards in the Stairways

The Manufacturing Building Stairways

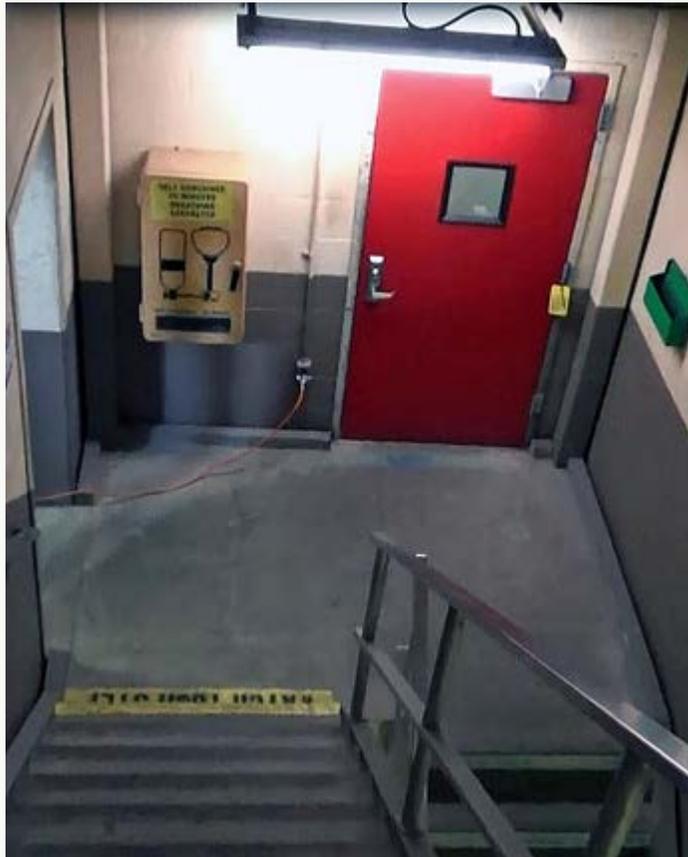


Photo Credits: U.S. Chemical Safety Board



Worker Hazards in the Stairways

The **Manufacturing Building Stairways** were not a safe haven.

The stairways

- have not been evaluated for the hazards of toxic gas or oxygen-deficient environment.

- are not connected to the building ventilation system.

 - The stairways are designed for fire escape.

 - Internal doors are not barriers to hazardous gases from the process areas.



Worker Safety in the Manufacturing Building

Areas of focus include:

