Operational Discipline for High Performance Process Safety

8 February 2023

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Process Safety Management (PSM) Performance

- Process Safety Management (PSM) is a "blend of engineering ***and management skills*** focused on preventing catastrophic accidents, particularly explosions, fire and toxic releases associated with the use of chemicals and petroleum products" (AIChE, CCPS, 2010)
  - The entire organization must be aligned and motivated to continually improve PSM performance to excellence
  - More than a collection of technical activities are required for success

Recognition of Process Safety Culture

Mar 20, 2007

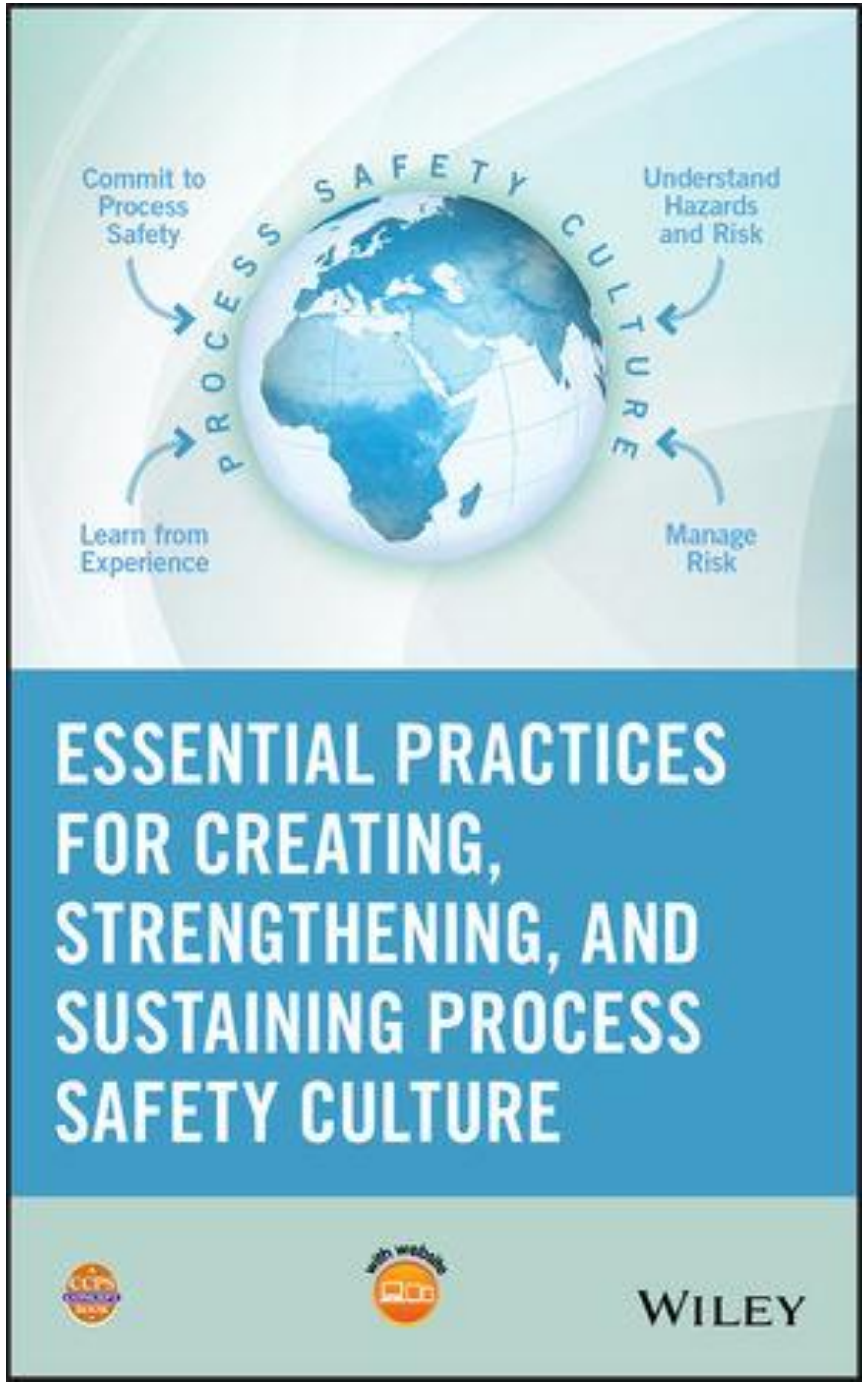
U.S. Chemical Safety Board Concludes "Organizational and Safety Deficiencies at All Levels of the BP Corporation" Caused March 2005 Texas City Disaster That Killed 15, Injured 180

Full Board to Weigh Recommendations to OSHA, Oil Industry, BP, and Union to Improve U.S. Refinery Safety at Public Meeting Tonight

UPDATED 9:30 p.m. CDT March 20, 2007, Texas City, Texas - At a public meeting here tonight attended by more than 200 people, the U.S. Chemical Safety Board (CSB) voted 5-0 to approve its final report on the March 2005 explosion at the BP Texas City Refinery, the worst U.S. industrial accident since 1990. The full text of the report and safety recommendations will be posted on CSB.gov within the next week.

CSB Chairman Carolyn W. Merritt said: "With the vote tonight, we embark on seeking the most significant safety improvements ever pursued by this agency. The 15 men and women who died here two years ago must not be allowed to perish in vain. Their lives, their dreams, and their hopes - and the manner in which they lost them - must never be forgotten."

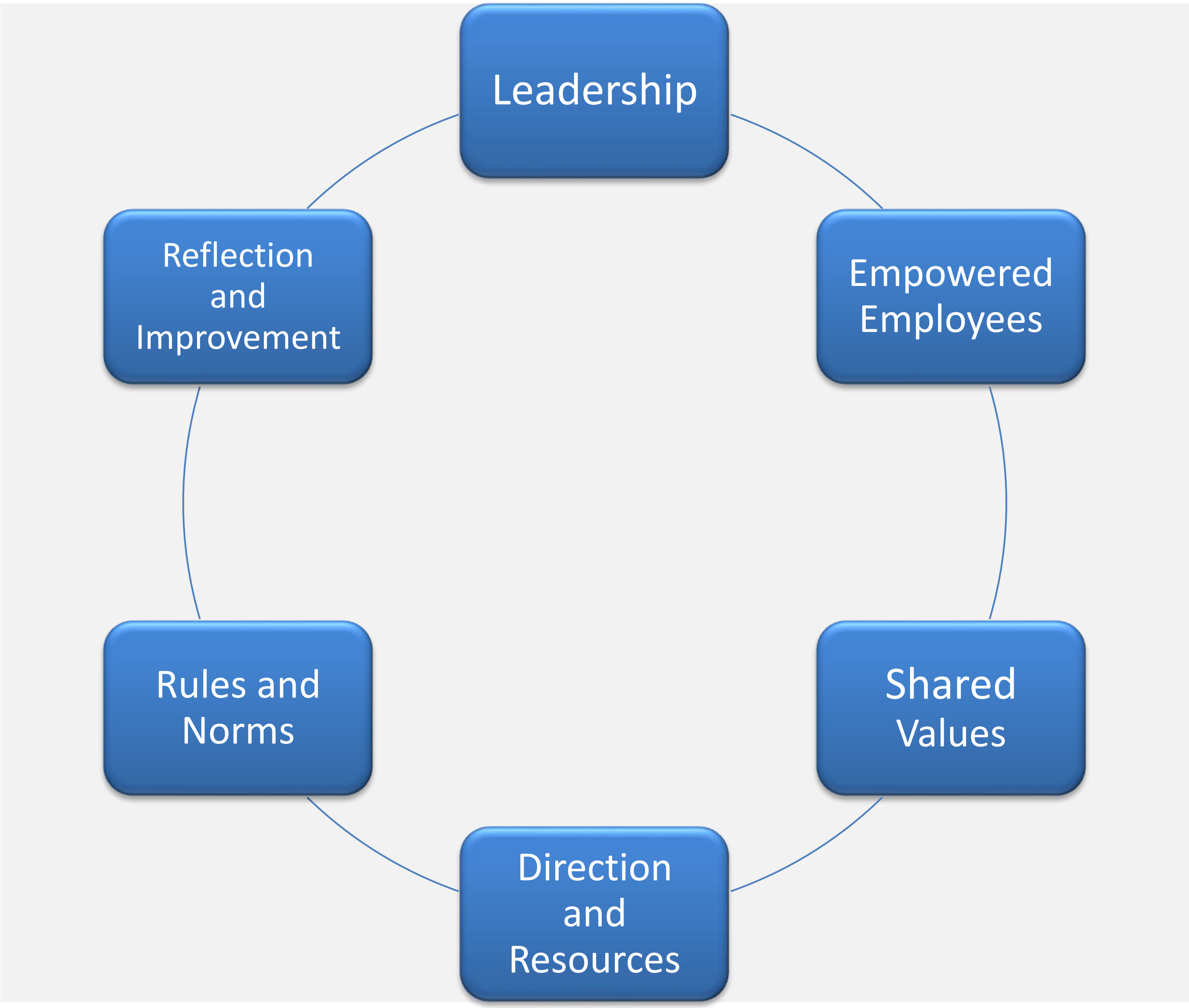
Houston, Texas, March 20, 2007 - In a 335-page final report released today, federal investigators from the U.S. Chemical Safety Board (CSB) conclude that "organizational and safety deficiencies at all levels of the BP Corporation" caused the March 23, 2005, explosion at the BP Texas City refinery, the worst industrial accident in the United States since 1990. The report calls on the U.S. Occupational Safety and Health Administration (OSHA) to increase inspection and enforcement at U.S. oil refineries and chemical plants, and to require these corporations to evaluate the safety impact of mergers, reorganizations, downsizing, and budget cuts.



