

CE 400 / CE 500

Process Safety Management

Lecture 02 Course Introduction

Elements of a PSM Program

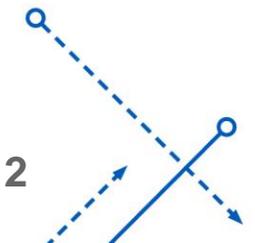
Instructor: David Courtemanche



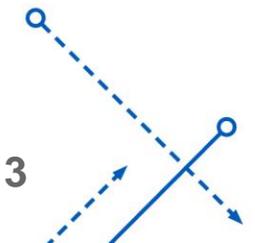
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Infamous Incidents in Chemical Process Industry

- Note that we say “incident” and not “accident”
 - Accidents “just happen”. Incidents can be prevented.
- **Flixborough, England**
 - Rupture of temporary line leads to release of 30 tons of cyclohexane
 - Explosion killed 28 people
- **Bhopal, India**
 - Water contamination in tank leads to undesired exothermic reaction
 - Toxic release kills over **2000** people, injures 20,000 more

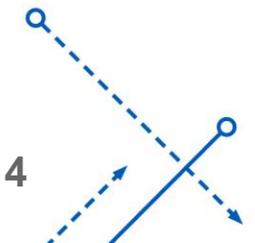


- **Pasadena, Texas**
 - Release of 85,000 pounds of mixture of ethylene, isobutane, hexane, and hydrogen leads to massive explosion
 - Explosion killed 23 people and leveled the plant
- **Texas City, Texas**
 - Issues during start up of a process unit lead to large release of flammable material
 - Explosion killed 15 people and injured 180 more
 - Many killed were in office trailers that could have been located elsewhere

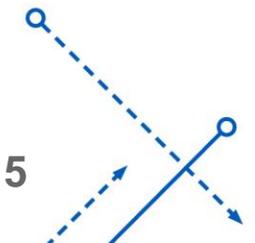


Example of chemical reactivity hazards

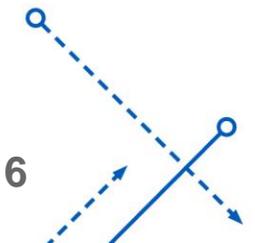
- <https://www.csb.gov/t2-laboratories-inc-reactive-chemical-explosion/>
- Topics that we will go into more detail as the semester progresses:
 - Chemical Reactivity – exothermic release of energy
 - Relief Design
 - Management of Change
 - Hazards Analysis
 - Facilities Siting



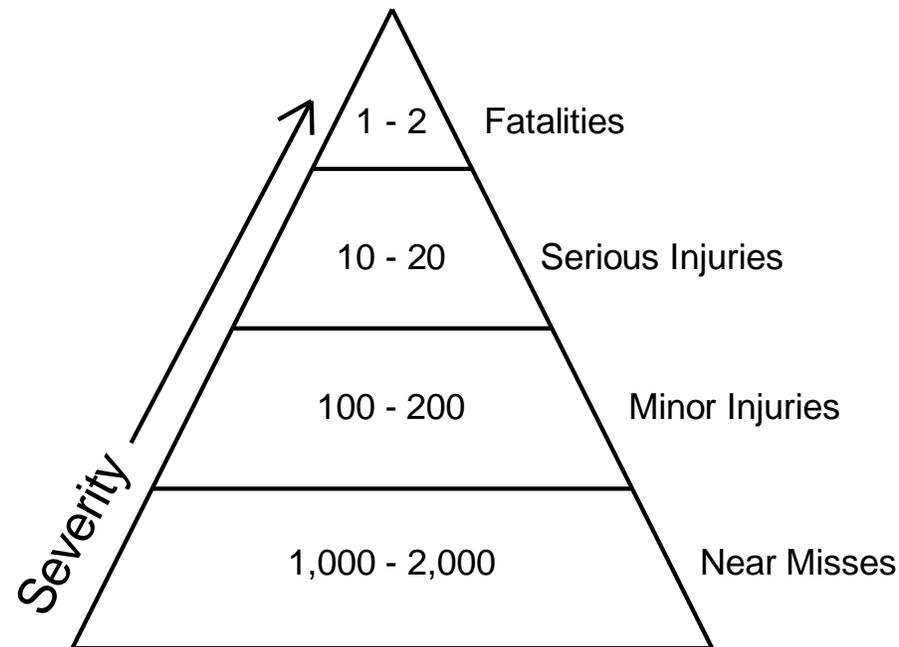
- Process Safety Management (PSM) is an organized program with the purpose of preventing Process Hazards Incidents
 - It is much more rigorous than “***being careful***”
- In the United States it is mandatory that businesses that fall under OSHA Standard 1910.119 follow the directives of that standard
 - Handling large quantities of specific chemicals
 - Handling large quantities of flammable chemicals
 - Defined by Flashpoint and boiling point
 - Flashpoint is the temperature where a liquid has sufficient vapor pressure to form a flammable atmosphere
 - <https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.119>