The Manufacturing Building

The Stairways

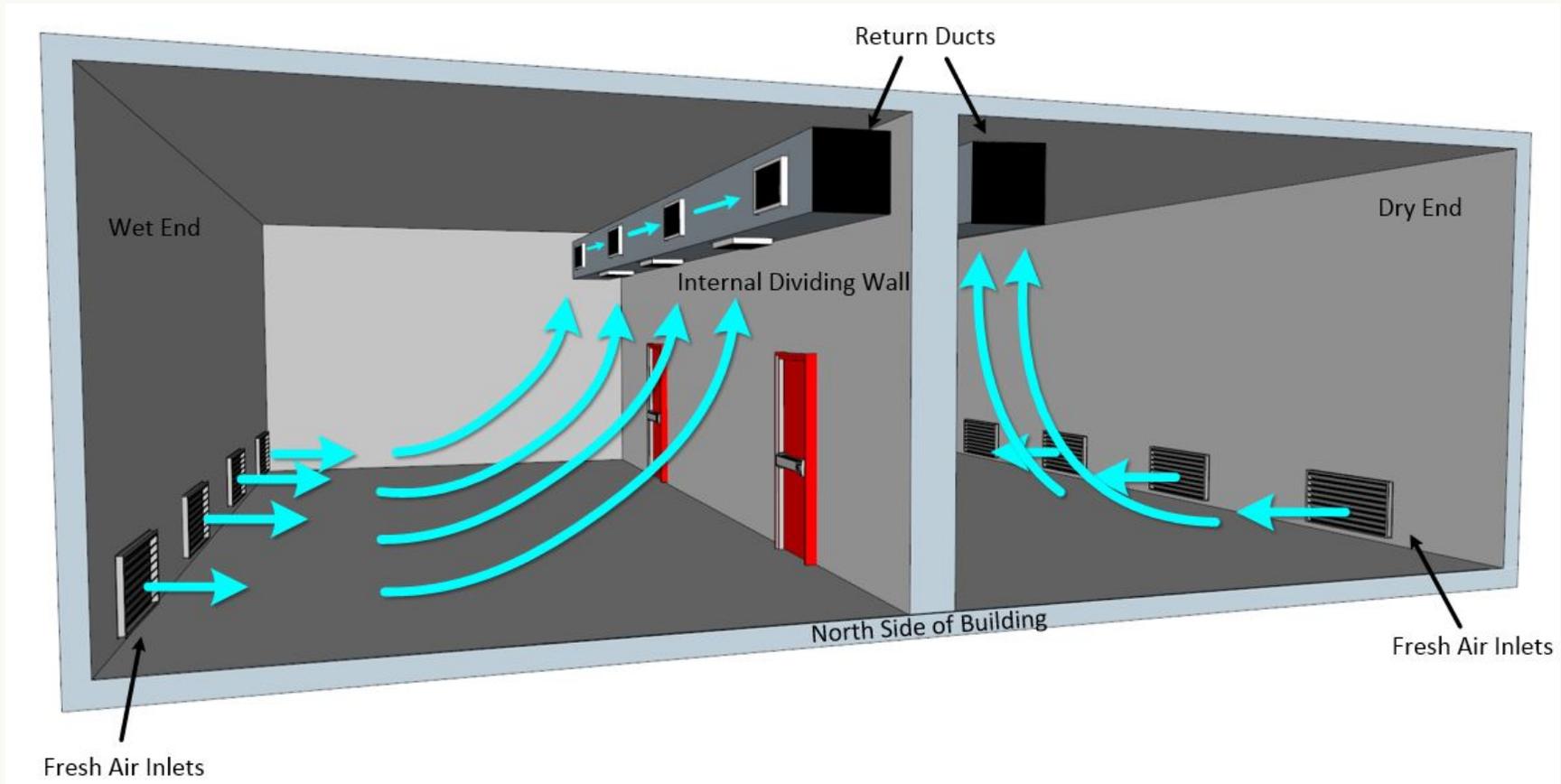
The Ventilation System

The Air Monitoring System



Building Ventilation System Hazards

The Manufacturing Building Ventilation System

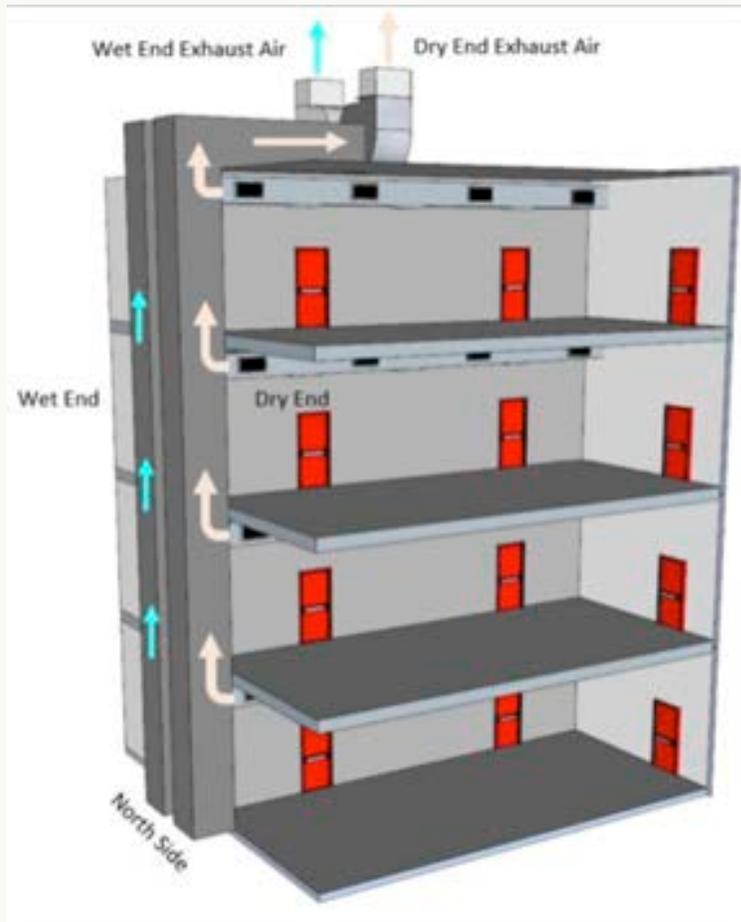


Ventilation System Drawing Credit: U.S. Chemical Safety Board



Building Ventilation System Hazards

The Manufacturing Building Ventilation System



Ventilation System Drawing and Photo Credit: U.S. Chemical Safety Board



Ventilation System Ineffective

Doors between Wet and Dry End are often propped open.
Wall penetrations create short circuited air flow patterns







Ventilation System Doesn't Meet Design Objective

A design objective of the **Manufacturing Building Ventilation System** is to “control contaminants to acceptable work place exposure levels”.

This objective was communicated to workers in the Operating Manual and the Safety and Occupational Health section of the unit Technical Standards.

Preliminary calculations indicate that, even had the fans been running, the design objective could not have been met.

There would have been insufficient ventilation **during the incident** to avoid a lethal atmosphere in the room where the release occurred.



Building Ventilation System Not Tested

A 2009 audit of the DuPont La Porte Process Safety Management System found that the ventilation system was not being tested.

A program to generate a periodic work order for dilution air flow testing was created in 2010

Testing did not occur in 2010.

Measurements for the Dry End fan taken in 2012, but there was no analysis.

No measurements for the Wet End fan, located in the area of the incident.



Ineffective Building Ventilation Maintenance

The ventilation fans are classified as Process Safety Critical (PSM Critical) equipment, but neither fan was in operation at the time of the incident.

PSM Critical: “failure could result in a high consequence event”

