



SPRING25 +21ST GCPS

A Joint AIChE and CCPS Meeting

April 6 – 10, 2025

Hilton Anatole | Dallas, TX

Process Safety Reflections from 21st GCPS

AIChE Dallas Section
September 2025

Nicholas P. Sands
DuPont Laureate
DuPont Engineering



Nicholas Sands

- DuPont Laureate
- ISA Fellow
- Process Automation Hall of Fame
- ISA/IEC Standards leader
- Automation & Process Control Competency Leader



PERSONAL INFO

- Current Location: Live in Dallas, TX
- Fun Fact #1 Highschool in Heidelberg, Germany
- Fun Fact #2 Born in Nuremberg, Germany
- Hobbies: Travel, standards, reading



EXPERTISE

DuPont SME for:

- Safety instrumented systems (SIS)
- Functional safety assessment (FSA)
- Alarm management (AM)
- Layer of protection analysis (LOPA)
- Control System Security

Expertise in:

- Alarm rationalization
- Interlock design and testing
- Human machine interface design
- Control strategies
- Control system commissioning
- Control loop performance



EDUCATION

- 1990 BSChE Virginia Tech
- 2004 Certified Automation Professional
- 2009 Control System Engineer PE



PROFESSIONAL EXPERIENCE



Process Control Engineer (FE) Victoria, TX '90 – '92
DCS projects and process control optimization for Adipic Acid, HCN pilot plant.

Project Control Engineer (FE) Victoria, TX '90 – '94
DCS project for ethylene copolymers plant.

Project Control Engineer (FE) Wilmington, NC '94 – '97
DCS projects and process control optimization for Terephthalic acid and PET recycle.

Process Control Consultant (FE) Wilmington, DE '97 – '99
New polyester plant projects in China and SC.

Site Process Control Leader Edge Moor, DE '99 – '03
Responsible for all control systems and team at TiO₂ plant.

Business Process Control Leader Deepwater, NJ '03 – '08
Managed process control groups for 18 sites.

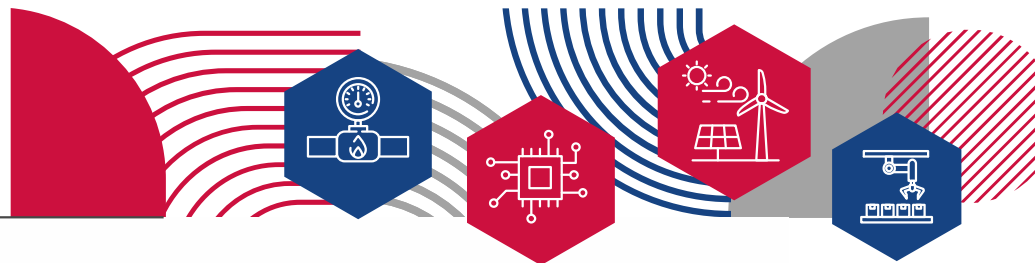
Project Control Engineer Moncks Corner, SC '08 – '12
Control engineer for \$500M Kevlar plant.

Business Control Consultant Multiple sites '12 – '18
Supported sites for Kevlar and intermediates, DCS and SIS projects.

Project Control Engineer Luxembourg, LU '18 – 24
Control engineer for \$400M Tyvek line.

Business Process Control Leader Richmond, VA '20 – 24
50% process control leader for Tyvek, developing current state and future state of automation.

Corporate Control Consultant Global '24 – ?
Supported site globally



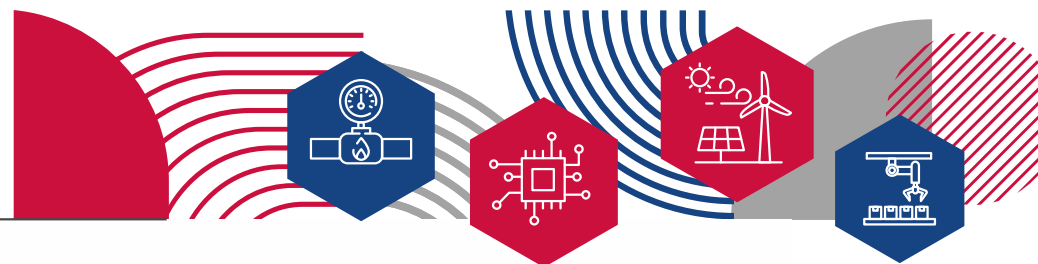
Agenda – Process Safety Reflections

- Safety Moment – Bhopal
- GCPS Overview
- Center for Chemical Process Safety
- CCPS Vision and more
- GCPS highlights

Disclaimer: These are not notes from the AIChE+GCPS meeting, but the reflections of an attendee and related published materials.



