National Safety Council
94th Annual Congress and Expo

Commitment to a Proactive Safety Culture: Abnormal Situation Recognition and Management

November 7, 2006
What is the CSB?

- Independent Federal Agency
- Authorized by 1990 Clean Air Act Amendments
- Authorized to Investigate Industrial Chemical Accidents and Recommend Prevention Measures
- Does not Fine or Promulgate Safety Regulations
What Is The CSB Structure?

- Currently have 3 sitting Board members
- 43 full time employees
- $9.2 million budget 2006
- 8 investigations completed in 2004
- 7 investigations completed in 2005
- 9 investigations underway
Notification of Incidents

- Reports from 6000 news sources on daily basis

- Report about 600 incidents per year
  - 84% are at companies < 500 employees
  - 62% are at companies < 100 employees

- 20 are serious enough for assessment

- 6-10 new investigations undertaken per year
  - 53% are companies with >500 FTE
Investigation Criteria

- Deaths or injuries onsite or offsite
- Property losses
- Offsite impact
  - Public/Environmental
- Incidents with broad national significance
- Resources available
CSB Mission is:

To *promote prevention of industrial chemical accidents*
What does prevention depend upon?

- Hazard Recognition
- Engineering and Design
- Management Systems
- Human Factors
Prevention?

- Is it an engineering problem?
- Is it a problem of employee compliance?
- Is it a matter of safety culture?
What is Safety Culture?

...*Development of the intellect* through training, education and experience.

*Enlightenment* that results from such training, education and experience...

*American Heritage College Dictionary*
The Billion Dollar Question is:

How *Do* You Prevent Accidents?
Let’s look at an engineering marvel but a safety culture failure
January 16, 2003
16 Days Later
Columbia Accident Investigation Board
Report Findings and Recommendations on Space Shuttle Disaster
August 26th, 2003
Accident Was *Not* An Anomalous, Random Event
Physical Cause

Breach in Thermal Protection System 81.7 seconds into flight caused by 3 lb insulating foam block hitting at 545 mph

Breach allowed hot air to melt wing structure resulting in shuttle break up and disintegration
Why Not Stop There?

We Know *What* Happened....

But.... Why?
Organizational Causes

- Changing priorities
- Budget cuts
- Inaction to warning events
- Reliance on safety history not good engineering and risk analysis
- Loss of knowledge and experience
- Compromised safety and technical organizations
- No abnormal operation recovery plan
- Complacency to inherent risks of space flight
“NASA will lose more shuttles and more astronauts unless it transforms its ‘broken safety culture’” NY Times, Aug 27, 2003
What does this have to do with industrial accident prevention?
Worlds Worst Industrial Chemical Accident

- Look For Root Causes, Management Systems and Safety Culture Problems

Bhopal India, December 1984
Play Video
Causes For Bhopal Accident

- Changing Priorities- (Profit to Jobs)
- Loss of maintenance
- Qualified supervision reduced
- Worker training inadequate
- Warnings not investigated or addressed
- Emergency and safety equipment broken
- Failure to recognize increasing risk
- No emergency response planning
An Incident that makes you wonder, “How far have we come in 20 years?”
March 23, 2005  Texas City, TX
15 Die in Refinery Fire  >170 Injured
Layout of Equipment in ISOM Unit

= trailer

ISOM

Blowdown

Warehouse

Splitter Tower
Incident Summary

• Splitter Tower overfilled and over pressurized

• Blowdown drum discharged to atmosphere

• Vapor cloud formed and ignited

• Occupied trailers nearby destroyed
Key Safety Issues

In 1992, OSHA cited a similar drum and stack at Texas City as unsafe. Citation dropped and drums never connected to flares

Raffinate splitter tower had history of abnormal startups were not investigated or corrected (16 in 5 years)

Between 1995 and incident, four liquid and gas releases of flammable material from the ISOM Unit blow down drum and stack occurred
Key Safety Issues

ISOM unit started up with existing malfunctioning level indicator, level alarm, and control valve

Operator and Supervisor inexperienced in ISOM Unit start up and emergency procedures

Occupied trailers placed too close to a process unit handling highly hazardous materials

Vehicular traffic uncontrolled in ISOM unit during turn around and start up
Complacency to inherent risk of ISOM Unit

