U.S. Chemical Safety and Hazard Investigation Board

Safety for one, safety for all: Overcoming challenges to sharing chemical incident data

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American Chemical Society / San Diego
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@Kulinowski
@chemsafetyboard
#ACSANDIEGO

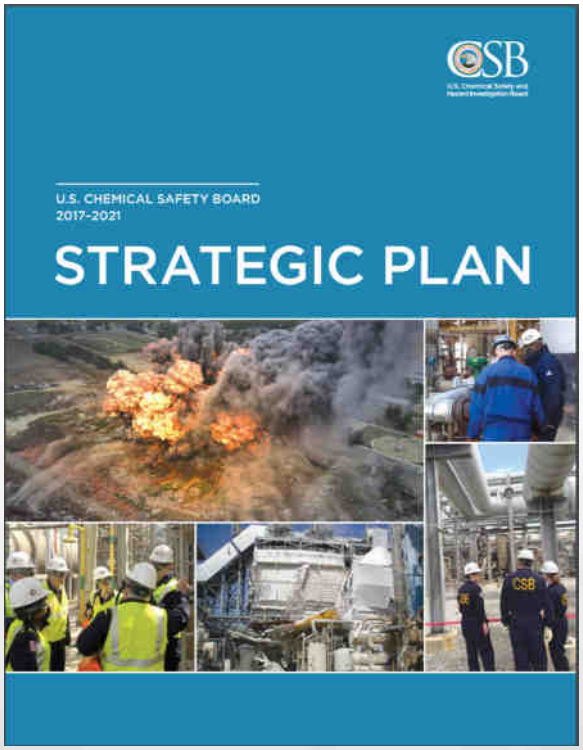

CBS
EVENING NEWS
WITH JEFF GLOR
DEADLY
PLANT EXPLOSION

Vision:

A nation safe from chemical disasters.

Mission:

Drive chemical safety change through independent investigations to protect people and the environment.



High-Impact Investigations

Arkema Chemical Fire / Crosby, TX
August 31, 2017

Texas Tech University / Lubbock, TX
March 17, 2019

Freedom Industries / Charleston, WV
January 9, 2014

ITC / Deer Park, TX
March 17, 2019

Why Share?

- If it happened to you, chances are it happened to someone else (or will).
- Lessons from incidents and near misses can help prevent future incidents.

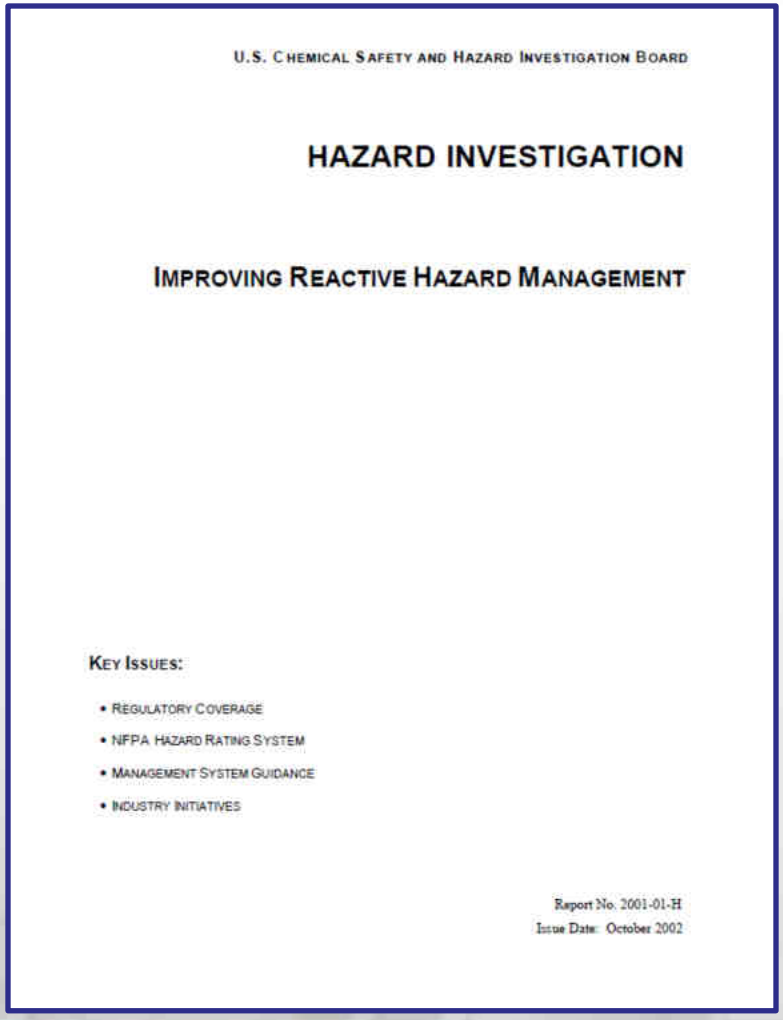
Why Not Share?