Yet, an “Urgent” repair order was written nearly a month before the incident.

And the failure of the fans did not result in additional safety precautions:

- No special operational procedures

- No special emergency response procedures

- No worker access restrictions

- No additional personal protective equipment (PPE) requirements



Worker Safety in the Manufacturing Building

Areas of focus include:

The Manufacturing Building

The Stairways

The Ventilation System

The Air Monitoring System



Air Monitoring Gas Detectors Ineffective

The **Manufacturing Building Gas Detector System** monitors methyl mercaptan.

There are methyl mercaptan detectors:

- Two on the first floor

- One on the fourth floor.

- None on the third floor where the release took place.



Photo Credit: U.S. Chemical Safety Board



Building Gas Detectors Do Not Effectively Warn Workers

No gas detector alert systems in the building.

The only alarm is in the control room.

No warning to workers if entry to the manufacturing building is dangerous.

It is possible to enter the building without knowing that a gas leak has occurred, and then become incapacitated before being able to react.



No Gas Detector Alert in the Building

Unlike the manufacturing building, this DuPont analyzer house oxygen analyzer provides warning of an unsafe atmosphere before entry.

An alarm sounds and the green light outside turns off to indicate it is not safe to enter.



Photo Credit: U.S. Chemical Safety Board



Insufficient Response to Methyl Mercaptan Alarms

The response to an alarm is not sufficient to warn workers or the public.

During the hours prior to the November 15, 2014 incident, multiple methyl mercaptan gas detectors alarmed (sounded).

Methyl mercaptan releases on November 13 and 14, 2014, were also detected by methyl mercaptan detectors.

Neither of these were ever reported as releases, nor investigated as serious process safety incidents.



