CSB Formosa (2004) Case Study

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U.S. Chemical Safety Board (CSB) Investigation Report: Formosa Plastics Vinyl Chloride Explosion, 2004

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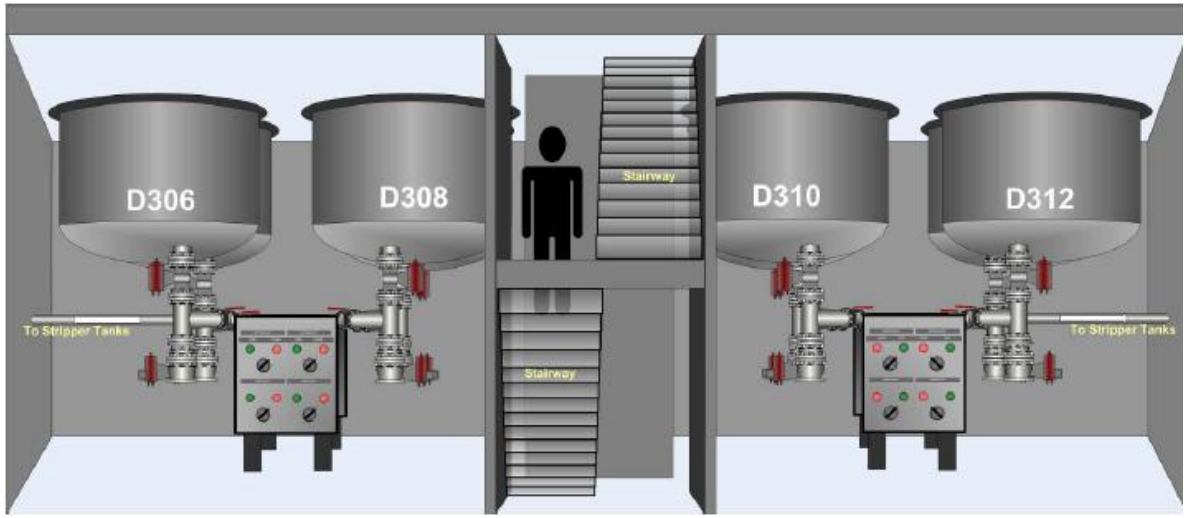
What Happened

- During a routine cleaning operation on a PVC reactor (D306), an operator mistakenly opened the nearby bottom valve of a polymerization reactor that was currently in operation (D310), apparently bypassing an active pressure interlock, instead of the bottom valve of the reactor that was being cleaned.
- The contents of the operating reactor quickly filled the room, resulting in an explosion and fire that destroyed most of the reactor facility and adjacent warehouse.
- As shown in the figure below, the reactors are near each other and have similar appearance.



Watch the CSB video if desired

Perhaps it's easy to blame the operator, but why would an operator do this?

CSB Incident Root Causes

- Borden Chemical (previous owner of the site) did not adequately address the potential for human error:
  - Borden Chemical did not implement 1992 process hazard analysis (PHA) recommendations to change the reactor bottom valve interlock bypass to reduce potential misuse.
  - In a 1999 PHA, Borden identified severe consequences for opening the reactor bottom valve on an operating reactor, but accepted the interlock, controlled by procedures and training, as a suitable safeguard.

CSB Incident Root Causes

- Formosa-IL did not adequately address the potential for human error:
  - After a 2003 incident at FPC USA's Baton Rouge facility, Formosa-IL did not recognize that a similar incident could occur at the Illiopolis facility or take action to prevent it.
  - Formosa-IL site management did not implement corrective actions identified in the investigation of a similar incident in February 2004 at Formosa-IL.
- Formosa-IL relied on a written procedure to control a hazard with potentially catastrophic consequences

How does our site protect against human error?

What is Operational Discipline?

- Following established system and procedural requirements correctly every time
- **Organizational OD:** for site or business leadership to create the programs and work environment and to provide appropriate resources that support desired behaviors
- **Personal OD:** for individual workers at all levels of the organization to know what they need to do their work correctly and safely every time

An effective OD program helps lead to
predictable behavior and actions that lead
to consistent execution of system requirements

OD Considerations

It is probably easy to blame the operator who bypassed procedures.

However, the deeper and more important lessons lay in the organizational failures that allowed unsafe practices to become normalized.

What are some of the OD organizational and personal failures that seem to have occurred in this incident?

Organizational OD Failures

- Management was apparently aware of repeated procedural shortcuts and previous incidents but failed to correct them in a timely way.
- PHA recommendations were not implemented or implemented quickly enough.
- Safe cleaning operations were dependent on procedures that had not been fully evaluated in PHAs.
- The similarity of reactor design did not differentiate reactors easily, especially with most instrumentation in the upper control room.
- Leadership apparently did not establish clear expectations or accountability for following procedures.

Personal OD Failures

- Individual operators apparently routinely chose to bypass written procedures.
- Workers apparently did not speak up or stop work when they saw or were aware of unsafe practices.
- Awareness of the operating environment in this situation, while aggravated by lack of local instrumentation, was insufficient.

Key Lessons

- OD has both organizational and personal dimensions — weak organizational OD is often a root cause that enables personal failures.
- A culture that tolerates shortcuts creates the conditions for potentially major incidents.
- Management must actively monitor and timely correct deviations rather than accepting them or appearing to endorse them.
- Strong OD and sensitivity to operations are essential for keeping hazardous materials “in the pipes.”

Review your site's OD through the lens of the Formosa incident.

If secretly surveyed, what percentage of personnel would say they always follow procedures as required without shortcuts? (It's not always 100%!)

Are procedural deviations being tolerated?

What systems are in place to catch and correct them?

What is one practical step your team could take to strengthen OD?