- Desire for anonymity
- Reputation
- Litigation
- Public pressure
- Regulation
- Cost

Runaway Chemical Reaction

On April 8, 1998, an explosion and fire occurred during the production of Automate Yellow 96 Dye at the Morton International Inc. plant in Paterson, New Jersey. The explosion and fire were the consequence of a runaway reaction, which overpressurized a 2000-gallon chemical vessel and released flammable material that ignited. Nine employees were injured.

CSB Study Collected Information on Reactive Hazards



U.S. CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD

HAZARD INVESTIGATION

IMPROVING REACTIVE HAZARD MANAGEMENT

KEY ISSUES:

- REGULATORY COVERAGE
- NFPA HAZARD RATING SYSTEM
- MANAGEMENT SYSTEM GUIDANCE
- INDUSTRY INITIATIVES

Report No. 2001-01-H
Issue Date: October 2002

Major Findings

- 167 reactive hazards incidents between 1980-2001
- 108 fatalities
- Public affected by 50 incidents
- 50% of incidents involved chemicals not covered by OSHA or EPA process safety regulations

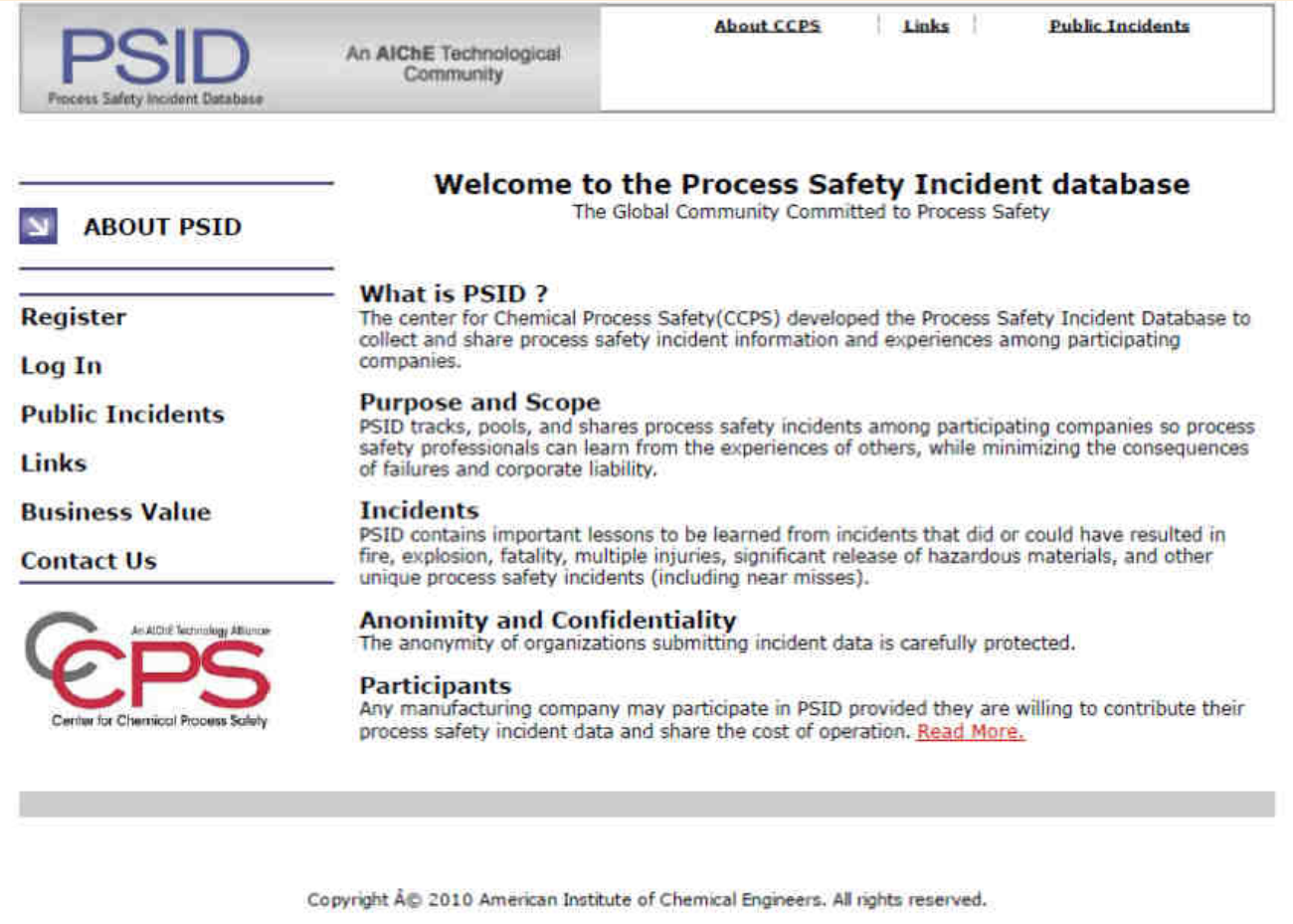
Study Limitations

- No single data source provides a comprehensive collection of chemical incidents
- Data often incomplete
- Incident data don't contribute to root cause analysis
- Few reporting requirements for no- or low-consequence events

CSB Study Calls for Information Sharing on Reactive Hazards

CSB RECOMMENDATION to INDUSTRY:
Develop and implement a program for reporting reactive incidents that includes the sharing of relevant safety knowledge and lessons learned with your membership, the public, and government to improve safety system performance and prevent future incidents.

RESULT:
The American Chemistry Council developed an internal system to annually collect a summary of process safety incident data from their members and pointed to other groups as more appropriate recipients of this recommendation.



Attributes:

- Collects near misses as well as incidents
- Anonymity and confidentiality are protected
- Members only. Not open to public or government.

Process Safety Messages for Manufacturing Personnel

CCPS has developed a product aimed at delivering process safety messages to plant operators and other manufacturing personnel. The monthly one-page *Process Safety Beacon* covers the breadth of process safety issues. Each issue presents a real-life accident, and describes the lessons learned and practical means to prevent a similar accident in your plant.

Process Safety Beacon

Register to receive the Beacon as a free monthly email by clicking here.

This archive of Process Safety Beacon can be searched by the keyword list below.

Please Log In to access the printable versions of the Beacon products. Please see the Membership page to find out if your organization provides access to the printable version of the Beacon products.

Language Filter: - All Languages -

Keyword Search: Activated Carbon Absorbers

AND (optional) ----------

Search

If the translation for a keyword is not available, the English keyword is shown in parenthesis.