Methyl Mercaptan Detector Alarm Setpoint Too High

The methyl mercaptan detectors are designed to prevent off-site impact

The alarm point of the methyl mercaptan detectors (25 ppm) is set at the Emergency Response Planning Guide (ERPG-2)

DuPont describes ERPG-2 as the limit where irreversible health effects begin after a 1 hour exposure.

ERPG-2 is below ERPG-3, where life-threatening effects begin after 1 hour.

The alarm point is above the permissible exposure limit for workers.

The OSHA permissible exposure ceiling limit is 10 ppm.

OSHA has recognized that this exposure limit is outdated.

OSHA recommends using the NIOSH or Cal-OSHA exposure limit of 0.5 ppm.



Worker Safety in the Manufacturing Building

The CSB is making pre-startup Recommendation R2 to DuPont to

Conduct an engineering evaluation of the manufacturing building and ventilation system, and implement corrective actions to ensure worker safety to the greatest extent feasible.

Document the design basis for the manufacturing building and ventilation system. Identify controls for highly toxic, asphyxiation and flammability hazards.

Details of the recommendations are found in the document.



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Non-Conformance with Relief Systems Codes

Standards, codes and regulations for relief systems are well established:

American Petroleum Institute Standard 521

American Society of Mechanical Engineers Boiler and Pressure Vessel Code

OSHA 1910.119 Process Safety Management

DuPont La Porte 5-year plan to evaluate relief systems due in 2015

Only 35% complete

Does not effectively evaluate relief scenarios and discharge locations

As a result, does not ensure worker or public safety



EPRG-3 Community Impact: Methyl Mercaptan Tank

2002: Realized fire case would cause off-site ERPG-3 concentrations.



Photo Credit: U.S. Chemical Safety Board

DuPont insulated the tank to reduce the off-site impact to below ERPG-3.

The insulation was subsequently removed.

No technical basis or management approval documents exist.



Asphyxiation Hazard: Nitrogen Relief System

Relief valves discharge directly under a pipe rack in close proximity to worker Manufacturing Building pathways.

DuPont standards prohibit discharge impinging on piping, or directed toward platforms and other areas used by workers.



Photo Credit: U.S. Chemical Safety Board



Toxic Gas Hazard: Caustic Scrubber Relief System

On December 16, 2014, highly toxic chlorine was released from a caustic scrubber relief valve.

The release was revealed by a chlorine detector, on the other side of this structure.

DuPont documents state the relief location is safe; 10 feet above the associated work platform.

Yet there are several other adjacent work platforms above the discharge.



Photo Credit: U.S. Chemical Safety Board



Toxic Liquid Hazard: Methyl Mercaptan Feed Pump

The Lannate feed pump piping includes relief valves designed to discharge toxic liquid methyl mercaptan to the ground, adjacent to where workers would be starting the pump.

Relief valves on the parallel API feed pump were removed in the 1990s.

No process hazards or relief valve analysis documents the potential discharge hazards for these valves.



Photo Credit: U.S. Chemical Safety Board



Public and Worker Safety from Emergency Relief Systems

The CSB is making Recommendation R3 to DuPont to

Ensure all IBU pressure relief systems are routed to a safe location prior to resuming IBU manufacturing.

Commission a pressure relief device analysis consistent with standards and codes. Ensure all pressure relief systems are routed to a safe location.

Details of the recommendations are found in the document.



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Ventilation System Has Never Been Evaluated by PHA

DuPont schedule indicates initial PHA in 2017.



Photo Credits: U.S. Chemical Safety Board





PHAs Miss Potential Hazardous Events

A PHA was used when valves were installed to connect the liquid methyl mercaptan feed line to the vapor waste gas vent header at railcar spots.

These valves provided the pathway for the liquid methyl mercaptan release in this incident.

No PHA was used when plans were made to use these valves to clear the liquid methyl mercaptan feed line.



Photo Credit: DuPont



New Robust PHAs Identify Many New Hazards

New baseline PHAs completed for two of 15 IBU processes.

These PHAs use a more robust hazard analysis methodology.

