Lessons learned after disasters in the Chemical Industry

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EPSC

- EPSC is an Industry funded association of approximately 40 chemical companies
- EPSC has cooperative groups on
  - IEC 61511
  - LOPA
  - Buncefield Learning Experience
  - Safety Critical Systems
  - Ageing Facilities
  - Competence
  - „Atypical" scenarios
- Cooperates with Competent Authorities in Technical Work Groups
- And was asked to chair the Buncefield PSLG Sub group 3 on Layer of Protection Analysis (June 2008-Dec 2009) to produce guidance on best practice.

Where are we?

- The Chemical and Process Industries have excellent Occupational Safety records
  - Superior to most other industry sectors
  - Industry programmes such as Responsible Care® played a role in reduction in incident frequency by up to 90% since mid 1990s
  - But

But

- Process Safety Incidents reduced but now on a plateau
- We still experience major accidents
  - Scenarios we overlooked , failed to learn from history, discounted
  - Attention to large consequence low likelihood factors

How does history help us?

- Baker report has a lot to offer
  - Establish Process safety as a Core Value
  - Provide strong leadership
  - Establish and enforce high standards of performance
  - Document the process safety culture emphasis and approach
  - Maintain a sense of vulnerability
  - Empower individuals to successfully fulfil teir safety responsibilities
  - Defer to expertise
  - Ensure open and effective communications
  - Establish a questioning and learning environment
  - Foster mutual trust
  - Provide timely response to process safety issues and concerns
  - Provide continuous monitoring of performance

Concentrating on 4 of these headings

- Document the process safety culture emphasis and approach
- Maintain a sense of vulnerability
- Foster mutual trust
- Provide continuous monitoring of performance

Vulnerability - Consequences

- Major accident history seems to tell us that we may be able to predict the „deviations" but we underestimated the consequence.
- We don"t seem to apply learning from incidents as well as w should
- The reliability of prevention systems was compromised.
- Specifically:
  - Phenomena chosen was wrong? (Buncefield)
  - Event not seen as credible? (Texas City)
  - Prevention systems not available (Buncefield, Bhopal) and now …..
  - Fukushima – weak preparedness – Tsunamis known but scale underestimated

Rare events

- Release conditions promote worst possible phenomenon
- Multiple failures coincide

- We can construct a matrix……

- video

		Knowledge	
		Known	Unknown
Awareness	Known	Known Known	Known Unknown
	Unknown	Unknown Known	Unknown Unknown

“Known/unknown” table from the statement of Donald Rumsfeld relating to the absence of evidence linking the government of Iraq with the supply of weapons of mass destruction to terrorist groups

Our approach to the matrix

- Known – Known
  - Things we know about and understand
    - Design standards, Checklists etc.
- Known – Unknown
  - Things we know that are unpredictable – requiring study and a conservative approach
    - HAZOP and other techniques
- Unknown – Known
  - Things we knew but have not followed up
  - Forgottten
    - Loss of corporate memory
- Unknown – Unknown
  - What else?
  - Creativity
  - Sense of vulnerability

Event scenarios

- Learning from Bhopal, Texas City, Buncefield
- The unpredicted worst case scenario happened (unknown unknown, unknown known?)
- Human factors a big contributor
- Safety Barriers inactive

At Buncefield it seems that:

Assumptions:

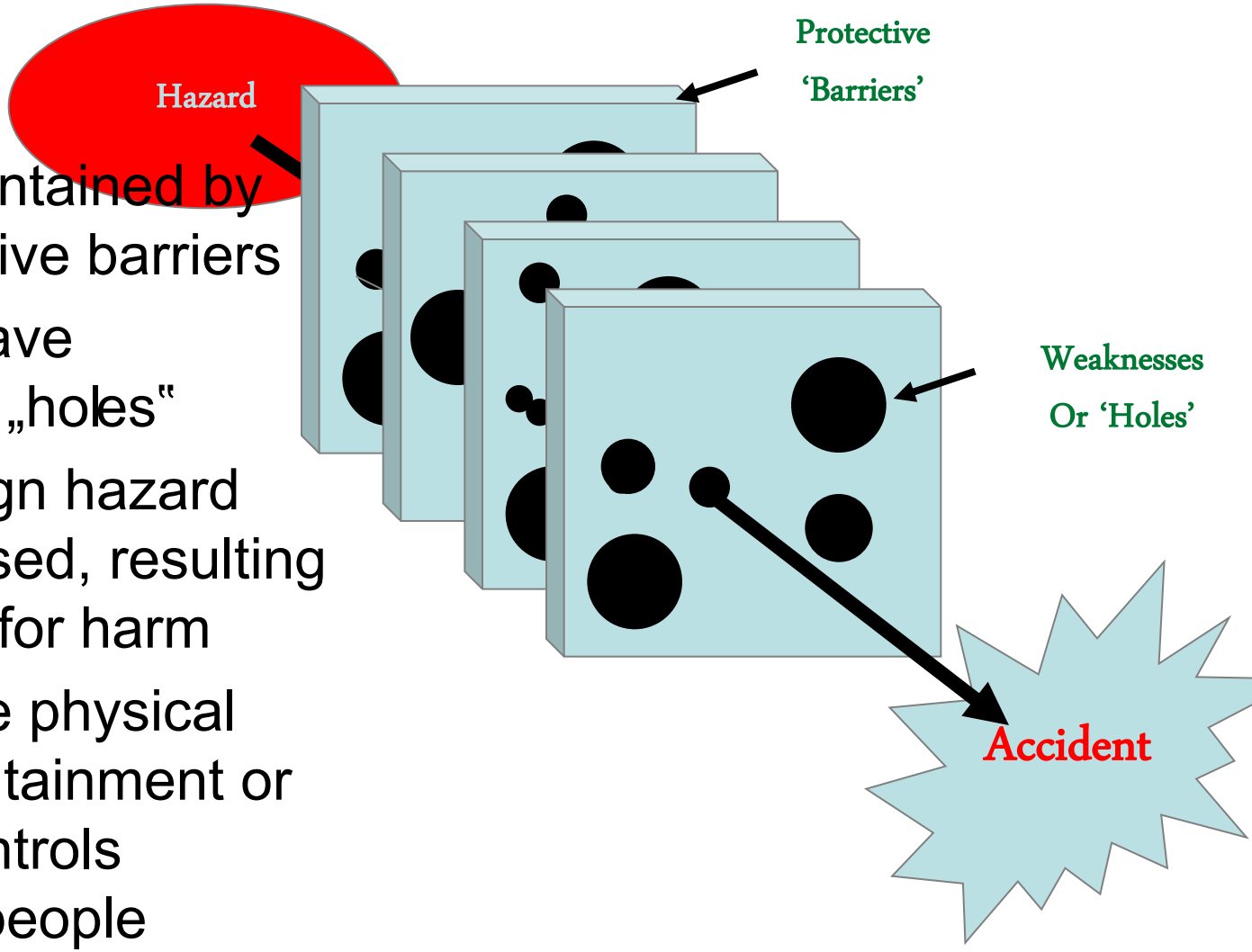
- Frequency of failure of level transmitter would be 1 dangerous in 10years
- The High Level overflow protection trip would fail 1 in 10 demands
- If an overflow occurs it the scenario would be a pool fire

Reality

- Level transmitter had failed 14 times in 4 months – no remedial action
- The High Level overflow protection trip was in a disabled state
- A huge Vapour cloud explosion

Reminder of the „Swiss Cheese Model"

- Hazards are contained by multiple protective barriers
- Barriers may have weaknesses or „holes"
- When holes align hazard energy is released, resulting in the potential for harm
- Barriers may be physical engineered containment or behavioural controls dependent on people
- Holes can be latent/incipient, or actively opened by people