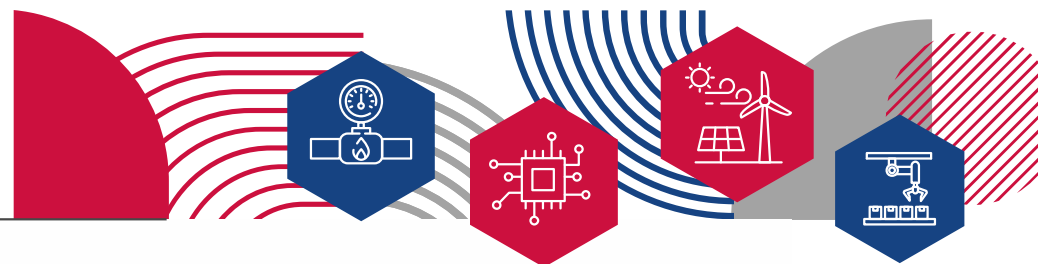
AI generated Image



 www.aiche.org/ccps		 http://www.aiche.org/CCPS/Publications/Beacon/index.aspx Messages for Manufacturing Personnel		This issue sponsored by www.iomosaic.com	
Bhopal – The Worst Industrial Disaster in History				December 2014	
		Just after midnight on December 3, 1984 (30 years ago), a pesticide plant in Bhopal, India released approximately 40 tons of highly toxic methyl isocyanate (MIC) into the atmosphere. There were thousands of fatalities, hundreds of thousands of injuries, as well as long term health, environmental, and economic impacts. This incident is widely considered to be the worst industrial disaster in history. It is believed that water entered MIC storage tank E610 (1). An exothermic reaction resulted, generating heat and pressure which opened the tank relief valve. Some critical instruments in the field and control room (2) were not working properly. A refrigeration system (3) was out of service and the refrigerant had been removed. Gas from the relief valve flowed to a caustic scrubber (4) which was shut down for maintenance. From there, the gas flowed to a flare (5) which was also shut down awaiting replacement of corroded piping. The toxic gas was released to the atmosphere without treatment exposing hundreds of thousands of people.			
		Note: All pictures taken in December 2004 at the plant in Bhopal There were many failures in design, management, safety culture, and operation of the facility which contributed to the tragedy. You can find many good resources on the Internet which describe the incident in great detail. Take some time this month to learn about the incident, and what it means to you in your job.			
Above: A sign in the plant control room					

Safety Moment Bhopal

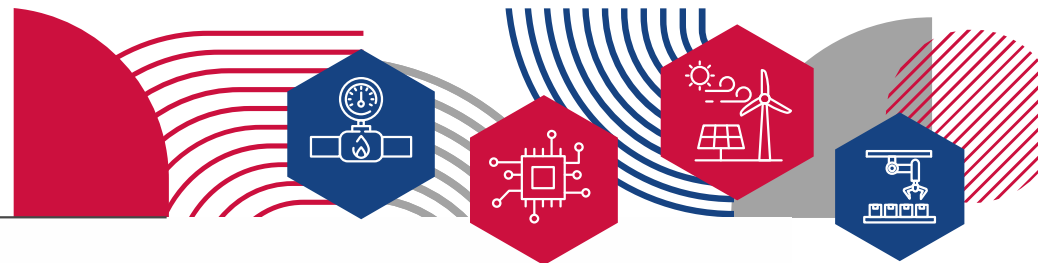
- Release of Methyl Isocyanate (MIC)
- Union Carbide India Limited (UCIL) plant
- Initially ~3k fatalities, eventually ~20k
- Union Carbide executives arrested in India
- \$1B settlement
- Union Carbide purchased by Dow
- Facility had significant design flaws
- One of the incidents that drove US Right-to-Know and Process Safety Management (OSHA PSM)
- Changed the use of MIC and similar chemicals in industry



Global Congress on Process Safety Overview

- GCPS general sessions
 - Excellent set of speakers
 - Wide range of topics
- 27th Process Plant Safety Symposium (PPSS)
- 40th Center for Chemical Process Safety (CCPS) International Conference
- 59th Annual Loss Prevention Symposium (LPS)
- 14th Process Safety Management Mentoring (PSM2) Symposium
- Perspectives on Process Safety from Around the World
- Poster sessions





AIChE IDEAL

INCLUSION
DIVERSITY
EQUITY
ANTI-RACISM
LEARNING

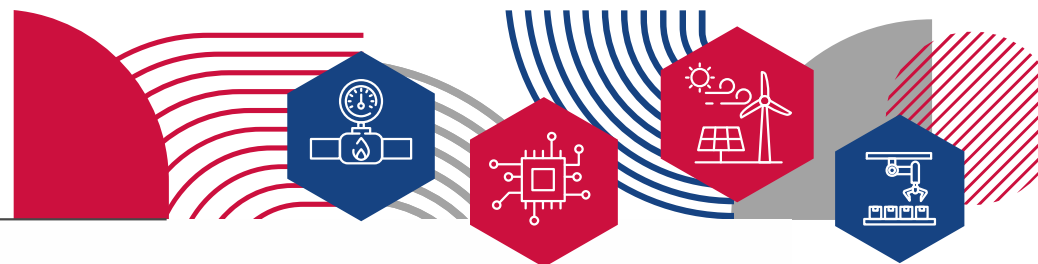
AIChE
The Global Home of Chemical Engineers