Many new potential hazardous events were identified

Hundreds of new corrective action items have been developed.

DuPont has agreed to implement an expedited schedule for the remaining IBU PHAs, applying this new methodology, prioritizing high-hazard processes.



Robust Process Hazard Analysis

The CSB is making Recommendation R4 to DuPont to

Develop and implement an expedited schedule to perform more robust PHAs, consistent with the previous recommendations, for all IBU units.

The PHA schedule must be prioritized based on anticipated risks to the public and workers in order to ensure that the highest risk areas receive priority consideration.

Details of the recommendations are found in the document.



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Active Workforce Participation

The CSB has identified that workers and their representatives play a very important role in major incident prevention.

In Guidelines for Risk Based Process Safety, the Center for Chemical Process Safety states:

...workers are potentially the most knowledgeable people with respect to the day-to-day details of operating the process and maintaining the equipment and facilities, and may be the sole source for some types of knowledge gained through their unique experiences. *Workforce involvement* provides management a mechanism for tapping into this valuable expertise.



Active Workforce Participation

With these benefits in mind, the CSB is making recommendations to

DuPont (R5), and

International Chemical Workers Union Council (ICWUC) of the
United Food and Commercial Workers (UFCW) and Local 900C (R7)

to work together to develop and execute a plan for effective participation
of the workforce and their representatives in the implementation of

Inherently Safer Design Review

Ensuring Worker Safety in the Manufacturing Building

Ensuring a Relief System Design Safe for Workers and the Public

Performance of the More Robust Process Hazard Analyses

Provide a copy of DuPont's integrated plan for restart to La Porte workers and
their local union representatives.

Details of the recommendations are found in the document.



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Public Accountability and Transparency

In the Chevron Richmond Refinery investigation, the CSB has identified that transparency between industry and the public improves health and safety for the facility and community.



Public Transparency and Accountability

With these benefits in mind, the CSB is making recommendation R6 to DuPont to make publicly available a summary of

the DuPont November 15, 2014 incident investigation report,
and a summary of actions to be undertaken for the implementation of

Inherently Safer Design Review

Ensuring Worker Safety in the Manufacturing Building

Ensuring a Relief System Design Safe for Workers and the Public

Performance of the More Robust Process Hazard Analyses

Details of the recommendations are found in the document.



Potential Investigation Pathways

Preconditions

- Safety Culture
- Normalization of Deviance
- Equipment Design

Hazard Awareness

- Process Hazard Analysis
- Management of Change

Troubleshooting Methods

- Leadership
- Communications
- Ad Hoc Non-routine Procedures

Emergency Response

Industry Guidelines

Regulatory Requirements



Agenda

Video Animation of November 15, 2014 Incident

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Back-up Slides – Verbatim Recommendations



Pre-Startup / Interim Recommendations

DuPont La Porte, Texas Chemical Facility

2015-01-I-TX-R1

Inherently Safer Design Review

Prior to resuming Insecticide Business Unit (IBU) manufacturing operations, conduct a comprehensive engineering analysis of the manufacturing building and the discharge of pressure relief systems with toxic chemical scenarios to assess potential inherently safer design options. At a minimum, evaluate the use of an open building structure, and the direction of toxic chemical leaks and the discharge of pressure relief systems with toxic chemical scenarios to a destruction system. Implement inherently safer design principles to the greatest extent feasible and effectively apply the hierarchy of controls such that neither workers nor the public are harmed from potential highly toxic chemical releases. Detail the analysis, findings, and corrective actions in a written report and make this report available to DuPont La Porte employees, their representatives, and the CSB.



Pre-Startup / Interim Recommendations

DuPont La Porte, Texas Chemical Facility

|2015-01-I-TX-R2²³

Ensure Manufacturing Building is Safe for Workers

Prior to resuming Insecticide Business Unit (IBU) manufacturing operations, conduct a robust engineering evaluation of the manufacturing building and the dilution air ventilation system that includes the implementation of corrective action(s) to the greatest extent feasible in order to ensure a safe environment for all workers. Develop a documented design basis for the manufacturing building and the air dilution ventilation system that identifies effective controls for highly toxic, asphyxiation, and flammability hazards and implement these controls to the greatest extent feasible. Address nonroutine operations and emergency response activities in the design basis. The design basis for the manufacturing building and the dilution air ventilation system must use the hierarchy of controls and inherently safer design principles to the greatest extent feasible.