Month • Year • Title

- 06 • 2019 • Corrosion under insulation
- 05 • 2019 • Surrounded by warning signs?
- 04 • 2019 • What if that "wrong" instrument reading is correct?
- 03 • 2019 • Undetected Ball Valve Failure
- 02 • 2019 • Critical safeguards must be kept functional!
- 01 • 2019 • Process Safety Stories
- 12 • 2018 • Common Cause Failures
- 11 • 2018 • Accumulation of small changes leads to an explosion
- 10 • 2018 • Hazardous Energy!
- 09 • 2018 • What if your process is acting differently?

CCPS Center for Chemical Process Safety
www.aiche.org/ccps

Process Safety Beacon

http://www.aiche.org/CCPS/Publications/Beacon/index.aspx

Messages for Manufacturing Personnel

This issue sponsored by ioMosaic
www.iomosaic.com

Accumulation of small changes leads to an explosion

November 2018

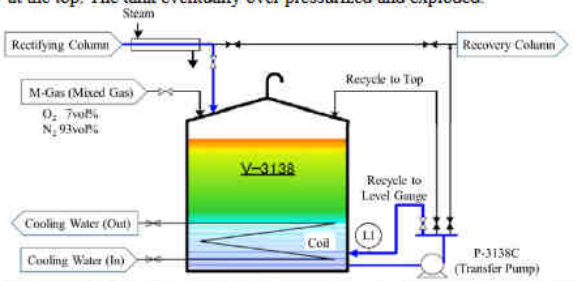
In September 2012, at an industrial site in Himeji, Japan, a 70 cu m (18,500 US gal) fixed roof acrylic acid (AA) tank exploded, and a fire followed. There was one fatality, a fire-fighter. 36 people were injured – 2 policemen, 24 fire-fighters, and 10 plant workers. The tank was destroyed and nearby facilities were significantly damaged (Photo 1). There were no major impacts to the neighborhood and environment.

The tank provided intermediate storage between two distillation columns for purifying AA. Originally the tank had been used at full capacity. The contents were cooled and mixed by pumping from the bottom of the tank to the top. Later, the normal operating level was reduced to a level below the cooling coil. The contents were no longer recirculated to the top of the tank, but instead to a nozzle near the bottom that was also used to connect a level gauge (Drawing 2).

At the time of explosion, the plant was conducting a test of the downstream distillation column, which required stopping feed from this tank. The level of the tank gradually increased to its original operating level. Without recycle to the top of the tank, the AA above the cooling coils was not mixed and cooled. The temperature of the incoming AA was believed to be below the onset temperature for polymerization, and the AA contained polymerization inhibitor. However, the temperature in the tank increased, especially at the top. The tank eventually over pressurized and exploded.

Courtesy of Nippon Shokubai

Photo 1: Destroyed AA Tank



Drawing 2: Only the bottom of the tank was cooled, the liquid above became hot

Reference: Nippon Shokubai Co., Ltd. Himeji Plant Explosion and Fire at Acrylic Acid Production Facility Investigation Report March 2013.

What happened?

- Originally the pipe feeding the tank was hot water jacketed to provide freeze protection, but this was changed to steam.
- Removal of a steam trap made temperature control unreliable.
- The top layer was no longer mixed with cooler AA, and stayed warm from incoming AA.
- There are two exothermic AA self-reactions – dimerization and polymerization. Polymerization inhibitor does not stop the dimerization reaction. Experiments showed that heat from dimerization raised the temperature sufficiently to start a runaway polymerization reaction.
- The hazard of heat from dimerization was not recognized, so recirculation to the top of tank was not resumed.
- The tank had no temperature indicator. The first indication of a problem was observation of AA vapors escaping from the top vent on the tank.

What can you do?

- Never make any changes to your plant, even changes you think are small, without following your plant Management of Change (MOC) procedures.
- When you see any change in your plant, ask if there has been an MOC review. If there has been, and you were not informed of the change, tell your supervisor. You should always be informed of changes in your plant that impact your job.
- If something is different from normal operation, confirm operating procedures or ask your supervisor what to do.
- Accumulation of small changes can cause an incident with a big consequence. All small changes must be identified and the risk to the total system analyzed and adequately managed.