CCPS Guidelines Definition of PSM Culture (2017)

"The pattern of shared written and unwritten attitudes and behavioral norms that positively influence how a facility or company collectively supports the development of and successful execution of the management systems that comprise its process safety management program, resulting in the prevention of process safety incidents."

Building Blocks to Great Culture



Key Building Blocks of Corporate Culture

Leadership

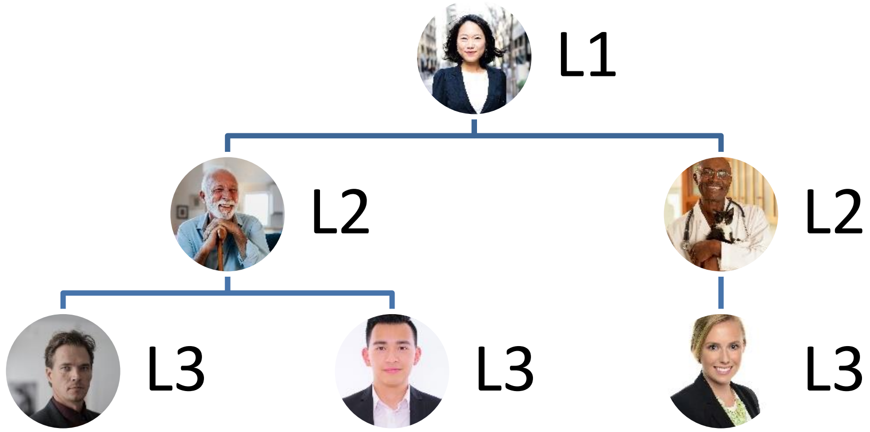
"Leaders not managers"

"Management is doing things right; leadership is doing the right things."
Peter Drucker

- Supportive, sensitive and caring
- Motivating
- Collaborative, delegating, and negotiating
- Decisive and disciplined
- Honest and high process safety values
- Exhibit high standards of process safety behavior

Who are the “leaders” for process safety?

- All roles in the organization
  - Plant Operators, Maintenance, Engineers
  - Contractors
  - Supervisors
  - Plant Managers
  - Divisional VPs
  - Executive team
  - Board members
- Everyone is responsible



Key Building Blocks of Corporate Culture

Reflection and Improvement

"Sense of vulnerability and goal of excellence"

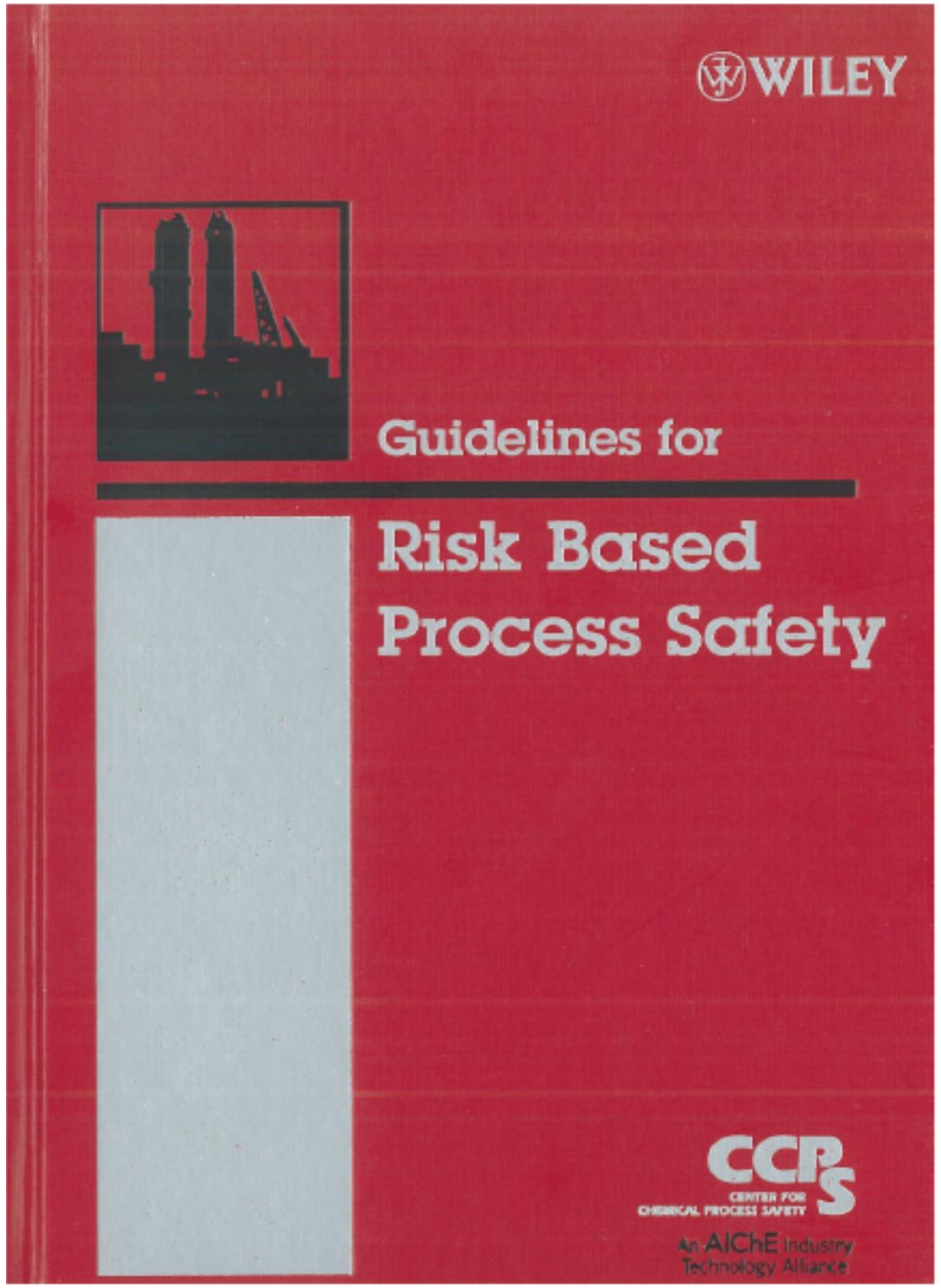
- Sense of vulnerability leads to healthy attitude on risk
- Continual improvement mindset
- Honest appraisal and acceptance of change
- Positive outlook rather than criticism
- Goal oriented to "excellence"