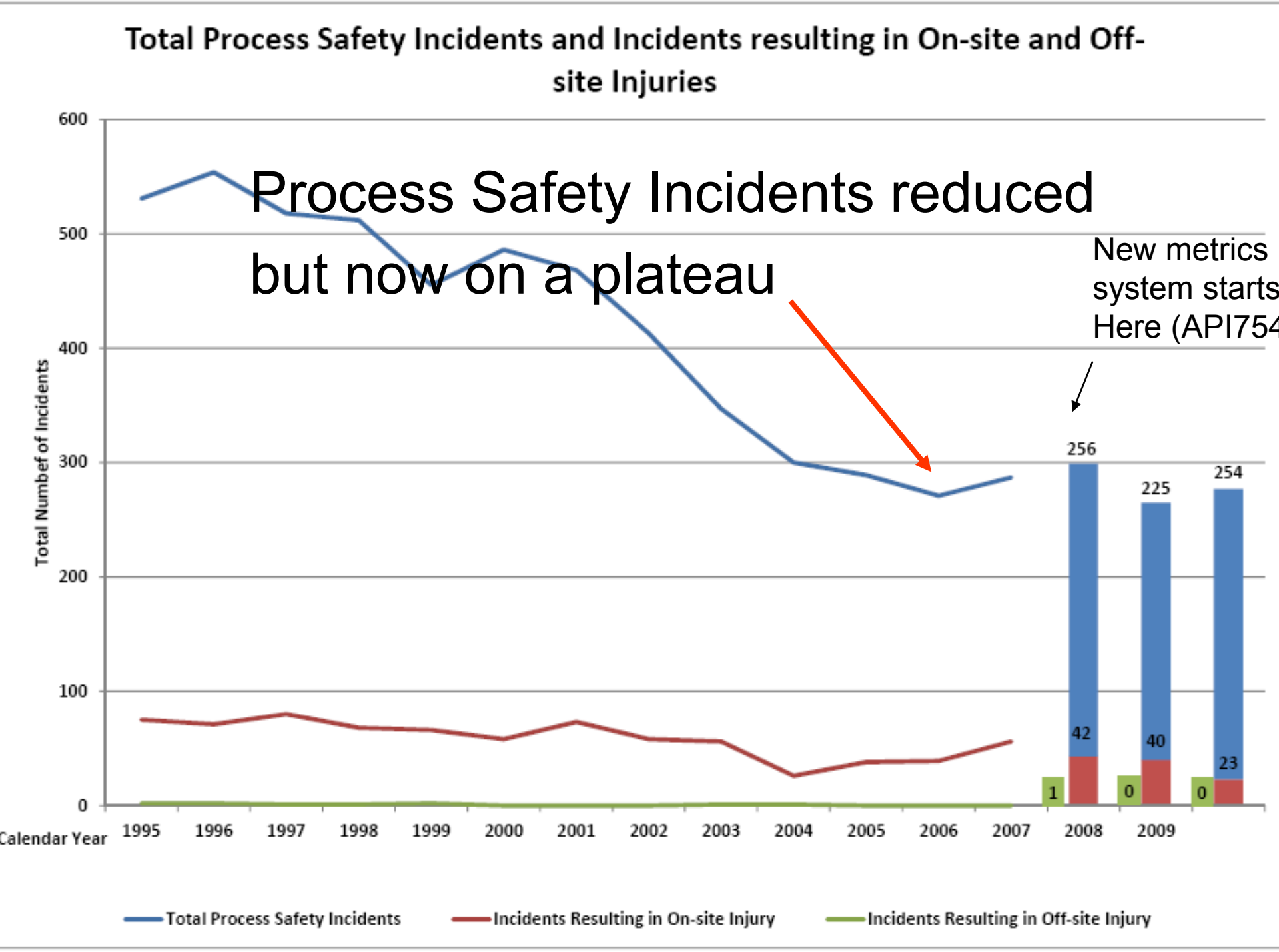


Improvements in Responsible Care(c)

- Foster mutual trust
- Provide continuous monitoring of performance

Response

- American Chemistry Council (ACC) metrics for Process Safety Incident reporting strengthened in responsible Care program
- CEFIC metrics – similar
- EPSC (Reporting and monitoring tool (FERRET)


Total Process Safety Incidents and Incidents resulting in On-site and Off-site Injuries
Process Safety Incidents reduced
but now on a plateau
New metrics system starts Here (API754
Total Numbef of Incidents
600
500
400
300
200
100
0
256
225
254
42
40
23
1
0
0
Calendar Year
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Total Process Safety Incidents
Incidents Resulting in On-site Injury
Incidents Resulting in Off-site Injury

Strengths, weaknesses and necessary changes

- Major strength:
  - Good participation
  - Reporting was simply based on numbers of incidents which met the standard definition
  - Mandatory for American Chemistry Council members
- Major Weakness:
- Changes:
  - Adjustments to „thresholds" for reporting
  - Severity assessment and reporting
  - Endorsed by American Petroleum Institute and Center for Chemical Process Safety (Bodies which did the work of upgrade)
  - Published as a standard ANSI/API 754
  - Some early results show up in the previous graph and analysis follows….

Process Safety Incidents
2010 Calendar Year

254 Total Incidents

Severity Rating of Negligible

Severity Rating of 4

Severity Rating of 3

Severity Rating of 2

Severity Rating of 1

US Data from ACC

Sample of public reporting in U.S. (ACC website)

	Total # Incidents	Negligible Incidents	Level 4 Incidents	Level 3 Incidents	Level 2 Incidents	Level 1 Incidents
Company Name	2010	2010	2010	2010	2010	2010
3M	0	0	0	0	0	0
Afton Chemical Corporation	0	0	0	0	0	0
Air Liquide USA LLC	0	0	0	0	0	0
Air Products and Chemicals, Inc.	9	1	5	3	0	0
Akzo Nobel Chemicals Inc.	4	0	2	2	0	0
Albemarle Corporation	5	0	3	2	0	0
Anderson Development Company	0	0	0	0	0	0
Arch Chemicals, Inc.	0	0	0	0	0	0
Aristech Acrylics LLC						
Arkema Inc.	8	0	3	5	0	0

Now in Europe – Process Safety Incidents

- European Federation of Chemical Company Associations (CEFIC) publishes its Process Safety Incident reporting system
  - Hopefully this will become publicly available
- The oil companies' European association for environment, health and safety in refining and distribution (CONCAWE) make public reports

In conclusion

- We have a long way to go
- If you worry about the cost of safety, try having an accident to see what real cost is! (Prof. Trevor Kletz)

- Thank you..