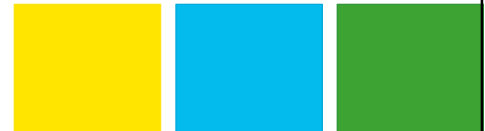




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Alain Fobelets | INOVYN

May 17, 2017



Summary

1. Introduction
2. Process Safety Management
3. Description of the event
4. Immediate causes
5. Lessons
6. Ensuring effective use of lesson learning events

1. Introduction

- Analysis of Process Safety Incidents (PSI)
- The chapters of Process Safety Management as a frame for the interpretation of the conclusions
- Sharing of lessons at all levels of the organisation
 - Production unit level
 - Professional organisation

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2. Process Safety Management

- Chapters dedicated to practices that have been identified as essential for the safe management of high-risk activities
- Regulatory context
 - The US-OSHA regulation 1910.119 (Process safety management of highly hazardous chemicals) which has been in force since the early 1990s
 - The Seveso regulation, now in its third version, provides more prescriptions on what a Process Safety Management should be

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2. Process Safety Management

- Process Safety Information
- Process Hazard Analysis
- Operating Procedures
- Hot Work permit
- Mechanical Integrity
- Training
- Management of Change
- Pre-Startup Safety Reviews
- Emergency Response and Planning
- Incident Investigation
- Compliance Audits
- Process Safety Culture
- Contractor Management
- Management - Leadership & Accountability

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3. Description of the event

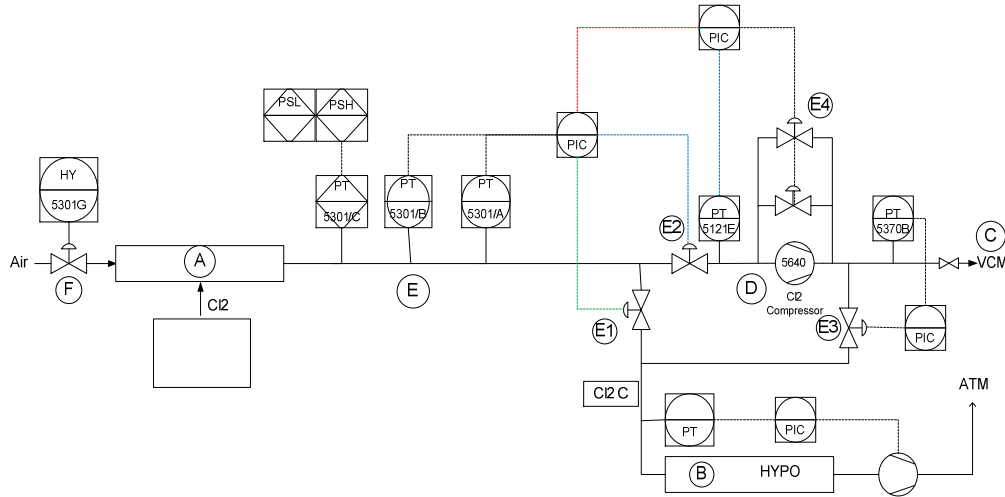
- Between 200 and 400 kg of gaseous chlorine were emitted to the atmosphere through the inlet air valves of the chlorine header during the restart of a monopolar cell room.
- Chlorine was emitted from the cell room building through ventilation louvers at the top of the roof.
- Chlorine was detected as far as 2000 m from cell room (max level reported 0.1 ppm).
- No injuries were reported.

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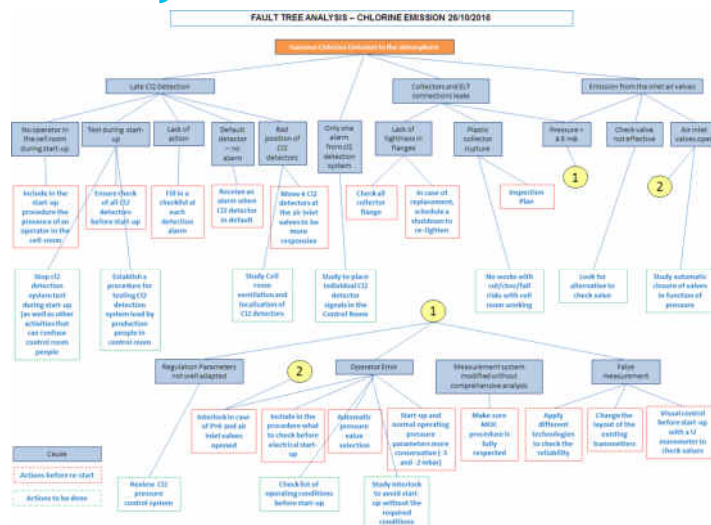
Process diagram