• Reliance on past performance not good risk analysis or engineering practices
• Abnormal startups not investigated or fixed
• Loss of mechanical integrity program
• Broken indicators, alarms, and control valves
• Unsafe design vented flammable liquid and gas into operating area and sewers
• Supervisor not experienced in process
• Operator not adequately trained
• Failure to recognize increasing risk
Trailer Siting

- Fatalities and many injuries occurred in or around trailers sited as close as 121 feet from blow down drum.
- Trailers not designed to protect occupants from fire and explosion hazards.
- Trailers sited around process areas for convenience.
Trailer Siting

- Under company trailer siting policy, trailers considered to pose little or no danger

- Conformed with guidance published by the American Petroleum Institute (API),

- API 752 provides no minimum safe distances from process hazards for location of trailers in refineries and other chemical facilities
Unit Start-up: Mechanical Integrity Issues

- Proper working order of key process instrumentation was not checked as required by the start-up procedure
- The raffinate splitter tower was started up despite malfunctioning key process instrumentation and equipment
Unit Start-up

- The tower level rose for three hours. A false level indicator showed the tower level declining.
- Tower equipped with no other instrumentation to indicate tower level.
- Start-up procedures did not require maintaining a balance of flow in and out of the tower.
- The operator did not manually balance the flow of hydrocarbons in and out of the tower.
Management Oversight & Accountability

- Facility management did not assure that experienced supervisor was in unit during startup as specified in company policies
History of Abnormal Unit Start-ups

- In 16 startups of the ISOM unit from April 2000 to March 23, 2005:
  
  Eight experienced at least two times the normal pressure
  
  Thirteen had liquid levels above the range of the level indicator i.e. > 10 ft, some lasting as long as four hours
A History of Abnormal Unit Start-ups

- Mgmt did not investigate abnormal start-ups despite corporate policy

- Investigations could have resulted in improvements to tower design, instrumentation, procedures, and controls
Blowdown Drum and Stack Incidents

- In 1992, OSHA cited and fined previous owner (Amoco) on hazardous design of a similar blowdown drum and stack at the Texas City refinery

- In settlement agreement, OSHA withdrew citation and fine

- Refinery continued to use blowdown drums without modification or flares
Process Design

- Blow down drum and stack were outdated and unsafe because they released flammable hydrocarbons to atmosphere rather than to safe location, such as a flare system.

- Since 1995, four releases from the blow down drum generated flammable vapor clouds at ground level.
Process Design

- In 2002, Mgmt evaluated connecting blowdown drum to flare system as part of environmental initiative but did not.

- At the time of the incident, tower did not have effective pressure control system to reduce high pressure and remove hydrocarbons to a safe closed system.
Vehicles

- Company’s traffic policy allowed vehicles unrestricted access to process units
- Approximately 55 vehicles were located in vicinity of blow down drum and stack
- Two running vehicles may have provided sources of ignition; one was >25 feet from the blowdown drum
Parallels With Bhopal Accident

● Reductions in well trained personnel, qualified and experienced management

● Failure to recognize or investigate and correct warning events/ near misses

● Loss of sound engineering, safety practice, maintenance and mechanical integrity

● No Emergency Plan

● Escalating risk unnoticed
Examine Your Own Safety Culture
Pay Attention To Warning Events

Do Not Normalize Abnormalities!
Acoustical Insulation Manufacturer Explosion

- Management systems failures
- Warning events ignored
- Maintenance issues delayed
- Housekeeping issue normalized
- Dust hazard missed

7 Killed and 37 Injured
Phenolic Dust Explosion

- **Supplier** knew of explosive potential
- **User Mgmt** knew of combustibility of resin
- **Mgmt** knew of dust problems
- Dust removal equipment ineffective
- Dusty work environment
- Improper cleaning techniques used
- Oven fires common
Maintain Critical Staffing Levels!

The cost of an event may be more than the saving found by cutting those who could have prevented it!
Runaway Reaction Explosion

- Safety and supervisory oversight too thin
- Technical expertise inadequate
- Critical equipment maintenance poor
- Operators unaware of process reactivity hazard
Design and Engineer for Safety

Plan Ahead!

If it can go wrong, it will!
Vessel Over-Pressurization

- Inadequate engineering
- All manual systems
- Vessel installed w/o pressure relief devices
- No automatic shutdowns
Don’t Treat Anything You Do as Routine!

