In Memory

This presentation is respectfully prepared and presented in memory of the 23 people who died in the explosion at the Phillips Petroleum Company’s Pasadena, Texas facility on October 23, 1989.
Outline

• “Process Safety” Thirty Years Ago
• Process Description
• The Incident
• Process Safety Today
• Questions?

“Process Safety” Thirty Years Ago

• “Process Safety” term
• US Regulatory history and response
• Industry record since then
“Process Safety” 30 years ago

- There were process safety-related efforts, such as
  - Hazards identification methods
  - Hazards reviews
- The “Process Safety” and “Process Safety Management (PSM)” terms as we know them today did not exist
- There were no “Process Safety Engineers”
- There were no “Process Safety Coordinators”

US Regulatory history and response

- Although some US regulations via OSHA existed, these focused on workplace and personal safety and health
- The Pasadena explosion accelerated development of OSHA’s “Process Safety Management” regulation (issued in 1992)
  
  Note: Other regions in the world had developed or have developed similar process safety–related regulations over the last four decades
Industry record since then

Significant incidents have occurred since then:

- Refinery explosion and fire in Texas City (2005)
  15 fatalities, 180 injuries
- Offshore rig, explosion, fire, and oil spill (2010)
  11 fatalities, 17 injuries
- Toxic chemical release in LaPorte, TX (2014)
  4 fatalities

Outline

- “Process Safety” Thirty Years Ago
  - Process Description
    - The Incident
    - Process Safety Today
    - Questions?
  - Operations
  - Maintenance
Operations

Reactor to HDPE Recovery

Loop Reactor

Feed

Settling Legs

8” Ball Valves

Takeoff Valves

Flash Gas

Flash Tank

High Density Polyethylene (HDPE) Recovery

Operations

Expanded Reactor View

Six Loop Reactors in Plant 5

150 ft. tall
30” Diameter
600 psi
200 °F

Ethylene Isobutane
Hydrogen/Hexene Catalyst

8” Ball Valves (6)

Highly flammable
Easily ignitable

Operations

Ball Valve Operation

Loop Reactor

Polyethylene “fluff”

8 ft. long Settling Legs

Takeoff Valves

8” Ball Valves

Air actuated
Settling Leg Maintenance

Performed with Loop Reactor running
Steps when unplugging settling leg

1) Close the 8” Ball Valve (Indicator reads closed)
2) Disconnect the 8” Ball Valve actuator air supply and discharge hoses
3) Lock the 8” Valve stem in its closed position
4) Remove the takeoff valve
5) Manually pull the log out

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• Summary
• Findings
Incident Impact

- 23 fatalities
  (22 within 150 ft. of the loop reactor)
- > 130 injuries
- Estimated 85,000 lbs were released and ignited within 2 min
- Blast force equivalent to 2.4 tons of TNT
- Vapor Cloud Explosion registered 3.5 magnitude on the Richter scale
- Significant property damage
Maintenance As Written

Steps when unplugging settling leg
1) Close the 8” Ball Valve (Indicator reads closed)
2) Disconnect the 8” Ball Valve actuator air supply and discharge hoses
3) Lock the 8” Valve stem in its closed position
4) Remove the takeoff valve
5) Manually pull the log out

Maintenance Issue

However, day of incident

Cannot reach Log fragment and then manually pull the log out
Findings after the explosion

Findings
1) The 8” Ball Valve stem was unlocked
2) The actuator air supply and discharge hose connections were reconnected in reverse
3) The 8” Ball Valve will malfunction open if the air supply is connected in reverse

Note: This data was obtained afterwards during the investigation.

Feasible conclusion due to findings

Reactor at 600 psi
Open 8” Valve
Plug
- Plug discharged out due to reactor pressure
- Nothing to stop flow from reactor
- Entire contents of reactor released outdoors

Company understood hazard and risk, thus the maintenance procedure with lockout and disconnected air supply

Takeoff valve removed (open to atmosphere)
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Process Safety Today

Lessons Learned from this incident
• Adhere to Safe Work Practices (SWP)
• Comply with standards and regulations
• Manage disabling of safeguards
• Adhere to operational discipline
• Live in the safe operating zone

These lessons still apply today!
Lesson that still applies today:

Safe Work Practices (SWP) exist for a reason

If a SWP suffers from a “workaround” *(when the exact steps are not taken to get to the same goal)*, there is the danger of a “normalization of a deviance” *(where the deviation becomes routine)*

Note: Normalization of Deviance was attributed to poor process safety culture at NASA for the 1986 Shuttle disaster and the 1984 Bhopal disaster

The “SWP” in the Pasadena explosion was the maintenance issue which did not address an known engineering design (the next lesson)

Lesson that still applies today:

Standards exist and regulations have been created for worker’s benefit

Many exist because of previous incidents which have caused harm

In Pasadena’s case, there was a corporate standard which could not be performed during the maintenance due to the existing design of the reactor system (corporate standard known as a “double block and bleed design”)

Building a “SWP” to deviate from a known corporate standard should be seriously addressed and not implemented
Manage Disabling of Safeguards

Lesson that still applies today:
Safeguards are designed and implemented to protect workers
Disabling them for any reason, even during a maintenance task, should not be performed without proper understanding of the risks, especially on a live process.

Adhere to Operational Discipline

Lesson that still applies today:
Every one must carry out each task the right way, every time when sustaining an effective Process Safety Program.

Everyone:
• Engineers
• Technicians
• Operators
• Mechanics
• Electricians
• Supervisors
• Managers
Operational Discipline and...

Safety Culture and Leadership:
- All levels in an organization

Strong leadership drives the organization’s process safety culture, resulting in strong process safety performance.

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Operational Discipline and...

Process Safety Systems (which include):
- Safe Work Practices (SWP)
- Standards
- Operating Procedures
- Maintenance Procedures
- Management of Change (MOC)
- And many other systems
Process Safety Today

Lessons Learned from this incident

- Adhere to Safe Work Practices (SWP)
- Comply with standards and regulations
- Manage disabling of safeguards
- Adhere to operational discipline
- Live in the safe operating zone

Live in the Safe Operating Zone

Lesson that still applies today:

*Poor* Process Safety Leadership  
*Weak* Operational Discipline  
*Ineffective* Process Safety Systems

- Poor process safety performance
- Greater process safety risk
- More incidents

Don’t operate in the unsafe zone!
Lessons Learned from this incident

• Adhere to Safe Work Practices (SWP)
• Comply with standards and regulations
• Manage disabling of safeguards
• Adhere to operational discipline
• Live in the safe operating zone

Any questions on these?

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