Small changes can cause a big consequence!

Aviation Safety Reporting System

- Voluntary self-reporting of "actual or potential discrepancies and deficiencies involving the safety of aviation operations"
- Not for accidents or criminal activities
- Collected by a 3rd party, not shared with regulator
- Anonymized but allows for follow-up to gather additional information

Portion of Pilot Reporting Form

GENERAL FORM

DO NOT REPORT AIRCRAFT ACCIDENTS AND CRIMINAL ACTIVITIES ON THIS FORM.
ACCIDENTS AND CRIMINAL ACTIVITIES ARE NOT INCLUDED IN THE ASRS PROGRAM AND SHOULD NOT BE SUBMITTED TO NASA.
ALL IDENTITIES CONTAINED IN THIS REPORT WILL BE REMOVED TO ASSURE COMPLETE REPORTER ANONYMITY.

IDENTIFICATION STRIP: *Please fill in all blanks to ensure return of strip.*
NO RECORD WILL BE KEPT OF YOUR IDENTITY. This section will be returned to you.

TELEPHONE NUMBERS where we may reach you for further details of this occurrence.

HOME _____ HOURS _____

OTHER _____ HOURS _____

NAME (required)

ADDRESS/PO BOX (required)

ADDRESS LINE 2

CITY (required) STATE ZIP (required)

TYPE OF EVENT/SITUATION

DATE OF OCCURRENCE (MM/DD/YYYY)
MM/DD/YYYY

LOCAL TIME (24 HR. CLOCK) [HH:MM]
HH:MM

PLEASE FILL IN APPROPRIATE SPACES AND CHECK ALL ITEMS WHICH APPLY TO THIS EVENT OR SITUATION.

REPORTER Reset

- ○ Captain
- ○ First Officer
- ○ Pilot Flying
- ○ Pilot Not Flying
- ○ Relief Pilot
- ○ Check Airman
- ○ Single Pilot
- ○ Instructor
- ○ Dispatcher: ____ yrs
- ○ Other: ____

FLYING TIME (IN HOURS)

Total Time: ____ hrs

Last 90 Days: ____ hrs

Time in Type: ____ hrs

CERTIFICATES & RATINGS

(Select Certificate)

- ☐ Flight Instructor
- ☐ Instrument
- ☐ Multiengine
- ☐ Flight Engineer
- ☐ Other: ____

ATC EXPERIENCE Reset

- ○ FPL
- ○ Developmental

Radar: ____ yrs Supervisory: ____ yrs

Non-Radar: ____ yrs Military: ____ yrs

AIRSPACE

- ☐ Class A
- ☐ Class B
- ☐ Class C
- ☐ Class D
- ☐ Class E
- ☐ Class G
- ☐ Special Use
- ☐ TFR

CONDITIONS / WEATHER ELEMENTS

(Select Condition)

- ☐ Fog
- ☐ Snow
- ☐ Hail
- ☐ Thunderstorm
- ☐ Haze/Smoke
- ☐ Turbulence
- ☐ Icing
- ☐ Windshear
- ☐ Rain
- ☐ Other: ____

LIGHT / VISIBILITY

(Select Light)

Ceiling: ____ feet

Visibility: ____ miles

RVR: ____ feet

ATC / ADVISORY SVC.