Fight Complacency!
Refinery Fire - 4 killed

- Safety and management oversight inadequate
- No hazard evaluation done - no escape
- MOC procedures not followed
- Known corrosion issues not addressed
- Complacency to inherent hazards of process
Plan Ahead for the Worst

Are You and Your Community Ready For a Disaster?
48,000 lb CL₂ Release

- Emergency safety shutdown system *inoperable*
- Emergency equipment *unusable*
- Emergency response plan *unworkable*
- No community protection plan
Become a Learning Organization

Communicate and Learn from Mistakes!!!!
Ethylene Oxide Explosion

- Safety interlock device overridden by untrained maintenance supervisor
- Failure to communicate identical explosion at sister facility
- Failure to install explosion prevention devices
Not One of These Was an Engineering Mystery
CSB Common Findings

- Lack of technical expertise
- Failure to recognize potential hazards
- Lack of proper engineering and design
- Lack of maintenance of production systems
- Failure to maintain safety systems
- Lack of procedures or training for emergencies
- Failure to plan for emergency response
- Failure to prepare community for emergency
Abnormal Situation Management Must Begin With Abnormal Situation Recognition!
CSB Investigations Reveal Gaps: **Hazard Awareness**

- Process Hazard Analysis incomplete
- Easily accessed info not used
- Operating personnel or technical experts not included
- Limited or no review of past incidents
CSB Investigations Reveal Gaps: Written Procedures

- Many not written or are ad hoc
- Often irrelevant, outdated, unusable and unused
- Procedures not enforced
- No procedures for emergency or upset operations
CSB Investigations Reveal Gaps: 

Training

- Little formal structured or documented training
- Not reinforced
- Little training in abnormal situations mgmt
CSB Investigations Reveal Gaps: Maintenance/MOC

- Critical equipment not working or neglected
- Maintenance requests unfulfilled
- MOC Procedures not followed / don’t exist
- Poor or no maintenance of safety systems
- Supervisory oversight deteriorated or none
- Safety start-up inspections and permits bypassed by supervision, contractors and employees
CSB Investigations Reveal Gaps: *Emergency Preparedness*

- Workers unaware of hazards or emergency plans to address hazards
- Emergency response organizations not prepared for site specific event of any size
- Public notification poor or nonexistent
- Public not trained in what to do
CSB Investigations Reveal Gaps:

**Incident Investigation**

- Minimal recognition of near miss incident
- Little or no investigation to find cause of event
- No follow through for corrective actions and prevention
- Not used in PHAs to prevent hazard
CSB Investigations Reveal Gaps: 

**Audits**

- Superficial / None
- Little follow-up
- Don’t recognize path to impending disaster or change anything
Albert Einstein said: “You only see what you know.”

Near miss events are like little lamps lighting the way to hazards that we cannot see for the darkness of ignorance.

Once illuminated it is up to us to remove it or fall victim to its awful potential.
Near Miss? or a Hit!

- Layers of protection prevent the catastrophe. Safety bypasses make holes in the protection.
- Every hole increases the chances for a hit!
Unless the “Near Hit” is taken as a warning of *bad things* to come, studies indicate it can actually *encourage* risky behavior because of human inclination to believe.

“I can beat the odds”
“Near Hit” Investigations Missing

- CSB Common Finding: Warning events that were not investigated or corrected
  - Equipment/Design Failures
  - Process Leaks and Fires
  - Odor or Vapor release events
  - Warning alarms ignored/deactivated
  - Pressure or relief valves actuate
  - Operational mistakes
  - Work permit procedures not followed
  - Personal Protective Equipment
Documentation Found
Warning of Hazards

- Audit findings
- Letters to management
- Safety Committee reports
- Requests to safety officers
- Uncompleted work orders
- Projects delayed repeatedly
- Budget proposals
- Insurance requests
- Engineering recommendations
- Vendor recommendations
Do You Have A Learning Safety Culture?
Murphy’s Law Has Not Been Repealed!

Really **BIG** accidents are just waiting for the little ones to get out of the way…..
To prevent catastrophic incidents, it requires both knowledge and commitment!

The world industrial community knows how to prevent catastrophic incidents. But… it is commitment to prevention that will determine if an incident will be prevented!
The Issue of LTIR!

- NASA Had lowest LTIR in Government
- BP had lowest LTIR in Petrochemical Industry
- Do not equate LTIR with low risk for Catastrophic Accidents!
Are you aware of the 800 pound gorilla in your facility?

Complacency to Catastrophic Risk!
Contact Us!

- WWW.CSB.gov
- Download materials
  *They’re Free!*
- Automail sign up
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