Core Principles of Process Safety Culture

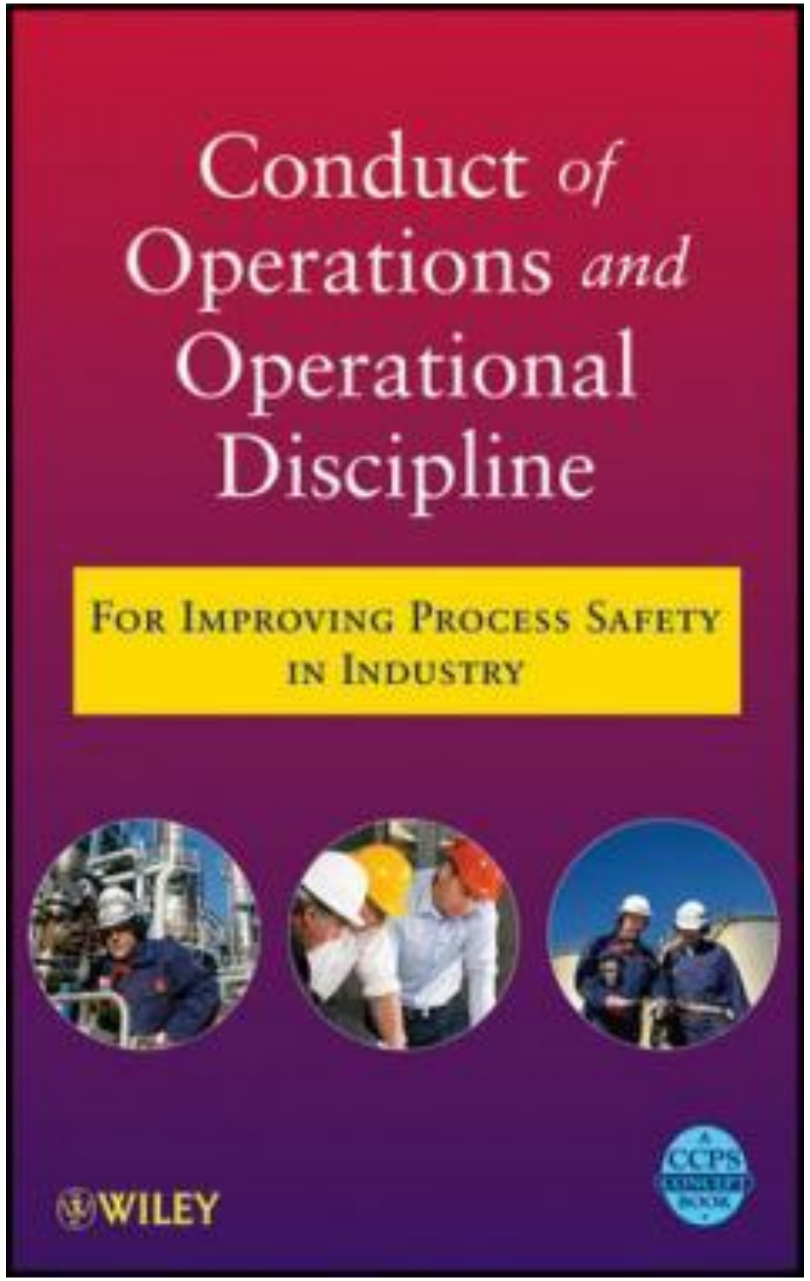
- Establish an Imperative for Safety
- Provide Strong Leadership
- Maintain a Sense of Vulnerability
- Understand and Act Upon Hazards/Risks
- Empower Individuals to Successfully Fulfill their Safety Responsibilities

- Defer to Expertise
- Ensure Open and Frank Communications
- Foster Mutual Trust
- Combat the Normalization of Deviance
- Learn to Assess and Advance the Culture

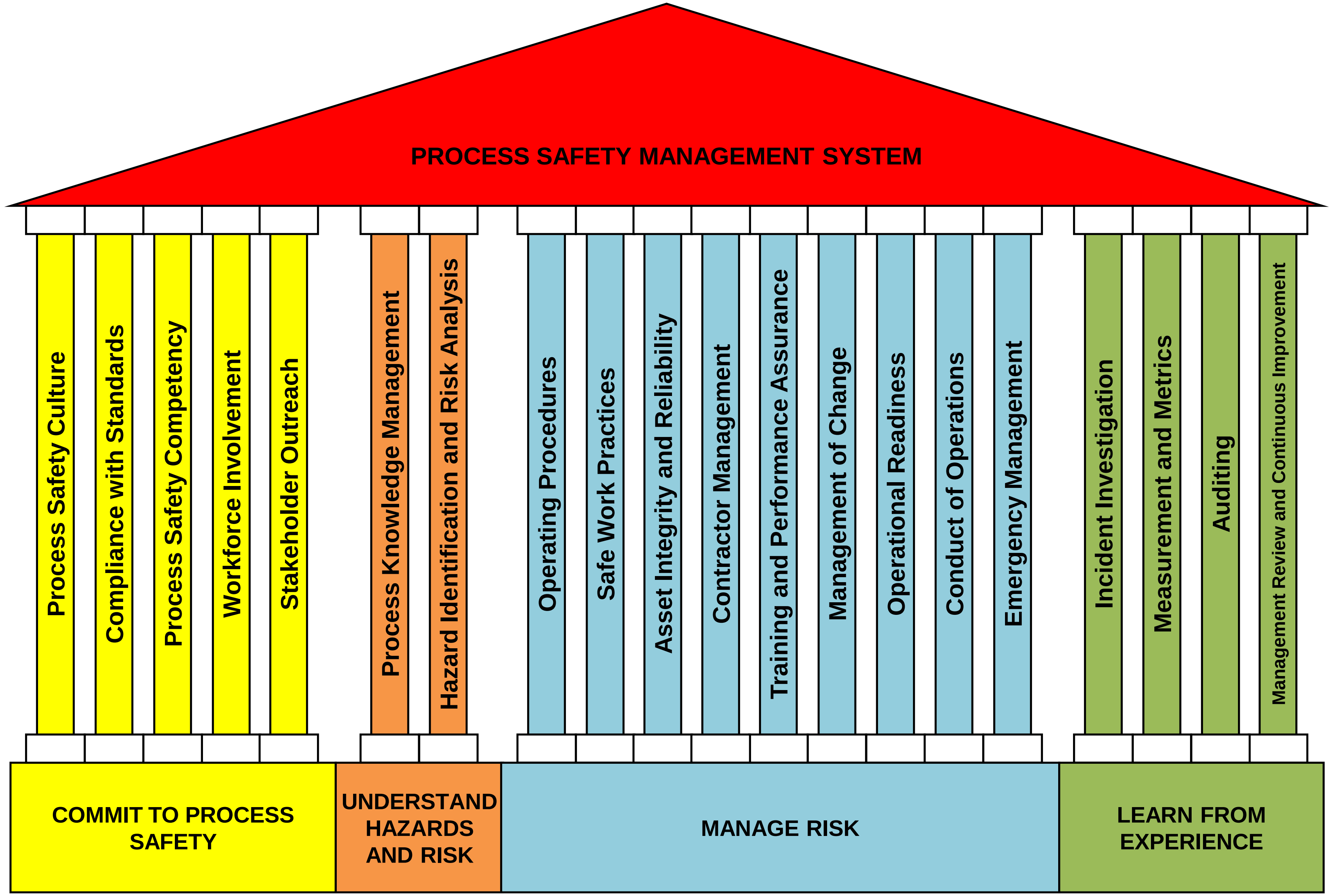
AIChE CCPS Risk Based Process Safety Management



Conduct of Operations and Operational Discipline Guidance by CCPS (2007, 2011)



CCPS Risk Based Process Safety Management System



Conduct of Operations – Principles[1]

- Conduct of Operations (COO) is the embodiment of an organization's values and principles in management systems that are developed, implemented, and maintained to:
  - 1) structure operational tasks in a manner consistent with the organization’s risk tolerance
  - 2) ensure that every task is performed deliberately and correctly
  - 3) minimize variations in performance

1 “Conduct of Operations and Operational Discipline – For Improving Process Safety in Industry”, CCPS, Wiley, 2011

Conduct of Operations – Principles[1]

- COO is the management system aspect of Operational Discipline (OD)
- COO sets up organizational methods and systems that will be used *to influence individual behavior and improve process safety*
- COO involves specifying how tasks (operational, maintenance, management, engineering)
- A good COO program helps visibly demonstrate the organization’s commitment to process safety.

1 “Conduct of Operations and Operational Discipline – For Improving Process Safety in Industry”, CCPS, Wiley, 2011

Operational Discipline (OD) - Principles

- Operational Discipline is the execution of the COO system by individuals in the organization.
- "Good" Operational Discipline relies on consistent and correct task execution
- Operational discipline includes day-to-day activities carried out by all personnel, not just by Operations.
- Ensure that all tasks is performed *deliberately and correctly and minimize variations* in performance.
- The culture is that individuals self-manage but seek wider involvement and expertise to ensure personal and process safety

How to Achieve a Great Process Safety Culture?
Great Culture Follows Good Practice Which Requires COO/OD

1. Vision and Goals

- Start with a vision for safe operations and continuous improvement goal and develop a strategy.
- Get commitment from all levels of the organization.

2. Assessment

- Identify key areas of improvement by a self assessment to focus on operational discipline issues
- RCA shows failure to follow procedures or lack of clear procedures or guidance or other indicators?

3. **Planning**

- Work together to establish expectations and work procedures that define excellence in process safety
- Define resources and support needed
- Develop multi-year roadmaps to close gaps and achieve desired level of process safety maturity. Track progress on maturity curves.

How to Achieve a Great Process Safety Culture?
Great Culture Follows Good Practice Which Requires COO/OD

4. Implementation
- Make upgrades to critical process safety elements that will improve COO/OD.

5. COO/OD
- **Establish a Conduct of Operations and Operational Discipline initiative**
- Train all parties on how to care for the program themselves with support.
- Maintain Operational Discipline and ongoing monitoring of performance.

6. Continuous Improvement
- Establish leading and lagging metrics relevant to the organization or to the current maturity level. Over time more metrics can be evaluated.
- Audit performance, quantify results
- Implement a management review and continuous improvement process.
- Improve as required.
- Review implementation effectiveness and adjust.