(Select ATC)

ATC Facility Name: ____

AIRCRAFT 1

Your Aircraft Type ____ (Make / Model, e.g. B737; NOT N #, Flt #, etc)

Operator FAR Part (Select FAR Part) Other: ____

Operator (Select Operator) Other: ____

Mission (Select Mission) Other: ____

Flight Plan (Select Flight Plan)

Flight Phase (Select Flight Phase) Other: ____

Route in Use

- ☐ Direct
- ☐ Visual Approach
- ☐ Airway (ID): ____
- ☐ Oceanic
- ☐ None
- ☐ STAR (ID): ____
- ☐ Vectors
- ☐ Other: ____
- ☐ SID (ID): ____

IF MORE THAN ONE AIRCRAFT WAS INVOLVED, PLEASE ADD AN ADDITIONAL AIRCRAFT

Add Aircraft

LOCATION Reset

Altitude: ____ (single value) ○ MSL ○ AGL

Distance: ____ and/or Radial: (bearing) ____ from:

- ○ Airport ____
- ○ ATC Fac ____
- ○ Intersection ____
- ○ NAVAID ____

CONFLICTS Reset

Estimated miss distance in feet:

Horizontal ____ Vertical ____

Was evasive action taken? ○ Yes ○ No

Was TCAS a factor? ○ TA ○ RA ○ No

Did terrain warning system activate? ○ Yes ○ No

DESCRIBE EVENT/SITUATION

Keeping in mind the topics shown below, discuss those which you feel are relevant and anything else you think is important. Include what you believe really caused the problem, and what can be done to prevent a recurrence, or correct the situation.

CHAIN OF EVENTS

- How the problem arose
- Contributing factors
- How it was discovered
- Corrective actions

HUMAN PERFORMANCE CONSIDERATIONS

- Perceptions, judgements, decisions
- Actions or inactions
- Factors affecting the quality of human performance

NASA ARC 277B (May 2009) GENERAL FORM V1.3.2

ASRS Products and Services

ALERT MESSAGES

Safety information issued to organizations in positions of authority for evaluation and possible corrective actions.

QUICK RESPONSES

Rapid data analysis by ASRS staff on safety issues with immediate operational importance generally limited to government agencies.

ASRS DATABASE

The public ASRS Database Online and data available in Database Report Sets or Search Requests full filled by ASRS staff.

CALLBACK NEWSLETTER

Monthly newsletter with a lessons learned format, available via website and email.

FOCUSED STUDIES

Studies/Research conducted on safety topics of interest in cooperation with aviation organizations.

https://asrs.arc.nasa.gov/docs/ASRS_ProgramBriefing.pdf

Sample Reports

Air Carrier (FAR 121) Flight Crew Fatigue Reports
A sampling of reports involving air carrier (FAR 121) flight crew fatigue.

Near Midair Collision Incidents
Reports concerning near midair collision events.

Flight Attendant Reports
A sampling of Flight Attendant reports involving aircraft cabin issues.

Maintenance Reports
A sampling of reports from aircraft maintenance personnel.

CALLBACK

From NASA's Aviation Safety Reporting System

ASRS

■ I was flying my second Captain trip, and I was practicing [an] HGS CAT III Approach. Inexperience is definitely a risk factor.... The weather was calm and clear. Somewhere around the FAF, I became distracted and forgot to call for final flaps 30 and the landing checklist. I allowed myself to become completely engrossed by the procedures and callouts. Distraction was the second risk factor. Somewhere below the 500 foot callout, I heard, "TOO LOW FLAPS". I looked at the flap indicator and saw that the flaps were still at 15. I immediately called for flaps 30 [and the landing] checklist. The First Officer complied, and by the time we had completed the checklist, the radio altimeter was making the [altitude] callouts. Things happened so fast that I did not think to go around. Being rushed was the third risk factor. I landed, and realized on landing rollout that "TOO LOW FLAPS" is not a caution, but a warning. I was in violation of go-around/missed approach requirements.

Attributes of an Effective Incident Sharing System

- Voluntary
- Confidential
- Publicly available
- Non-punitive for noncriminal behavior
- Run by trusted independent 3rd party with subject-matter expertise
- Supports analysis of incident data

U.S. Chemical Safety and Hazard Investigation Board

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