60k
TOTAL MEMBERS

110+
COUNTRIES REPRESENTED BY
OUR MEMBERS

40+
TECHNICAL & PROFESSIONAL
COMMUNITIES

- We believe efforts to support and promote **inclusion** must narrow gaps and address root causes and manifestations of inequities.
- We hold forth a vision for a **diverse** profession in which discrimination and conscious bias are unwelcome and unacceptable and where unconscious bias is recognized and eliminated.
- AIChE will initiate and support proactive efforts to combat the influences of racism and bias as a key part of our **equity**, diversity and inclusion initiatives.
- We are committed to **anti-racism** and to understanding, addressing and mitigating the effects of racism within and beyond our profession through sharing of identified best practices.
- We believe that moving from understanding to action requires an openness and commitment to **learning**; through education we will build allyship.



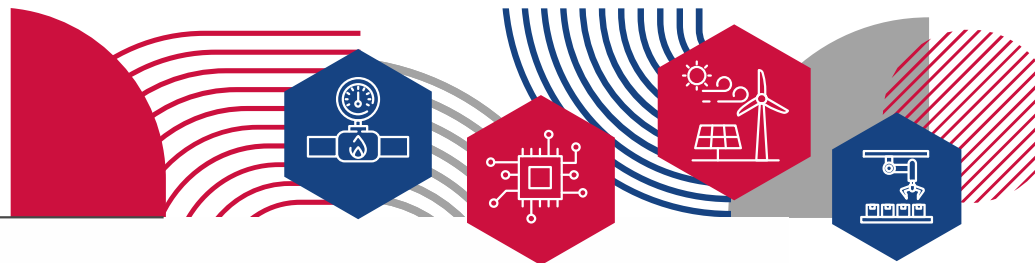
Center for Chemical Process Safety (CCPS)

CCPS is committed to achieve **a world without Process Safety incidents** by:

- Serving as a premier worldwide resource for Process Safety knowledge and understanding
- Advancing Process Safety culture, technical concepts and management practices
- Enhancing individual and organizational Process Safety competency
- Fostering collaboration within and across organizations, at all levels
- Promoting Process Safety as a key societal value and foundation for responsible, sustainable operation

Timeline

- 1984 Bhopal Disaster
- 1985 CCPS Founded
- 1986 Guidelines for Hazard Evaluation Procedures
- 1990 A Challenge to Commitment
- 1992 Safety in Chemical Engineering Education (SaChE)
- 2016 Introduction to Process Safety for Undergraduates and Engineers
- 2022 Process Safety Metrics Guide for Leading and Lagging Indicators
- 2024 International Process Safety Week
- 2025 40th Anniversary
 - Over 100 publications
 - 17 conferences



Excellence in Process Safety

The Five Tenets

These five industry tenets, combined with a fervor for great process safety, provide a powerful framework for Excellence in Process Safety's success. Process safety results will dramatically improve if a company has:



In a **Committed Culture**, executives involve themselves personally, managers and supervisors drive excellent execution every day, and all employees maintain a sense of vigilance and vulnerability.



Vibrant Management Systems are engrained throughout the organization. Vibrant systems readily adapt to the organization's varying operations and risks.



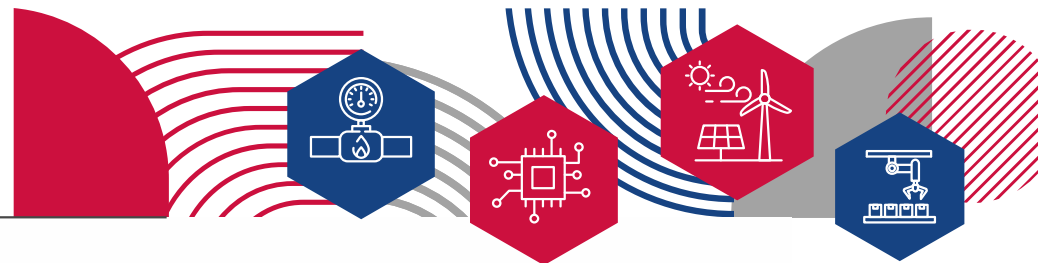
Disciplined Adherence to Standards means using recognized design, operations, and maintenance standards. These standards are followed every time, all the time, and are continually improved.