Normalization of Deviation

Examples:

- Operating outside the defined safe operating envelope (SOE).
- Safety systems remain bypassed beyond the time limits specified or are continually extended.
- Chronic nuisance alarms.
- Operators do not believe their indications because the instrumentation is chronically not calibrated or inaccurate.
- Chronically overdue ITPM tasks.
- Growing lists of equipment deficiencies and increasing aging of these deficiencies.
- New/revised equipment started up without conducting a PSSR.
- The resolution of PSM-related action items is chronically overdue
- Operators do not follow approved procedures, particularly when supervision is not present – toleration for short-cuts.
- Different operating practices, decision-making processes, and assumptions between shifts or teams.
- Conflicts of interest persist in the management of PSM programs elements.
- Operator rounds become check-the-box activities.

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Conduct of Operations and Operational Discipline Contribution to Major CSB Incidents

Conduct of Operations and Operational Discipline – Primary Findings
A2, A5, A10
C3, C11, C12, C18, C26, C43, C50, C57, C58
D9
J2, J19, J28, J38, J49, J50, J51, J52, J53, J54, J55, J56, J57, J58, J61, J63, J67, J70, J72, J73, J114, J127, J130, J147, J151, J165, J171, J174, J178, J180, J182, J183, J188, J190, J192, J208, J209, J211, J217, J243, J247, J248, J259, J262, J270, J271
S3, S4, S5, S13, S14
Conduct of Operations and Operational Discipline – Secondary Findings
A6, A7
C13, C15, C20, C24, C27, C28, C60, C76
D7, D19
J21, J22, J24, J25, J32, J35, J40, J64, J65, J75, J76, J91, J108, J109, J116, J119, J128, J129, J131, J133, J162, J163, J170, J176, J181, J184, J185, J186, J212, J237, J253, J261
S1, S10, S12, S15

	Investigation
C1.	Arkema Inc. Chemical Plant Fire
C2.	Acetylene Service Company Gas Explosion
C3.	AirGas Facility Fatal Explosion
C4.	AL Solutions Fatal Dust Explosion
C5.	Allied Terminals Fertilizer Tank Collapse
C6.	Barton Solvents Explosions and Fire
C7.	Bayer CropScience Pesticide Waste Tank Explosion
C8.	Bethlehem Steel Corporation Gas Condensate Fire
C9.	Bethune Point Wastewater Plant Explosion
C10.	BLSR Operating Ltd. Vapor Cloud Fire
C11.	BP America Refinery Explosion
C12.	BP Amoco Thermal Decomposition Incident
C13.	CAI / Arnel Chemical Plant Explosion
C14.	Carbide Industries Fire and Explosion
C15.	Caribbean Petroleum Refining Tank Explosion and Fire
C16.	Chevron Refinery Fire
C17.	CITGO Refinery Hydrofluoric Acid Release and Fire
C18.	Combustible Dust Hazard Investigation
C19.	ConAgra Natural Gas Explosion and Ammonia Release
C20.	CTA Acoustics Dust Explosion and Fire
C21.	D.D. Williamson & Co. Catastrophic Vessel Failure
C22.	Donaldson Enterprises, Inc. Fatal Fireworks Disassembly Explosion and Fire
C23.	DPC Enterprises Festus Chlorine Release
C24.	DPC Enterprises Glendale Chlorine Release
C25.	DuPont Corporation Toxic Chemical Releases
C26.	DuPont La Porte Facility Toxic Chemical Release
C27.	E. I. DuPont De Nemours Co. Fatal Hotwork Explosion
C28.	Emergency Shutdown Systems for Chlorine Transfer
C29.	Enterprise Pascagoula Gas Plant Explosion and Fire
C30.	EQ Hazardous Waste Plant Explosions and Fire
C31.	ExxonMobil Refinery Explosion
C32.	First Chemical Corp. Reactive Chemical Explosion
C33.	Formosa Plastics Propylene Explosion
C34.	Formosa Plastics Vinyl Chloride Explosion
C35.	Freedom Industries Chemical Release
C36.	Georgia-Pacific Corp. Hydrogen Sulfide Poisoning
C37.	Hayes Lemmerz Dust Explosions and Fire
C38.	Herrig Brothers Farm Propane Tank Explosion
C39.	Hoeganaes Corporation Fatal Flash Fires
C40.	Honeywell Chemical Incidents
C41.	Imperial Sugar Company Dust Explosion and Fire
C42.	Improving Reactive Hazard Management
C43.	Kaltech Industries Waste Mixing Explosion
C44.	Kleen Energy Natural Gas Explosion
C45.	Little General Store Propane Explosion
C46.	Macondo Blowout and Explosion
C47.	Marcus Oil and Chemical Tank Explosion
C48.	MFG Chemical Inc. Toxic Gas Release
C49.	MGPI Processing, Inc. Toxic Chemical Release
C50.	Morton International Inc. Runaway Chemical Reaction
C51.	Motiva Enterprises Sulfuric Acid Tank Explosion
C52.	NDK Crystal Inc. Explosion with Offsite Fatality
C53.	Oil Site Safety
C54.	Packaging Corporation of America Hot Work Explosion
C55.	Partridge Raleigh Oilfield Explosion and Fire
C56.	Praxair Flammable Gas Cylinder Fire
C57.	Pryor Trust Fatal Gas Well Blowout and Fire
C58.	Sierra Chemical Co. High Explosives Accident
C59.	Sonat Exploration Co. Catastrophic Vessel Overpressurization

See www.csb.gov for incident investigation reports

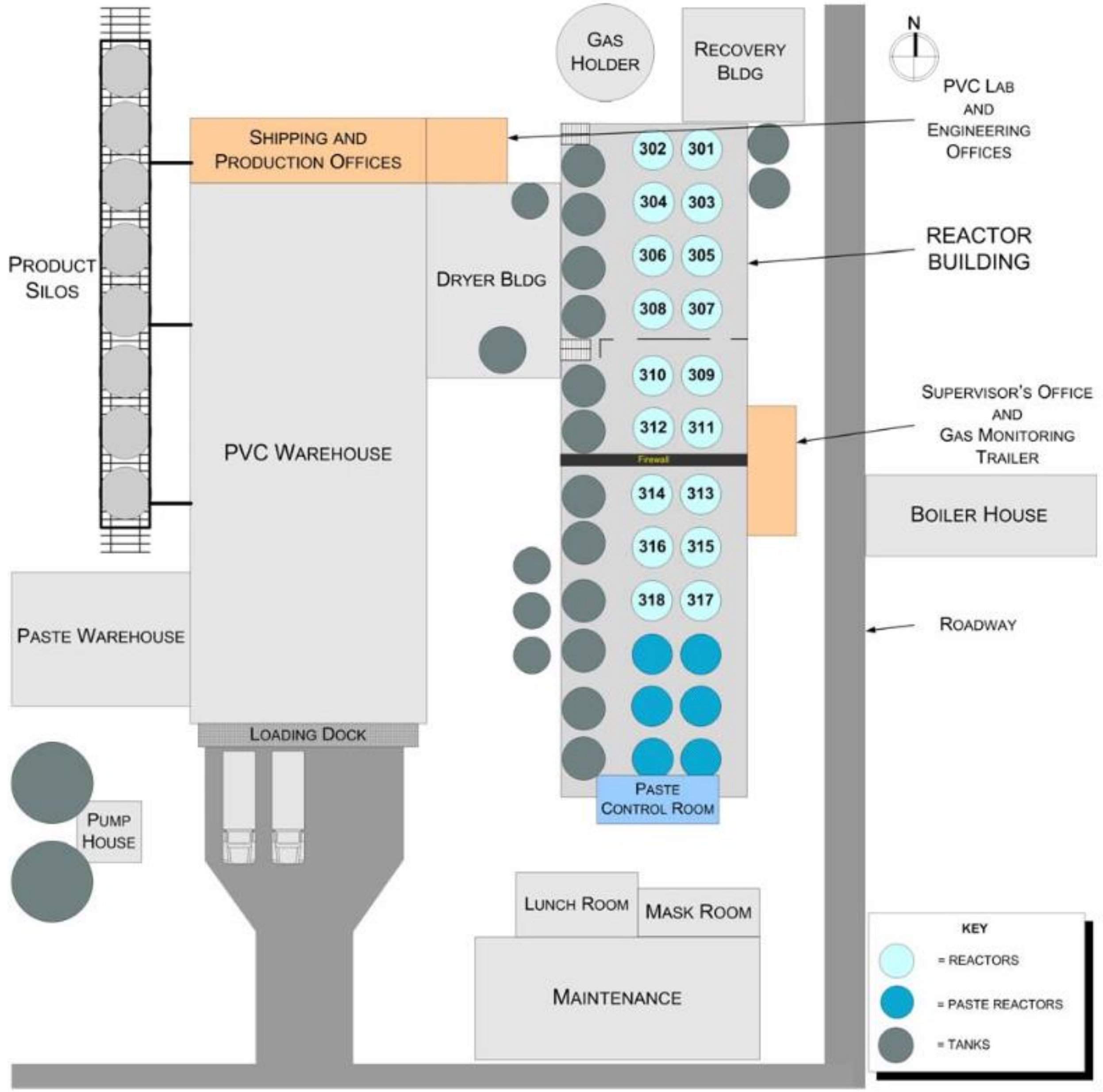
1 “Driving Continuous Process Safety Improvement from Investigated Incidents”, CCPS, Wiley, 2021

CSB Case Study – Formosa Plastics

- April 23, 2004, an explosion and fire at the Formosa Plastics Corporation, polyvinyl chloride (PVC) manufacturing facility in Illinois, USA, killed five and severely injured three workers.
- The explosion and fire destroyed most of the reactor facility and adjacent warehouse and ignited PVC resins stored in the warehouse.
- The facility was permanently shut down.