²³ It is understood that depending on the mitigation approach taken by DuPont some aspects of recommendation R1 or recommendation R2 may not be applicable in the future. The CSB recommendations program provides sufficient flexibility to allow a recommendation to be “no longer applicable” following the CSB’s recommendation evaluation process. For example, if DuPont moves the equipment containing highly toxic chemicals to an open outdoor structure to address recommendation R1 the evaluation of the air dilution ventilation system in recommendation R2 may no longer be applicable.



Pre-Startup / Interim Recommendations

DuPont La Porte, Texas Chemical Facility

2015-01-I-TX-R3

Ensure Relief System Design is Safe for Workers and the Public

Prior to resuming manufacturing operations, ensure all Insecticides Business Unit (IBU) pressure relief systems are routed to a safe location and effectively apply the hierarchy of controls to protect workers and the public. Commission a pressure relief device analysis, consistent with API Standard 521 and the ASME Code, including a field review. Include an evaluation of relief system discharge location to ensure that relief systems are discharged to a safe location that will prevent toxic exposure, flammability, or asphyxiation hazards in order to ensure public and worker health and safety to the greatest extent feasible. Include an evaluation of relief scenarios consistent with API Standard 521.



Pre-Startup / Interim Recommendations

DuPont La Porte, Texas Chemical Facility

2015-01-I-TX-R4

Perform More Robust Process Hazard Analyses

Develop and implement an expedited schedule to perform more robust process hazard analyses (PHAs) consistent with R1, R2, and R3 for all units within the Insecticides Business Unit (IBU). At a minimum, the PHAs must effectively identify and control the hazards referenced in this document utilizing the hierarchy of controls. The PHA schedule must be prioritized based on anticipated risks to the public and workers in order to ensure that the highest risk areas receive priority consideration. At a minimum, the more robust PHAs must be consistent with the approach applied to post-incident reviews described above in paragraph 10.



Pre-Startup / Interim Recommendations

DuPont La Porte, Texas Chemical Facility

2015-01-I-TX-R5

Ensure Active Workforce Participation

Work together with the International Chemical Workers Union Council of the United Food and Commercial Workers (ICWUC/UFCW) Local 900C and the ICWUC/UFCW staff (at the request of the local) to develop and implement a plan to ensure active participation of the workforce and their representatives in the implementation of Recommendations R1 through R4. In addition, provide a copy of DuPont's integrated plan for restart to La Porte workers and their local union representatives.



Pre-Startup / Interim Recommendations

DuPont La Porte, Texas Chemical Facility

2015-01-I-TX-R6

Public Transparency and Accountability

Make publicly available (on a website) a summary of the DuPont November 15, 2014 incident investigation report, the integrated plan for restart, and actions to be taken for the implementation of Recommendations R1 through R5. This website must be periodically updated to accurately reflect the integrated plan for restart and implementation of Recommendations R1 through R5.



Pre-Startup / Interim Recommendations

International Chemical Workers Union Council (ICWUC) of the United Food and Commercial Workers (UFCW) and Local 900C

2015-01-I-TX-R7

Ensure Active Workforce Participation

Work together with DuPont to develop and implement a plan to ensure active participation of the workforce and their representatives in the implementation of Recommendations R1 through R4.

This PowerPoint presentation is not a stand-alone document.

It is meant as a visual accompaniment to the September 30, 2015 CSB Public Meeting concerning the November 15, 2014 toxic chemical release at DuPont's La Porte Texas site.

It does not supplant the actual analysis which is documented on the CSB web site.

<http://www.csb.gov/dupont-laporte-facility-toxic-chemical-release-/>