



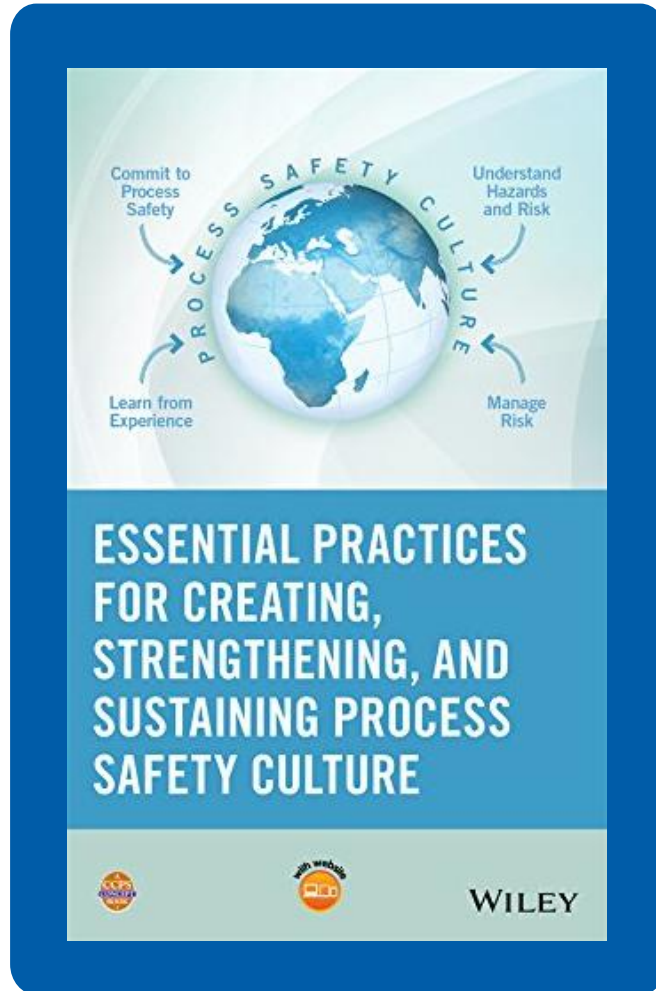
Process Safety Culture in Hydrogen (PS4H2)

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Definition of Process Safety Culture



- Pattern of shared written and unwritten attitudes and behavioral norms
- Positive influence on collective support for development of and successful execution of a process safety management program
- Resulting in the prevention of process safety incidents

Process Safety Culture Maturity Levels

Generative (Excellence)

Attitude: Safety is fully embedded in the organizational DNA.

Characteristics:

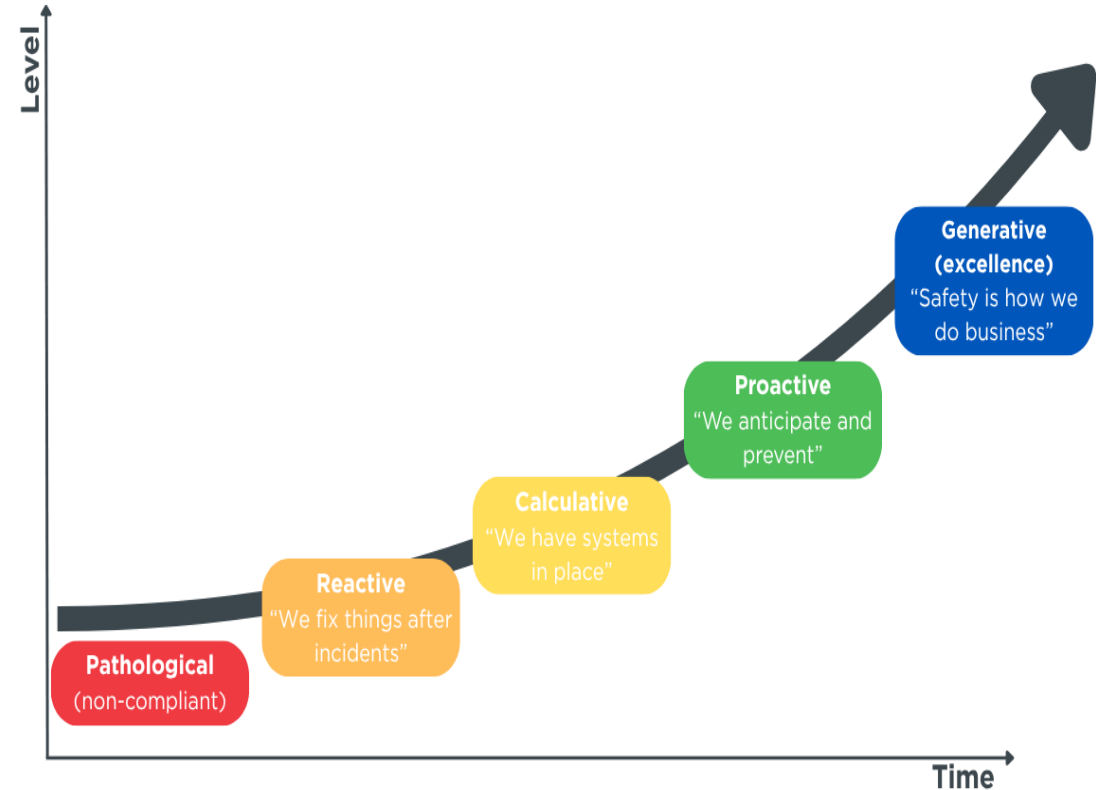
- Everyone takes ownership of process safety.
- Learning culture is robust and shared widely.
- PSM is a strategic priority aligned with business success.
- Adaptable and resilient systems that go beyond compliance.