CSB Case Study – Formosa Plastics

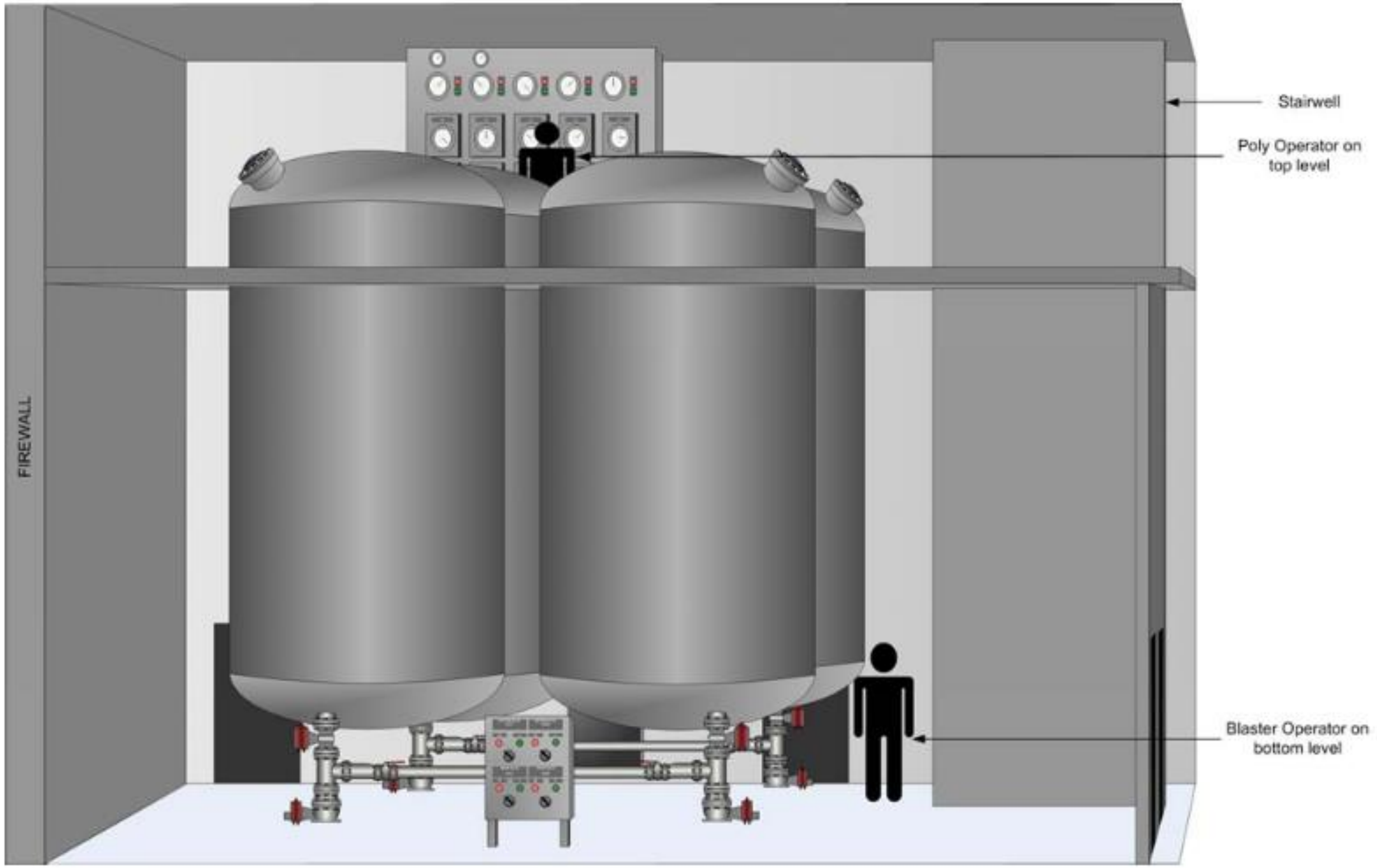
- Multiple reactors located indoors
- Batch polymerization of vinyl chloride monomer.
- Following reaction, batch was transferred, and reactor purged of hazardous gases.
- Reactor was then opened at top manway and power washed.
- Bottom valve opened and cleaning water drained to building floor drains.



CSB Case Study – Formosa Plastics

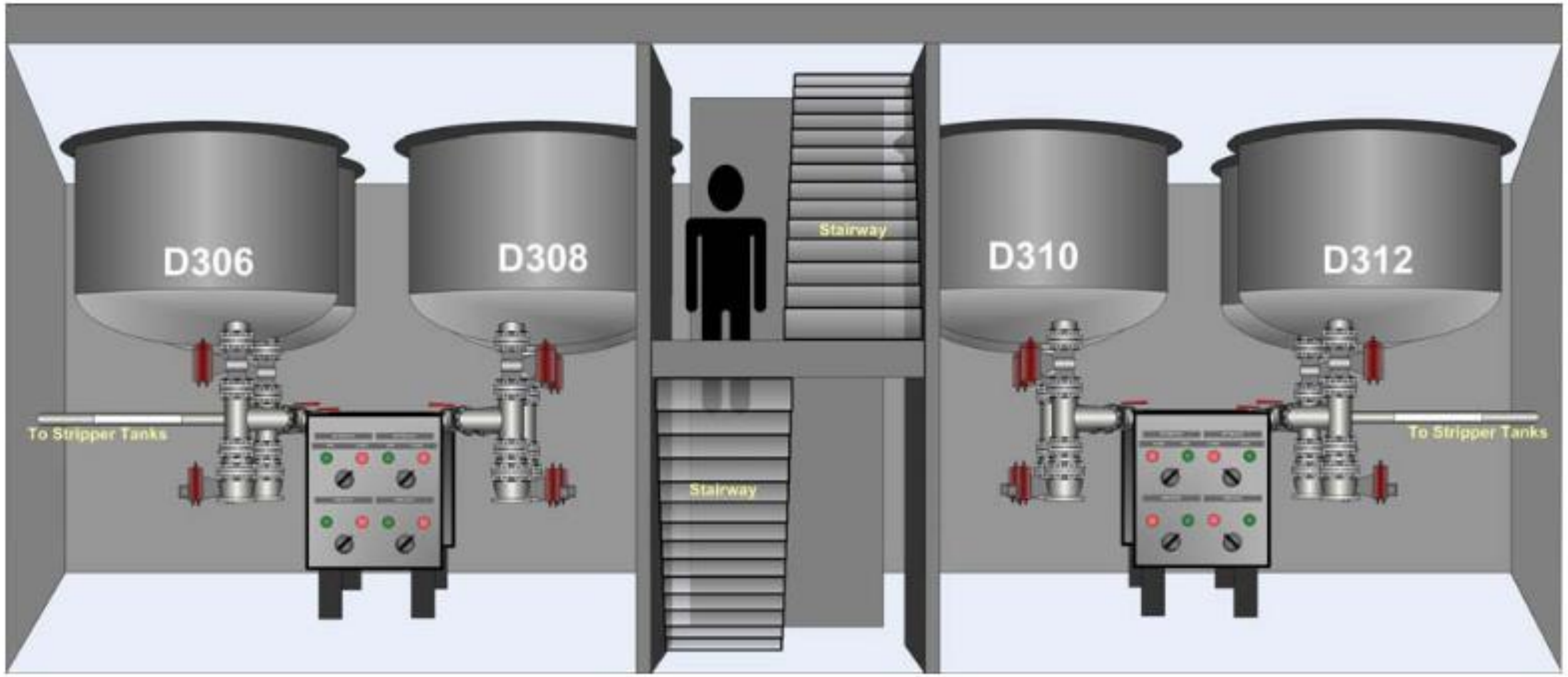
- Lack of communication between operating floors.

- No indication at bottom level of reactor status.



CSB Case Study – Formosa Plastics

- Operator turned left at bottom of stairs instead of right and went to reactor D310 (pressurized and active) instead of D306 (depressurized and in cleaning mode)
- Instead of draining D306 he bypassed an active interlock and drained D310.



