Process Safety Value and Learnings

Central Valley Chemical Safety Day
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Key Points

• Process Safety compliance experience and risks
• A look at one Process Safety leverage point
• Future direction and activities
Process Safety is:

A practice for ensuring containment of chemicals and other hazardous substances. The PSM practice allows for the proactive identification, evaluation and mitigation of releases that could occur as a result of failures in process, procedure or equipment.
Experience and risks

• Flixborough, England, June 1, 1974

• Mexico City, Mexico, November 19, 1984

• Bhopal, India, December 3, 1984

• Piper Alpha Platform, North Sea, July 6, 1988

• Texas City Refinery, March 3, 2005

• Deepwater Horizon / Macondo, April 20, 2010
Key Elements

- Process safety information
- Process hazard analysis
- Operating procedures
- Training
- Contractors
- Pre-startup safety review

- Mechanical integrity
- Hot work permit
- Management of change
- Incident investigation
- Emergency planning and response
- Compliance audits
- Employee participation
Leverage point: Incident investigations

- Process Safety incident investigations
  - “...incident that resulted in, or could reasonably have resulted in a catastrophic release of highly hazardous chemical in the workplace..”
- To get ahead of potential PS program health problems (LOPC or abnormal situation reporting):
  - Follow API 754 Release Reporting Guidelines
  - Consider prompt self-reporting of:
    - any LOPC
    - fire or evidence of fire
    - explosion and/or over pressure resulting in distortion
    - critical process alarm, including ESD activations
    - failure of safety critical equipment (SCE)
    - encroachment
    - NDE results < Tmin
Leverage point: Incident investigations

- Vociferously read and digest post incident reports of others to look for parallels that could occur in your operations
  - Longford Incident 9/25/1998 Australia*
- Corporate headquarters should maintain safety departments, which can exercise effective control over the management of major hazards
- All major changes, both organizational and technical, must be subject to careful risk assessment
- Alarm systems must be designed so that warnings of trouble do not get dismissed as normal (normalized)
- Frontline operators must be provided with appropriate supervision and back up from technical expert
- Routine reporting systems must highlight safety-critical information
- Communication between shifts must highlight safety-critical information
- Incident reporting systems must specify relevant warning signs. They should provide feedback to reporters and opportunities for reporters to comment on feedback
- Reliance on lost-time injury data in major hazard industries itself a major hazard
- A focus on safety culture can distract attention from the management of major hazards
- Maintenance cutbacks foreshadow trouble
- Auditing to be good enough to identify bad news and ensure it gets to the top
- Companies should apply the lessons of other disasters

* Excerpts from Royal Commission on Longford Gas Plant Disaster and “Lessons from Longford” - Andrew Hopkins 5/2000
Leverage point: Incident investigations

Grangemouth 5/29/2000 Incident Scotland*

- BP Group and Complex Management did not detect and intervene early enough on deteriorating performance;

Lesson 1 - Major accident hazards should be actively managed to allow control and reduction of risks. Control of major accident hazards requires a specific focus on process safety management over and above conventional safety management.

Lesson 2 - Companies should develop key performance indicators (KPI’s) for major hazards and ensure process safety performance is monitored and reported against these parameters.

Wider Messages for Industry

Message 1 - Major hazard industries should ensure that the knowledge available from previous incidents both within their own organization and externally are incorporated into current safety management systems.

Message 2 - Operators should give increased focus to major accident prevention in order to ensure serious business risk is controlled and to ensure effective corporate governance.

* Major Incident Investigation Report BP Grangemouth Scotland 8/18/2003 - Health and Safety Executive
Leverage Point: Incident Investigations

- Texas City refinery incident (Baker Report)*
  A. BP’s incident goal of “no accidents, no harm to people” emphasized personnel safety, but not process safety. BP interpreted improving personnel injury rates as an indication of acceptable process safety performance.
  B. BP’s corporate safety management system does not ensure timely compliance with internal process safety standards (equipment standards, rupture disks under relief valves, critical alarms and ESD’s, area classification, and near miss investigation).
  C. BP primarily used injury rates to measure process safety performance; its reliance on injury rates significantly hindered its perception of process risk (see corporate safety culture). **BP has not instituted effective root cause analysis procedures to identify “systemic” causal factors that may contribute to future accidents.** BP’s PSM system likely results in under reporting of incidents and or near misses...
  D. BP has sometimes failed to address promptly and track to completion process safety deficiencies identified during hazard assessments, audits, inspections, and incident investigations. Especially apparent with overdue mechanical integrity inspection / testing. (See process safety management systems)

“Despite some significant progress with process safety indicator in the downstream oil industry, in the offshore sector BP, Transocean, industry associations, and the regulator had not effectively learned critical lessons of Texas City and other serious process incidents at the time of the Macondo blowout.” Chemical Safety Board (CSB) Team public hearing July 24, 2012
<table>
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<tr>
<th>Findings / Recommendations</th>
<th>Longford</th>
<th>Grangemouth</th>
<th>Texas City</th>
<th>Challenger</th>
<th>Columbia</th>
<th>Macondo</th>
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A way forward: inherently safe design

- **Minimize**: Reducing the amount of hazardous material present at any one time, e.g. by using smaller batches
- **Substitute**: Replacing one material with another of less hazard, e.g. cleaning with water and detergent rather than a flammable solvent
- **Moderate**: Reducing the strength of an effect, e.g. having a cold liquid instead of a gas at high pressure, or using material in a dilute rather than concentrated form
- **Simplify**: Designing out problems rather than adding additional equipment or features to deal with them. Only fitting options and using complex procedures if they are really necessary
An example of ISD under evaluation

- Current “as is” situation: Water plants currently using 35% Hydrochloric Acid for water treatment
- If LOPC of 35% HCL, significant onsite and potential offsite impacts could occur
- “To be” condition: consider replacement or moderation of material in use
Evaluation of options: HCL vapor pressure

Vapor Pressure mm Hg vs Concentration %

- 35% Concentration (current)
- 25-28% (proposed)
Chemical Name: HYDROCHLORIC ACID
Solution Strength: 35% (by weight)

Hazardous Component: HYDROGEN CHLORIDE
Wind: 4 miles/hour from n at 3 meters

THREAT ZONE:
Model Run: Gaussian
Orange: 255 yards --- (20 ppm - ERPG-2)
Yellow: 681 yards --- (3 ppm - ERPG-1)

Time: March 5, 2014 0734 hours PST (using computer’s clock)
Chemical Name: HYDROCHLORIC ACID
Solution Strength: 28% (by weight)

Hazardous Component: HYDROGEN CHLORIDE
Wind: 4 miles/hour from n at 3 meters

THREAT ZONE:
Model Run: Gaussian
Orange: 59 yards --- (20 ppm - ERPG-2)
Yellow: 171 yards --- (3 ppm - ERPG-1)

Note: Threat zone was not drawn because effects of near-field patchiness make dispersion predictions less reliable for short distances.
Questions or thoughts?