Intentional Competency Development ensures that all employees who impact process safety are fully capable of meeting the technical and behavioral requirements for their jobs.



Enhanced Application & Sharing of Lessons Learned communicates critical knowledge in a focused manner that satisfies the thirst for learning.



Excellence in Process Safety

The Four Societal Themes

We've come a long way since Flixborough, Seveso and Bhopal. Yet, in spite of industry's continuing process safety vigilance, catastrophic events still happen. To transform process safety culture, industry and the public need to work together to improve.

Excellence in Process Safety details how the five tenets of culture, management systems, standards, competency, and lessons learned are enhanced by the community's involvement, and supported by these four societal themes:



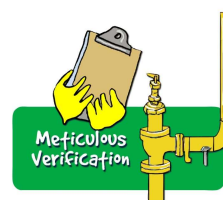
This **Enhanced Stakeholder Knowledge** allows the public to effectively challenge industry to prevent process safety incidents. The same holds true for industry challenging the public to understand process safety risks.



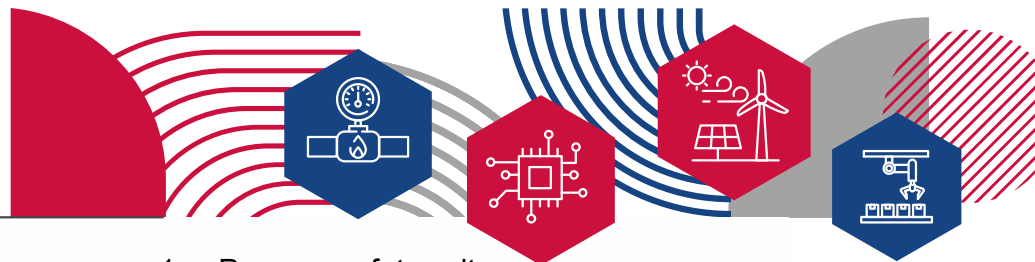
Responsible Collaboration means working together on a common goal of excellent process safety performance.



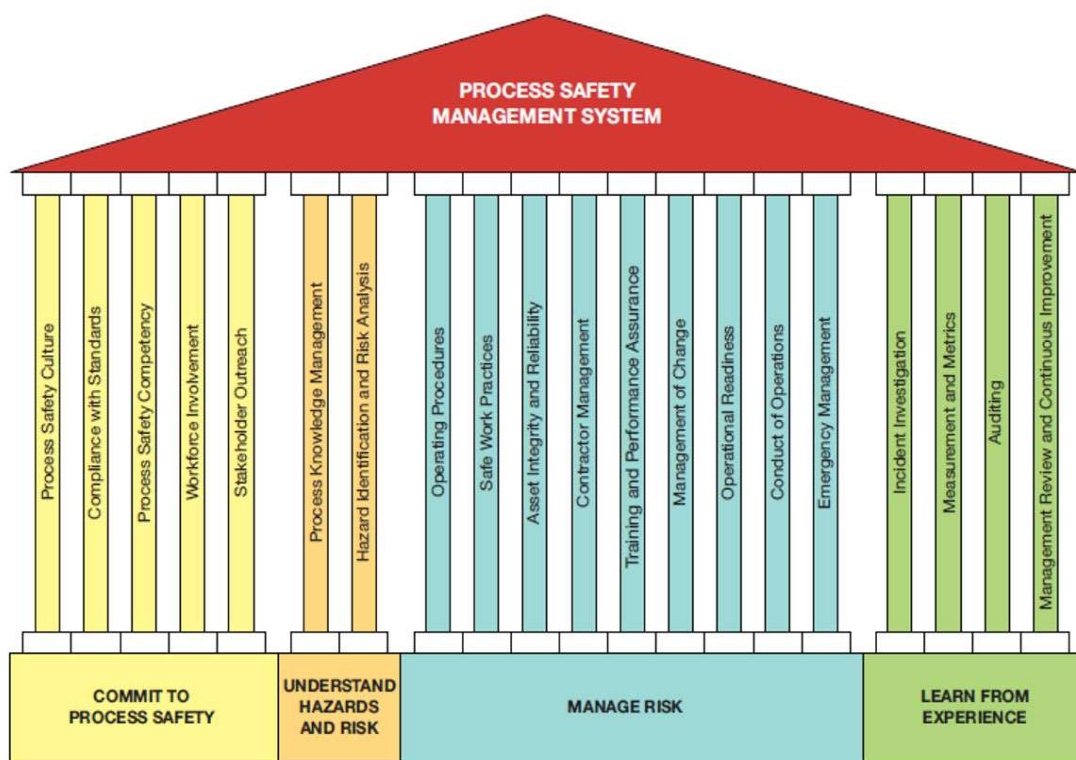
Harmonized Standards provide consistent guidance for design, operations, and maintenance, to support effective understanding of process safety risk.