CSB Case Study – Formosa Plastics

Key Findings

- Process Hazards Analysis and previous incidents identified consequences of inadvertent opening of reactor bottom valves but did not implement improvements to prevent bypassing the bottom valve interlock.
- Operator approached wrong reactor and had no means to determine the operating status of that reactor.
- Operator implemented an unauthorized bypass of the active reactor bottom valve and drained hot reaction mass into reactor room.

AcuTech COO/OD Candidates

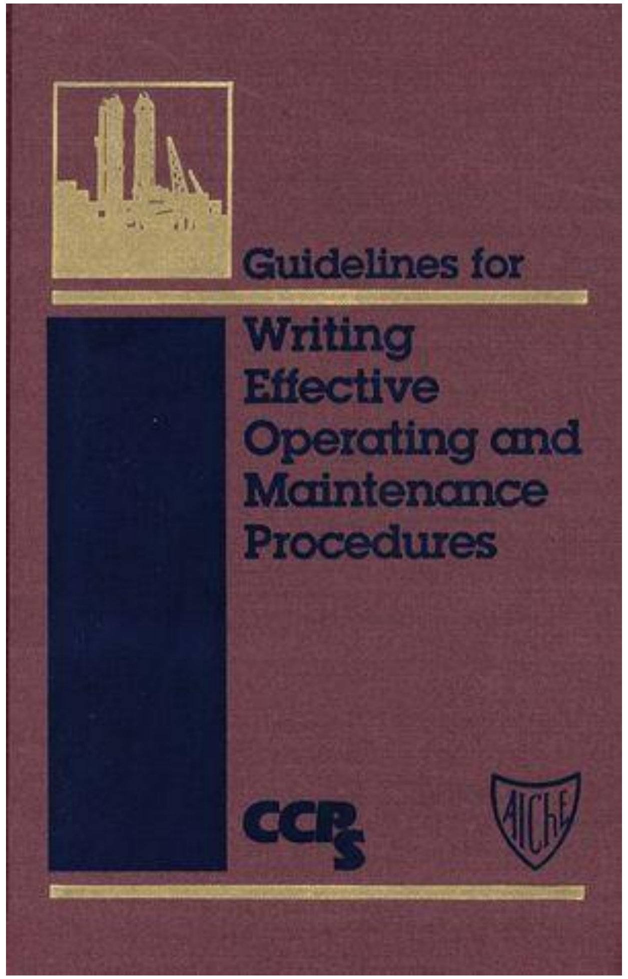
1. Assigning competent personnel
2. Fitness-for-duty
3. Fatigue management
4. Hazard recognition
5. Establish PSM Related Standards & Key Performance Indicators
6. Clear lines of authority
7. Resolution process
8. Stop work authority
9. Emergency shutdown authority
10. Emergency planning and response
11. Training, Skill Maintenance, and Individual Competence
12. Adherence to written and approved procedures
13. Adherence to safe operating envelope
14. Response to abnormal plant conditions
15. Intolerance of the normalization of deviations
16. Formal shift turnover
17. Operator Rounds
18. Alarm management
19. Maintaining the capability of safety systems
20. Bypassed, removed, or impaired PSM related safety systems, protective features, alarms, or similar equipment
21. Occupied Structures
22. Equipment ownership
23. Control of work
24. Process area access
25. Labeling, color-coding, and signage
26. Formal housekeeping program
27. Rotation and operation of installed spare equipment
28. Safety Critical Equipment

Operating Procedures Example

Wrong Outcome - Why?

Action to Improve Process Safety

- SOPs were not updated or complete
- It was determined to undertake a large project to improve the procedures
- An outside firm was commissioned to do this with review by plant personnel at the end
- Management believed they had greatly improved operating consistency and the basis for training and competency development
- The procedures were implemented but not carefully audited for conformance



- The SOPs were not successful since the teams didn't have confidence in them and believed they were not reflective of safe operating and maintenance practices
- Workers were ignoring them and taking their own approach to operations and maintenance
- The SOPs were not written by the teams that had the duty to execute them and the knowledge of how to safely operate the process
- The review was cursory at the end since they didn't have ownership and too difficult to review later
- They were not admitting they weren't following them for fear of reprisal

PSM Standards & Key Performance Indicators

- Documenting Process Safety Management Metrics provides the details of how PSM program is performing.
- AcuTech uses 14 PSM KPIs for measuring COO/OD. Examples:
  - Safe upper and lower design limits exceeded
  - Overdue ITPM Tasks and their aging
  - Protective system, device or function bypasses
  - Safety critical equipment failed
  - Open MOC packages and percent MOC PHA completion
  - Overdue PHAs action items per schedule

Overdue Hazard Analysis Action Items Example

Normalized Situation

- PHA action items were casually made during PHAs with a poor risk decision-making process
- Leadership did not ensure action items were carefully made or addressed in a timely manner and assigned to supervisors
- Supervisors' performance was not measured on risk reduction but focused on profitable operational performance
- Action items mounted over the years and were not supported financially nor with adequate personnel resources
- Risk was built up as hundreds of action items were not resolved

		Consequences				
		Insignificant	Minor	Moderate	Major	Catastrophic
		1	2	3	4	5
Health and Safety Values		A near miss, First Aid Injury (FAI) or one or more Medical Treatment Injuries (MTI)	One or more Lost Time Injuries (LTI)	One or more significant Lost Time Injuries (LTI)	One or more fatalities	Significant number of fatalities
Environmental Values		No impact	No or low impact	Medium impact. Release within facility boundary	Medium impact outside the facility boundary	Major impact event
Financial Loss Exposures		Loss below $5,000	Loss $5,000 to $50,000	Loss from $50,000 to $1,000,000	Loss from $1,000,000 to $10,000,000	Loss of above $10,000,000
Likelihood	A Possibility of repeated events, (1 x 10^{-1} per year)	Significant Risk	Significant Risk	High Risk	High Risk	High Risk
	B Possibility of isolated incidents, (1 x 10^{-2} per year)	Moderate Risk	Significant Risk	Significant Risk	High Risk	High Risk
	C Possibility of occurring sometimes, (1 x 10^{-3} per year)	Low Risk	Moderate Risk	Significant Risk	High Risk	High Risk
	D Not likely to occur, (1 x 10^{-4} per year)	Low Risk	Low Risk	Moderate Risk	Significant Risk	High Risk
	E Rare occurrence, (1 x 10^{-5} per year)	Low Risk	Low Risk	Moderate Risk	Significant Risk	Significant Risk

Solutions

- Improve the workflow and risk tolerance process for the risk decision-making tools
- Educate PHA teams on their proper use
- Give supervisors the duty to execute on action items with from mandatory to recommended approaches and reward good decision-making and performance
- Monitor action item resolution and put KPIs on delinquent items
- Establish a rule that action items cannot be deferred continuously
- Budget for these activities and provide adequate resources to address them in a risk-based and timely manner

Field Survey

- Unlocked safety valve isolation valves

Stop Work Authority

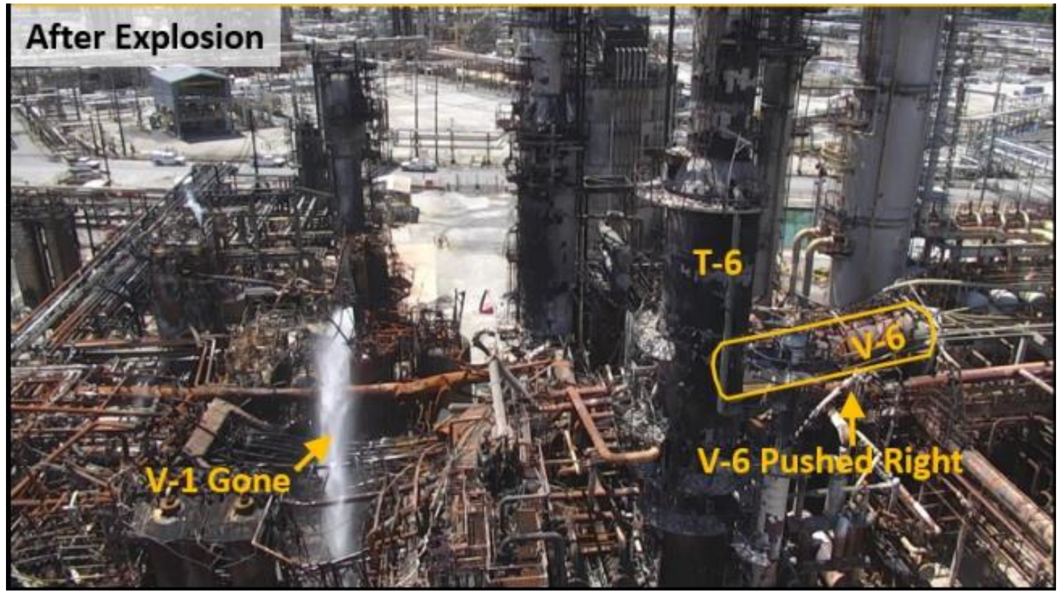
Stop Work Authority should be granted in a written procedure:

- All personnel and contractors are granted the authority to stop the work of themselves or others.
- This includes work of higher seniority, peers in the organization, contractors, or any others if the operations or task they are observing is unsafe or could develop into an unsafe condition or act.
- Personnel shall not be subject to retribution, punishment, reprimand or any other adverse action as a result of exercising this authority.