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Fault Tree Analysis



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4. Immediate causes

1. One week before the release, 3 pressure transducers (PT) were replaced by 3 new ones based on a different technology.
2. A first startup took place right after the change without any problem, giving confidence in the reliability of the modification.

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4. Immediate causes

3. Second restart conditions were not identical to the first startup. During the second restart, pressure measurements were affected by condensate and temperature change since calibrating (common mode failure). This resulted in a slight overpressure in the header instead of the expected depression.
4. Chlorine detection system was being tested during the restart. This generated many false alarms. The real alarm was ignored.

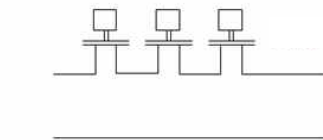
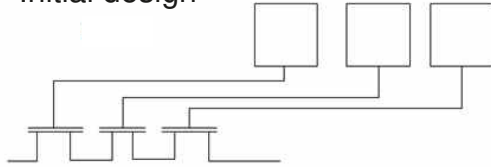
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4. Immediate causes: pressure transducers

Initial design



modified design



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5. Lessons: objective and challenge

The objective: avoid repeat incidents

- At same location
- Elsewhere

The challenge:

- Translate an incident
 - Chain of events with very specific detailed information
- Into lessons
 - Recommendations applicable by all

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5. Lessons: the tools

The tools:

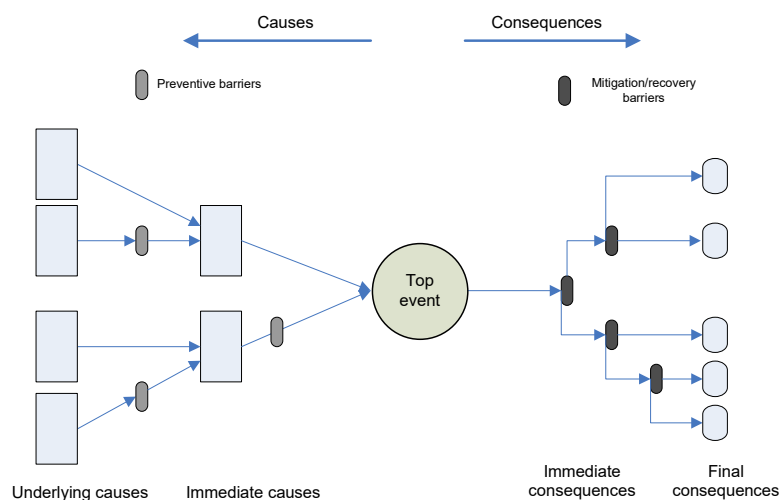
- Identify the 'central event'
- Identify the desired sequence of events (design intent)
- Identify deviations from the design intent
- Identify how the management has to be improved to avoid deviations