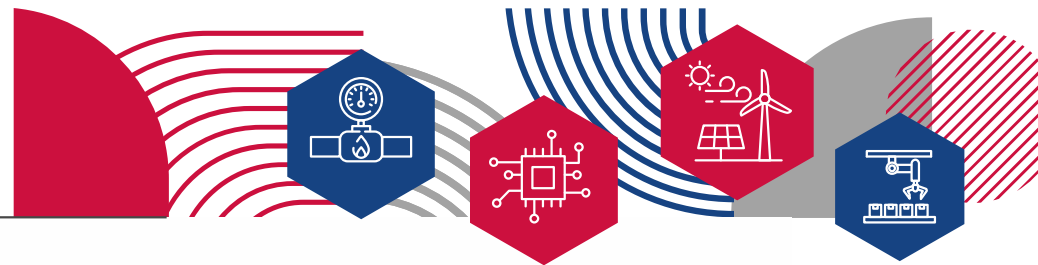
Companies use various assessment techniques to assure their process safety management systems are working as intended.



Risk Based Process Safety

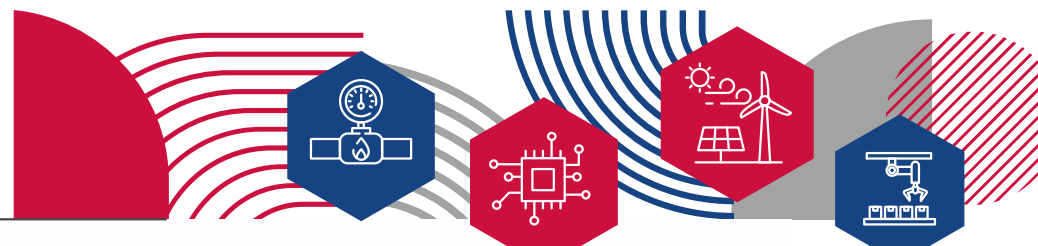


1. Process safety culture
2. Compliance with standards
3. Process safety competency
4. Workforce involvement
5. Stakeholder outreach
6. Process knowledge management:
7. Hazard identification and risk analysis (HIRA)
8. Operating procedures
9. Safe work practices
10. Asset integrity and reliability
11. Contractor management:
12. Training and performance assurance
13. Management of change (MOC)
14. Operational readiness
15. Conduct of operations
16. Emergency management
17. Incident investigation
18. Measurements and metrics
19. Auditing
20. Management review and continuous improvement