Emergency Shutdown Authority

PES Philadelphia
21 Jun 2019:

- **Hydrocarbon release in HF Alkylation unit**
- **Unit damaged by VCE**
- **Approx 420,000 lbs HF acid in unit at time of incident**



Emergency Shutdown Authority

PES Philadelphia 21 Jun 2019:

- **Quick ESD action by control room operator dumped HF acid before BLEVE destroyed the unit 20 min later**

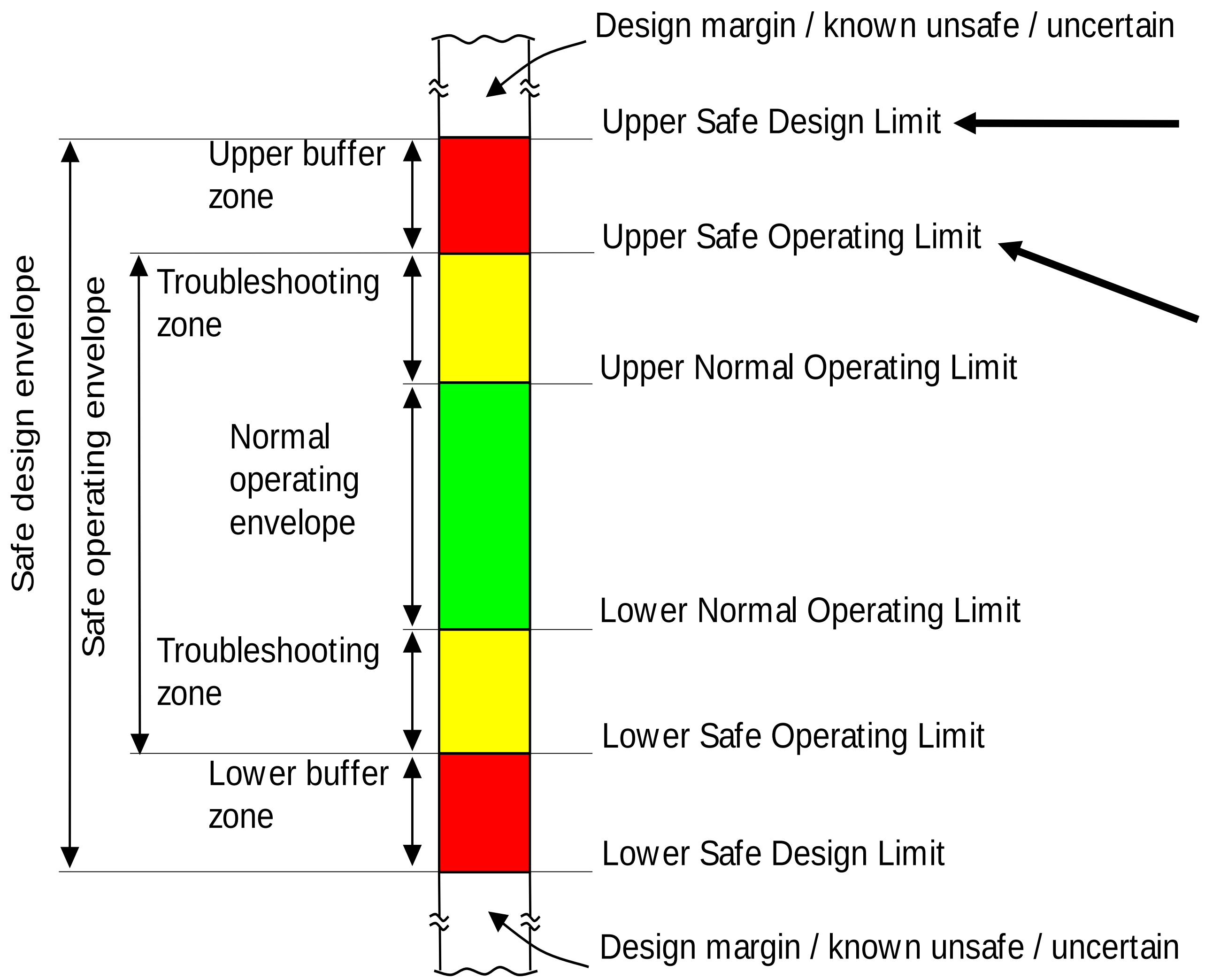
Emergency Shutdown Authority

PES Philadelphia
21 Jun 2019:

- **Quick ESD action by control room operator prevented HF toxic cloud release**
- **HF vapor cloud would have travelled km**
- **1.3 million people live within 13.5 km**

Philadelphia Energy Solutions
Refinery Philadelphia
2019 v 2023

Adherence to Safe Operating Envelope



- PSV setpoint + accumulation
- Max design temp
- Excess material, e.g., O2

- MAWP/PSV setpoint
- MAWT
- Excess material, e.g., O2

Adherence to Safe Operating Envelope

- Adhering to the Safe Design Envelope and Safe Design Envelope ensures that:
  - design conditions for the equipment are not exceeded
  - processes stay within the operating limits necessary to ensure product quality and process efficiency
- If these limits are not followed verbatim a serious incident is nearly inevitable.

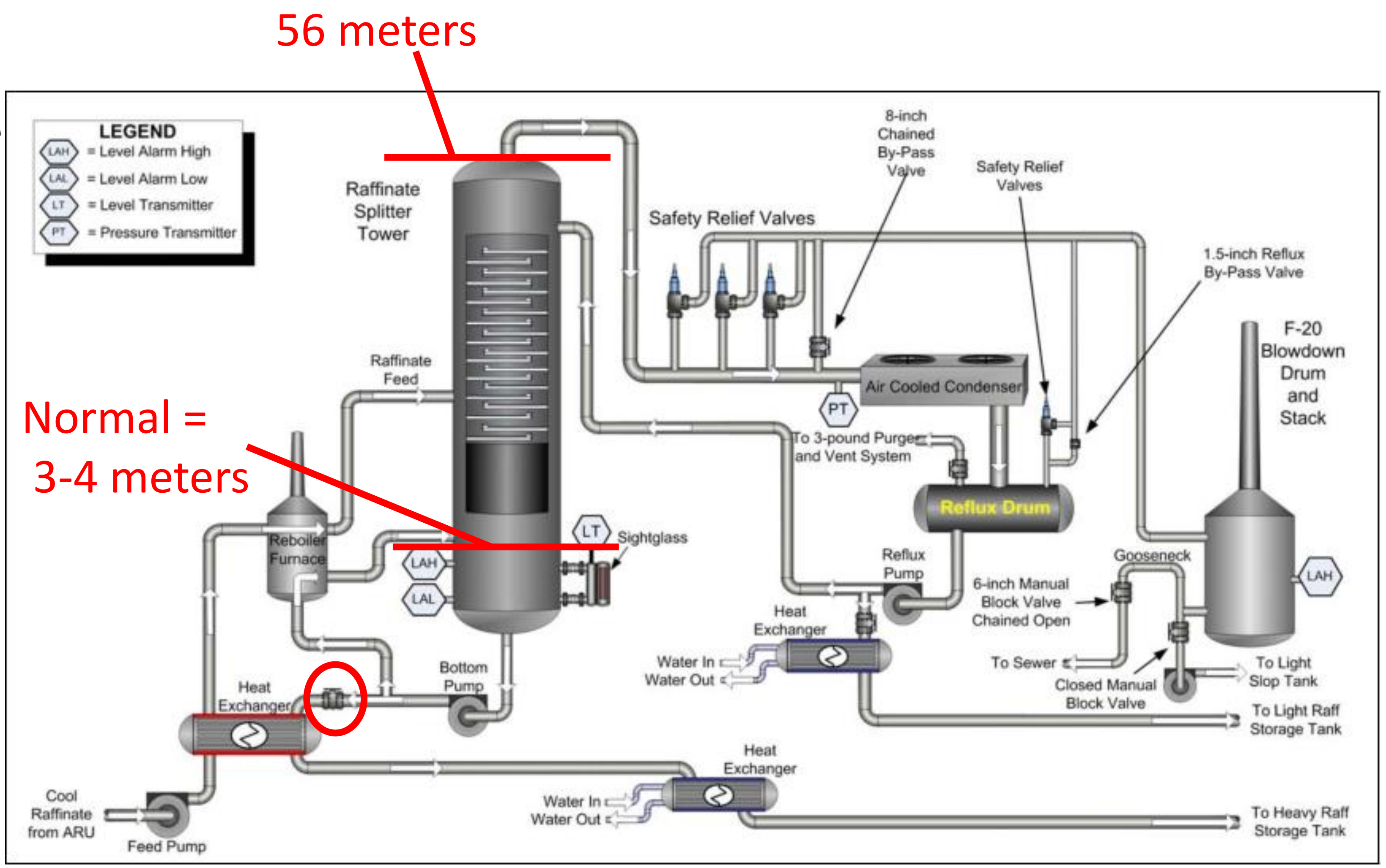
Response to Abnormal Plant Conditions

- Written procedures cannot be a substitute for an understanding of the basic principles of safety, scientific knowledge, or plant operation.
- Personnel must be able to “step back” and understand the principles of what they are operating.