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5. Lessons - the tools

1. The bow tie model

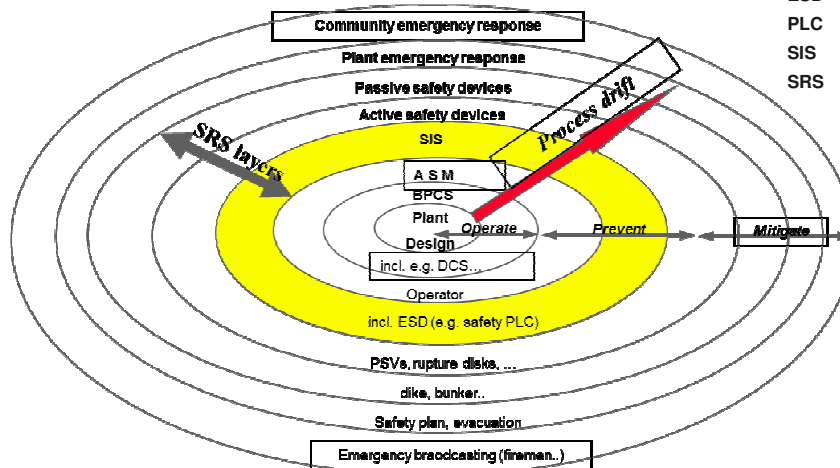


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5. Lessons - the tools

2. The safety layers



ASM	Abnormal Situation Management
BPCS	Basic Process Control System
DCS	Distributed Control System
ESD	Emergency Shutdown System
PLC	Programmable Logic Controller
SIS	Safety Instrumented System
SRS	Safety Related Systems

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5. Lessons: the tools

3. The Process Safety Management

- Process Safety Information
- Process Hazard Analysis
- Operating Procedures
- Hot Work permit
- Mechanical Integrity
- Training
- Management of Change
- Pre-Startup Safety Reviews
- Emergency Response and Planning
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5. Lessons

1. For critical measurement, there should be at least two different technologies (to reduce the risk of common mode failure).
- Relevant PSM chapters:
 - Process Safety Information
 - Hazard Analysis

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5. Lessons

2. A comprehensive risk analysis with multi-disciplinary team has to be performed when modifying critical elements
- Relevant PSM chapters:
 - Management of Change
 - Hazard Analysis

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5. Lessons

3. Startups are critical operations. The operations team should be fully focused on the restart. Field presence is mandatory and control room disturbances have to be avoided.
 - Relevant PSM chapters:
 - Pre-Startup Safety Reviews
 - Operating procedures

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5. Lessons

4. Safeguards. Testing the chlorine detectors and generating false alarms amounts to bypassing a safeguard. Alternative safeguards must be put in place during the tests
 - Relevant PSM chapters:
 - Hazard Analysis
 - Hot Work Permit
 - Emergency Response and Planning

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6. Ensuring effective use of lesson learning events

- Process Safety KPIs at Process Unit level and at Business level
 - Losses of containment,
 - activation of safety systems,..
- With defined criteria for reporting at Business level
- ‘SHE Alert’ for every ‘reportable’ event and monthly distribution through Site Management

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6. Ensuring effective use of lesson learning events


Gaseous Chlorine emission during cell room startup



Site - Country

What	Why	Learning
<ul style="list-style-type: none"> • Between 200 and 400 kg of gaseous chlorine emitted to atmosphere by chlorine header inlet air valves during first phase of ASAHI monopole ASAHI cell room • Chlorine went out of cell room building by ventilation openings at the top of the roof • Chlorine has been detected as far as 2000 m from cell room (max level reported 0.1 ppm) • No injuries reported 	<p>Pressure measurement (3 FT) were replaced by new and different ones one week before</p> <p>Pressure measurement were affected by condensates and temperature change since calibrating</p> <p>Chlorine detection system were tested during the morning when emission took place</p>	<p>For critical measurement try to have at least two different technologies</p> <p>A comprehensive risk analysis with multidisciplinary team have to be performed when modifying critical elements</p> <p>Start-up are critical operations, complete operation team have to be involved, field presence is mandatory and control room disturbance have to be avoided</p>





Compromised Safety Principles

PSS Any changes must be properly assessed and subjected to WOC procedures

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6. Ensuring effective use of lesson learning events

- In addition, direct distribution of SHE Alerts to Site Managers, Site SHE Managers for:
 - Significant events from other businesses, companies
 - Repeat events
 - High Potential events
- Follow up of incident investigations and corrective actions
- Audits with attention to Communication (through visual management) to the workforce

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6. Ensuring effective use of lesson learning events

Ongoing improvements:


- Provide coaching for writing the SHE Alerts
- Hazop studies
 - As continuously available tool
 - As support for exchange of PSI scenarios

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Thank you very much

Alain Fobelets