CCPS Books

	Guidelines for Process Safety in Outsourced Manufacturing, 2nd Edition Mar, 2026		Guidelines for Preparing Process Equipment for Maintenance and Return to Service Apr, 2025		Guidelines for Process Safety Knowledge Management Mar, 2024		Guidelines for Pressure Relief and Effluent Handling Systems, 2nd Edition Apr, 2017		Guidelines for Safe Automation of Chemical Processes, 2nd Edition Dec, 2016		Guidelines for Asset Integrity Management Nov, 2016		Comprehensive Quality by Design for Pharmaceutical Product Development and Manufacture Oct, 2017		Chemically Reacting Flow: Theory, Modeling, and Simulation, Second Edition Oct, 2017		Nanotechnology Commercialization: Manufacturing Processes and Products Oct, 2017
	Handbook for Process Safety in Laboratories and Pilot Plants: A Risk-based Approach Aug, 2023		Guidelines for Managing Abnormal Situations Dec, 2022		Guidelines for Revalidating a Process Hazard Analysis, 2nd Edition Nov, 2022		Guidelines for Implementing Process Safety Management, 2nd Edition Jun, 2016		Introduction to Process Safety for Undergraduates and Engineers Jun, 2016		Guidelines for Integrating Management Systems and Metrics to Improve Process Safety Performance Feb, 2016		(Chinese) Guidelines for Auditing Process Safety Management Systems, 2nd Edition Sep, 2017		(Chinese) Conduct of Operations and Operational Discipline: For Improving Process Safety in Industry May, 2017		Guidelines for Evaluating Process Plant Hazard Analysis May, 2017
	Human Factors Handbook for Process Plant Operations: Improving Process Safety and System Performance Apr, 2022		Managing Cybersecurity in the Process Industries: A Risk-based Approach Apr, 2022		Process Safety for Engineers: An Introduction, 2nd Edition Apr, 2022		Guidelines for Defining Process Safety Competency Requirements Oct, 2015		事例に学ぶ化学プロセス安全 Beacon の教訓と事故防止の知恵 Mar, 2015		Guidelines for Initiating Events and Independent Protection Layers in Layer of Protection Analysis Feb, 2015		Guidelines for Pressure Relief and Effluent Handling Systems, 2nd Edition Apr, 2017		Chemical Engineering for Non-Chemical Engineers Mar, 2017		(Chinese) Guidelines for Evaluating Process Plant Buildings for External Explosions, Fires, and Toxic Releases, 2nd Edition Jan, 2017
	Process Safety in Upstream Oil and Gas Jun, 2021		Driving Continuous Process Safety Improvement From Investigated Incidents Apr, 2021		Guidelines for Process Safety During the Transient Operating Mode: Managing Risks during Process Start-ups and Shut-downs Jan, 2021		Guidelines for Determining the Probability of Ignition of a Released Flammable Mass Jun, 2014		Guidelines for Enabling Conditions and Conditional Modifiers in Layers of Protection Analysis Nov, 2013		Guidelines for Managing Process Safety Risks During Organizational Change Mar, 2013		Hydroprocessing for Clean Energy: Design, Operation, and Optimization Jan, 2017		Guidelines for Safe Automation of Chemical Processes, 2nd Edition Dec, 2016		Guidelines for Asset Integrity Management Nov, 2016
	Teach Yourself the Basics of Aspen Plus, Second Edition Sep, 2016		Efficiency of Biomass Energy: An Exergy Approach to Biofuels, Power, and Biorefineries Jun, 2016		Guidelines for Implementing Process Safety Management, 2nd Edition Jun, 2016		Guide for Making Acute Risk Decisions Oct, 2019		Guidelines for Inherently Safer Chemical Processes: A Life Cycle Approach, 3rd Edition Oct, 2019		More Incidents That Define Process Safety Oct, 2019		Guide for Making Acute Risk Decisions Oct, 2019		Guidelines for Inherently Safer Chemical Processes: A Life Cycle Approach, 3rd Edition Oct, 2019		More Incidents That Define Process Safety Oct, 2019
	Introduction to Process Safety for Undergraduates and Engineers Jun, 2016		Introduction to Catalysis and Industrial Catalytic Processes Apr, 2016		Optimization Methods in Metabolic Networks Mar, 2016		Guidelines for Investigating Process Safety Incidents, 3rd Edition May, 2019		Process Safety Leadership from the Boardroom to the Frontline May, 2019		Guidelines for Integrating Process Safety into Engineering Projects Dec, 2018		Guidelines for Investigating Process Safety Incidents, 3rd Edition May, 2019		Process Safety Leadership from the Boardroom to the Frontline May, 2019		Guidelines for Integrating Process Safety into Engineering Projects Dec, 2018
	Guidelines for Integrating Management Systems and Metrics to Improve Process Safety Performance Feb, 2016		Guidelines for Defining Process Safety Competency Requirements Oct, 2015		(Chinese) Incidents That Define Process Safety Sep, 2015		Bow Ties in Risk Management: A Concept Book for Process Safety Sep, 2018		Recognizing and Responding to Normalization of Deviance Aug, 2018		Essential Practices for Creating, Strengthening, and Sustaining Process Safety Culture Jul, 2018		Bow Ties in Risk Management: A Concept Book for Process Safety Sep, 2018		Recognizing and Responding to Normalization of Deviance Aug, 2018		Essential Practices for Creating, Strengthening, and Sustaining Process Safety Culture Jul, 2018
	(Chinese) Guidelines for Enabling Conditions and Conditional Modifiers in Layers of Protection Analysis Jun, 2015		Energy Management and Efficiency for the Process Industries Apr, 2015		事例に学ぶ化学プロセス安全 Beacon の教訓と事故防止の知恵 Mar, 2015		Dealing with Aging Process Facilities and Infrastructures Apr, 2018		Guidelines for Siting and Layout of Facilities, 2nd Edition Mar, 2018		Guidelines for Combustible Dust Hazard Analysis May, 2017		Dealing with Aging Process Facilities and Infrastructures Apr, 2018		Guidelines for Siting and Layout of Facilities, 2nd Edition Mar, 2018		Guidelines for Combustible Dust Hazard Analysis May, 2017



OceanGate Titan Implosion

Process Safety Lessons from the OceanGate *Titan* Implosion

Presentation by Richard Carter of Watchmen Instrumented Safety Experts Ltd.