Response to Abnormal Plant Conditions

BP Texas City

- Operators continued to feed the ISOM splitter tower for hours with the outlet valve to storage closed.
- Nobody asked where all the material was going.
- If the input feed flow is constant and the outlet flow is zero, then the process must be accumulating the material somewhere.
- Several trained and competent operators failed to ask this simple question over an approximately ten-hour time period.



Response to Abnormal Plant Conditions

- Another example: if the maximum operating temperature in a process is 250C but the process seems to want to run at a temperature greater than 250C in a stable manner, is that allowed?
  - How the engineer or manager responds to this issue is an Operational Discipline issue.
  - How personnel respond to abnormal plant conditions and think through what is happening and apply their knowledge is an important Operational Discipline issue.
- The training program for all personnel whose jobs can affect process safety should emphasize critical thinking for abnormal scenarios.

Normalization of Deviation

- **Normalization of deviations is the most common process safety cultural deficiency.** Many major incidents have included this attribute as a contributor.
- The normalization of deviance means that out-of-specification conditions, i.e., deviations, are allowed to remain in place without any action being taken to correct them.
- If, over time these uncorrected conditions result in no negative consequences, they can then become "normalized" or part of the normal status of facility equipment or operations.

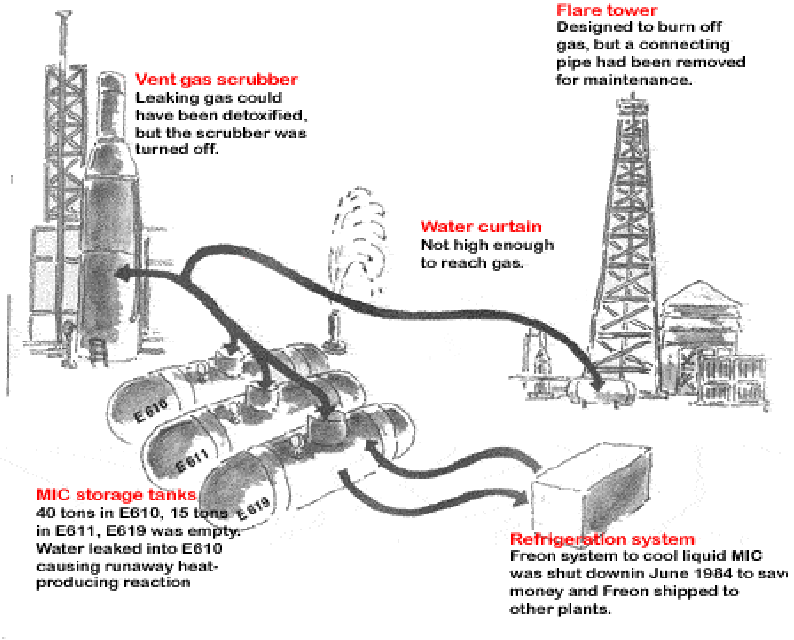
Normalization of Deviation

Examples:

1. Operating outside the defined safe operating envelope (SOE).
2. Safety systems/features that remain bypassed beyond the time limits specified or are continually extended.
3. Chronic nuisance alarms.
4. Operators do not believe their indications because the instrumentation is chronically not calibrated or inaccurate.
5. Chronically overdue ITPM tasks.
6. Growing lists of equipment deficiencies and the increasing aging of these deficiencies.

Normalization of Deviation

Bhopal



Challenger

Longford, AUS

Columbia

Maintaining the Capability of Safety Systems

- **An extremely important attribute of Operational Discipline is the maintenance of the capability of safety systems.**
- Safety systems consist of protective features such as:
  - Alarms
  - indications
  - Trips
  - Interlocks
  - pressure relief devices and systems
  - critical utilities (i.e., utilities whose failure could cause or contribute to a process safety incident, e.g., cooling water systems in a refinery)
  - fire protection equipment
  - other equipment that are critical to process safety.

Maintaining the Capability of Safety Systems

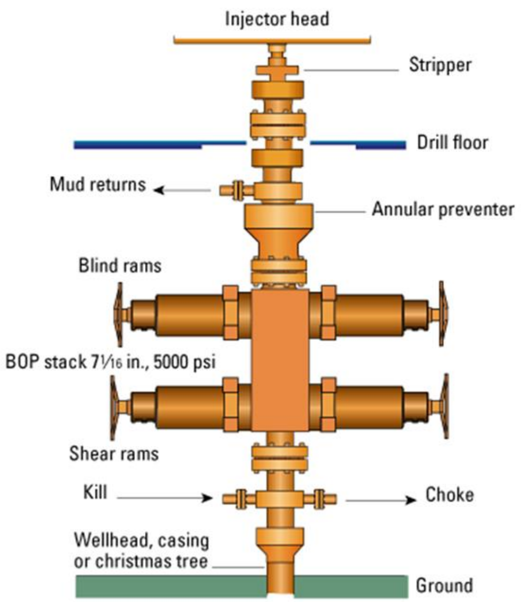




Maintaining the Capability of Safety Systems

Macondo-Deepwater Horizon
Gulf of Mexico
20 Apr 2010:

- **Blowout preventer failed**
- **No testing of blowout preventer**
- **11 fatalities and platform destroyed**
- **Months of env damage on US Gulf Coast**



Safety Critical Equipment

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HAZOP Study Worksheet

Causes

Safeguards

Node: 1. VHT Feed and Preheat

Drawings / References: A-950-B-1004; A-950-B-1003

Deviations	Causes	Consequences	CAT	Unmitigated Risk			Safeguards				S	Mitigated Risk		HAZOP Recommendations		Residual Risk			Remarks
				S	L	RR	Tag	Description	Tag - COPY	Description - COPY		L	RR	HAZOP Recommendations	Responsibility	S	L	RR	
1. Low/ No Flow	1. 3" Manual valve closed from FGRU Initiating Event1.2.1.1 Initiating Event1.3.1.1 Initiating Event1.4.1.1	1. Decreased flow of FGRU gas to VHT, decreased flow of paraffinic gas to R-901, slight increase in exotherm, not expected to cause runaway, operability issue, no hazardous consequences identified to VHT LOPA Scenario: 1.2	H&S	C3	5	15 VH C3-L5	PAHH-XXXX	on compressor discharge with action to S/D	2. PAHH-XXXX	on compressor discharge with action to S/D	C5	5	25 VH C5-L5			C 5	1	5 M C5-L1	
		2. Decreased flow increased level overpressure, personnel injury LOPA Scenario: 1.3	H&S	C4	4	16 VH C4-L4	PAHH-XXXX	on compressor discharge with action to S/D	2. PAHH-XXXX	on compressor discharge with action to S/D	C4	4	16 VH C4-L4			C 4	1	4 M C4-L1	
		3. Decreased flow of FGRU gas to VHT, potential blocked outlet of FGR compressors C-1180/ 81, increased flaring, potential overpressure of discharge piping > 3.5 x MAWP, piping rupture, release of untreated flare gas, potential fire/explosion or H2S exposure, personnel injury, environmental impact, asset damage LOPA Scenario: 1.4	H&S	C5	3	15 VH C5-L3	PSV Copmressor	set at 250 psig	1. PSV Copmressor	set at 250 psig	C5	3	15 VH C5-L3	1. See LOPA Scenario		C 3	1	3 L C3-L1	
							PAHH-XXXX	on compressor discharge with action to S/D	2. PAHH-XXXX	on compressor discharge with action to S/D				4. HAZOP Rec:.Evaluate installing a PAHH on C-1180/81 FGRU Compressor discharge to shutdown the compressors and protect against a blocked discharge scenario.					
							PIC-9080	Spillback controller	3. PIC-9080	Spillback controller									
		4. Decreased flow of FGRU gas to VHT, potential blocked outlet of FGR compressors C-1180/ 81, increased flaring, environmental impact	H&S	C2	2	4 M C2-L2	FI	Flow meter on flare	4. FI	Flow meter on flare	C2	2	4 M C2-L2			C 2	1	2 L C2-L1	
							AI	analyzer on flare	5. AI	analyzer on flare									
							CCTV	with operator monitoring and troubleshooting	6. CCTV	with operator monitoring and troubleshooting									

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