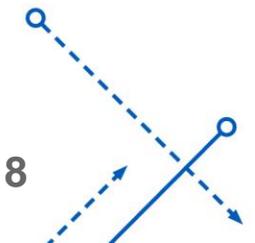
- A responsible organization will develop a safety culture
- This means that operating in a safe manner will be a undisputed priority in everything that the company does
- The impact on safe operation will be considered for:
 - Every new operation or product
 - Every modification to the process
 - Every step of every operating or maintenance procedure
 - Training of every personnel change
 - New employees
 - Employees taking on new roles



- Although the primary concern is to prevent Serious Injuries and Fatalities, all deviations from standard operations must be dealt with in serious manner
- Not taking care of the “little things” will lead to the occurrence of “big things”



- OSHA – Occupational Safety and Health Administration
- Part of the United States Department of Labor
- OSHA 1910.119 is the regulating document that mandates Process Safety Management programs for the chemical industry



- In response to catastrophic events in the Chemical Process Industry which occurred in the mid-1980s to early 1990s the US government agency OSHA (Occupational Safety and Health Standards) promulgated* a mandatory standard for Process Safety Management
- <https://www.osha.gov/Publications/osha3132.html>
- Appendix A of this document has a list of 130 specific toxic and reactive chemicals and their quantities which place an operation under this standard
 - Any flammable liquid or gas in excess of 10,000 pounds also qualifies

* put (a law or decree) into effect by official proclamation

- This regulatory standard is actually quite flexible for each company to develop their own methods with which to comply
- That does NOT mean it is easy to comply or that the government does not hold companies accountable for failure to meet the intent and letter of the law
- Following this standard gives a structured method to pursue Process Safety, as opposed to “let’s be careful”
- There are 14 elements prescribed for a Process Safety Management program
- Typically a corporation will have their own Corporate Standards which set up the structure and requirements of each site’s PSM program
 - The standard must be written such that if a site meets the requirements of the corporate standard they will be in compliance with OSHA
- Each site then has a manual with the specific details of how they will comply with the corporate standard

Develop and maintain written safety information identifying workplace chemical and process hazards, equipment used in the processes, and technology used in the processes

- Proper documentation of the process technology is necessary in order to train new employees and to be used in assessing hazards.
- In addition to detailing the hazards we need to detail:
 - Equipment information (volumes, dimensions, pressure and temperature ratings, materials of construction, etc)
 - Operating limits (flows, concentrations, temperatures, pressures, etc)
 - Safeguards
 - Process chemistry, process steps, flow diagrams, etc

Perform a workplace hazard assessment, including, as appropriate, identification of potential sources of accidental releases, identification of any previous release within the facility that had a potential for catastrophic consequences in the workplace, estimation of workplace effects of a range of releases, and estimation of the health and safety effects of such a range on employees

- This is a Process Hazards Analysis (PHA)
- PHAs allow us to identify potential situations **BEFORE** they happen
- Often times when the topic of a PHA comes up, someone will say, “Oh, you’re doing a HAZOP?”
 - HAZOP (Hazards and Operability) is **one** method to do **one** section of a PHA!
 - We will spend more time later in the semester on this topic

Consult with employees and their representatives on the development and conduct of hazard assessments and the development of chemical accident prevention plans and provide access to these and other records required under the standard

- This one is pretty simple – the operators and mechanics need to be involved in the teams conducting PHAs and Emergency Response Plans
 - They also need to have access to these documents if they want to see them
- OSHA requirements aside: I don't feel that you can do an acceptable job on these activities if the operators and mechanics are not involved

Establish a system to respond to the workplace hazard assessment findings, which shall address prevention, mitigation, and emergency responses

- Another simple one: You have to have a system in place to track the recommendations from your PHA to make sure that they actually get done.
- Otherwise your PHA is really not going to improve the safety of your facility
 - In a manufacturing operation everyone is very busy and long term recommendations will always be put off and probably forgotten if they are not tracked!

Review periodically the workplace hazard assessment and response system

- If you do not regularly audit your system for administering the PSM program it will eventually stop working
 - PHAs won't get done
 - Recommendations won't get completed
 - Process Technology package will become outdated
 - Operating Procedures will become outdated
 - The list goes on and on!