- On June 18, 2023 (Dive 88), the submersible TITAN imploded at 3,346 meters instantly killing all five occupants.
- Primary Cause: Structural Failure of the Hull
- Unproven Materials and Design
- Lack of Certification, Oversight, and Testing
- Overreliance on Real-Time Monitoring (RTM)
- Ignored Warnings and Safety Concerns
- Toxic Safety Culture and Regulatory Gaps

Information from US Coast Guard Marine Board Investigation Report – August 2025

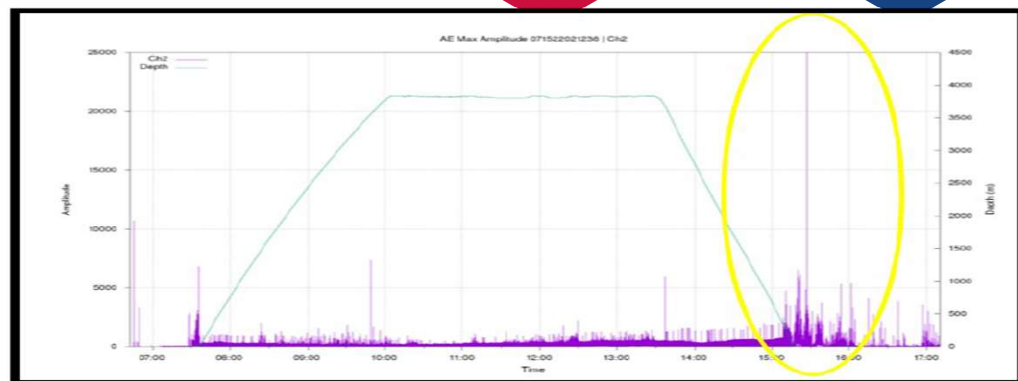
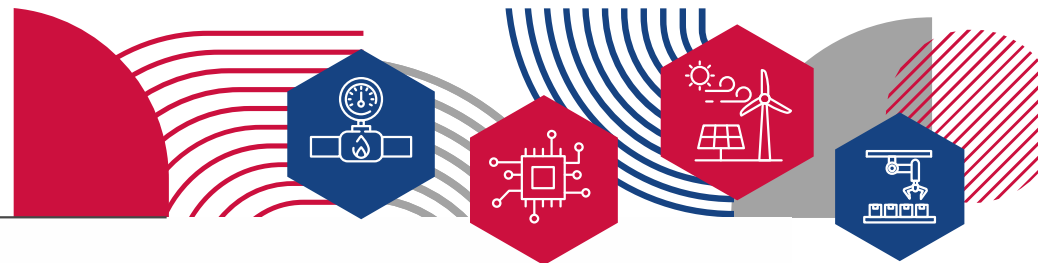


Figure 215: Dive 80 Acoustic Emissions Data for channel 2 (which is located on the forward port side of the TITAN hull). The yellow circle (added by MBI) highlights the acoustic emission for time of the "loud bang" which occurred as the TITAN was still submerged but nearing the surface. Source: OceanGate.



Figure 155: Main components of the CYCLOPS II (TITAN) pressure hull. Source: OceanGate.



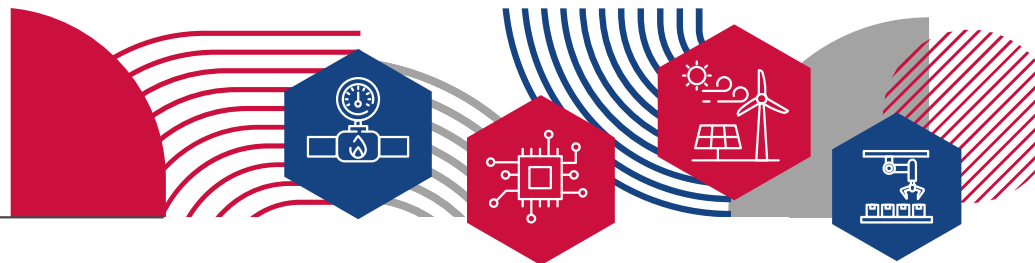
Changes to EPA Risk Management Plan (RMP)

Maneuvering the Technical Minefield of the Amplified RMP Rule

Alana Hodge, Provenance Consulting

Timeline

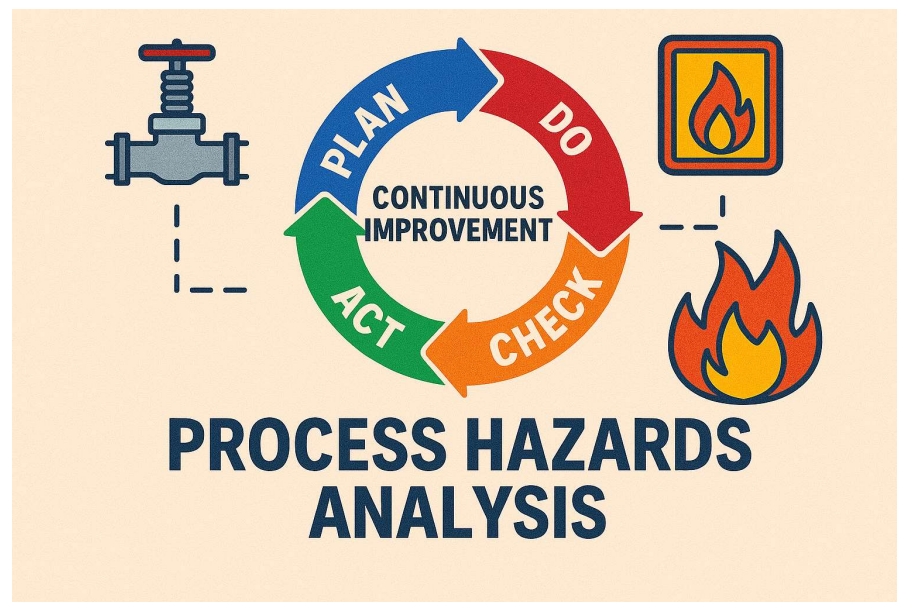
- Jan 2021 Executive order to update RMP
 - Jan 2024 update signed - Safer Communities by Chemical Accident Prevention
 - Mar 2024 Final rule issued
 - May 2024 Some changes enforced
 - May 2027 Remaining changes enforced
 - Mar 2025 EPA announced reconsideration of the changes
 - Late 2026 EPA expected to issue final rule
- Safer technologies and alternatives analysis (STAA): Required for facilities in certain high-risk sectors.
 - Third-party compliance audits: Mandated after a facility has a reportable accident.
 - Root cause analysis: Required for incident investigations following a qualifying accident.
 - Increased public information: Included enhanced transparency around chemical hazard information, though with some restrictions.
 - Extreme weather and power loss: Required facilities to consider risks posed by natural hazards and power loss in their hazard analyses

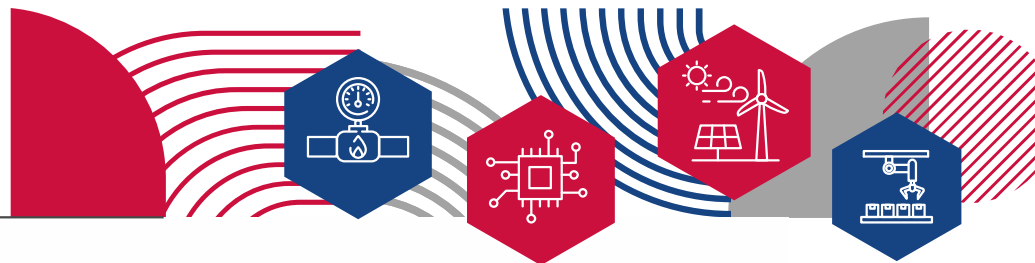


Improving PHAs

PHA – Common Misses with Significant Risks
Felicia Miller & Darshan Lakhani, ABSG Consulting Inc.

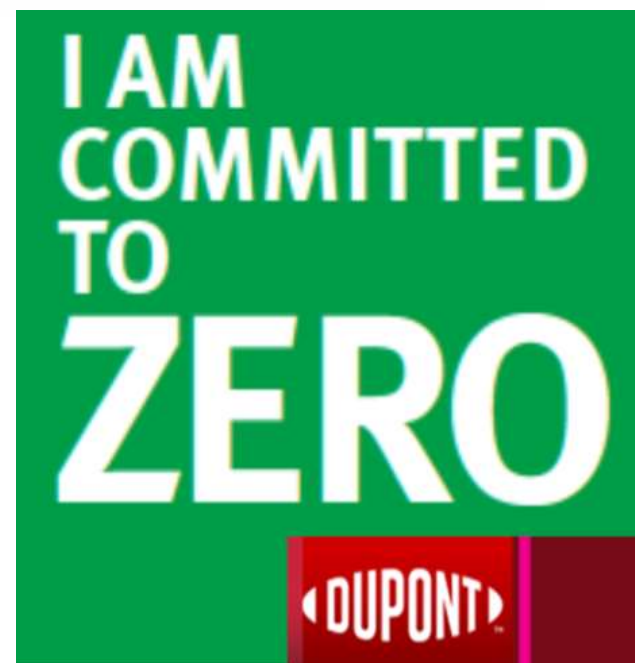
1. Stopping at Overpressurization
2. Not Evaluating Relief Discharge Location
3. Failure to Document Fire Scenarios
4. Failure to Consider All Loss of Primary Containment (LOPC) Events
5. Insufficient Previous Incident Documentation
6. Lack of Management of Change (MOC) Documentation
7. Inadequate Hazard Identification
8. Insufficient Team Involvement
9. Inadequate Documentation and Recordkeeping
10. Lack of Follow-Up or Improper Decline of PHA Action Items





Summary

- My first GCPS conference
- Not my first CCPS conferences
- Reminder of CCPS mission
- Inspires a drive to improve process safety
- Many good programs
- Many smart people
- Many things to learn



SPRING26+22ND GCPS

A Joint AIChE and CCPS Meeting

April 12 - 16 • Houston, TX



Next Year - Houston



- April 12 to April 16, 2026
- Hilton Americas – Houston
- George R. Brown Convention Center