Proactive

Attitude: Safety is valued and **anticipated**, not just managed.

Characteristics:

- Employees actively look for potential hazards.
- Near misses and weak signals are reported and acted upon.
- Management walks the talk; safety integrated in decision-making.



Risk Based Process Safety - RBPS

How can we be sure we prepare and maintain safety?

- AcuTech recommended Process Safety Management (PSM) system
- 20 Elements of AIChE Center for Chemical Process Safety (CCPS) Risk Based Process Safety Management System
- Organized by 4 Pillars:
 - Commit to Process Safety
 - Understand Hazards & Risks
 - Manage Risk
 - Learn from Experience
- “Plan-Do-Check-Act”
 - Demming style continuous improvement & culture focused

AcuTech Model Process Safety Management System



Based on four underlying pillars supported by the 20 elements of the Center for Chemical Process Safety (CCPS) Risk Based Process Safety Model.

High Reliability Organizations (HRO)

- Why are some organizations so reliable?
 - Evaluations of nuclear power plants and air traffic control systems developed into applicable process for industries
 - Adopted today by healthcare and aviation
 - Shares characteristics with firefighting incident command system

Characterized by:

- Preoccupation with Failure
- Sensitivity to unexpected change
- Commitment to resilience
- Reluctance to Simplify
- Deference to Expertise
- Mindful Leadership

Leads to:

- Trust – bottom-up communication of bad news
- Improvement – proactive audits and continuous training
- Accountability – sense of ownership and accountability



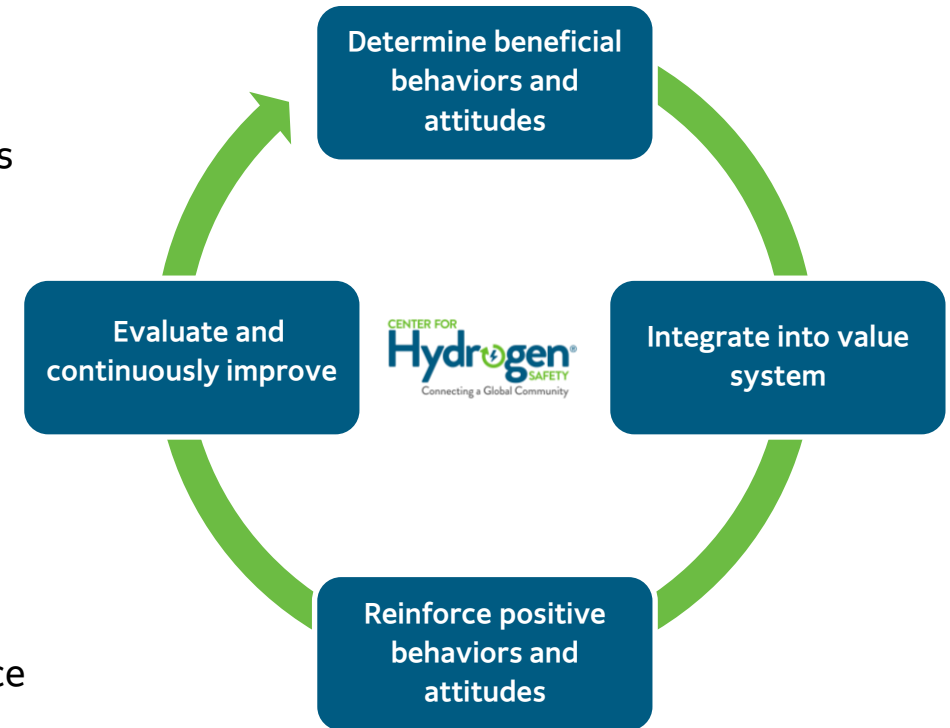
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Process Safety Culture for Hydrogen

- Establish an imperative for Safety
 - Preoccupation with failure; preoccupation with leaks
 - Learning culture is robust and shared widely
- Maintain a Sense of Vulnerability
 - Healthy attitude on risk
 - Commitment to resilience and anticipation of errors and initiating events
 - Sensitivity of unexpected change
- Understand and Act upon Hazards and Risks
 - Reluctance to simplify
 - CHS - Safety Planning Guidance & H2 Tools.org
 - CCPS - Risk Based Process Safety
- Provide Mindful Leadership
 - Goal oriented “Excellent Maturity”
 - PSM is a strategic priority aligned with business success
 - Adaptable and resilient management systems that go beyond compliance
- Empower Individuals to Successfully Fulfill their Safety Responsibilities
 - Everyone takes ownership of process safety
 - Deference to expertise
 - Honest appraisal and acceptance of change
 - Positive outlook rather than criticism



Compliance & PSM Management Systems

- Compliance requirements require a plan
 - You need a plan
- Best planning methods are evolving
 - Process Safety guidance specific to hydrogen is not further advanced than the market itself
- Combination of management systems
 - RBPS is best in class in chemical process industry
 - provides framework
 - CHS Safety Plan
 - applies to wide range of hydrogen projects
 - supplemented by H2Tools

Compliance (14 Elements)	Risk Based (20 Elements)	CHS Safety Plan
Process Safety Information (PSI)	Process Knowledge Management	Description of Work
		Project Safety Documentation
	Process Safety Competency	Organizational Policies & procedures
Employee Participation	Workforce Involvement	Involve all parties & stakeholders
	Stakeholders Outreach	
Process Hazard Analysis (PHA)	Hazard Identification & Risk Analysis	Identification of Safety Vulnerabilities
		Risk Reduction Plan
Compliance with Standards	Compliance with Standards	Codes & Standards
Trade Secrets		
Operating Procedures	Operating Procedures	Procedures
Mechanical Integrity	Asset Integrity & Reliability	Equipment & Mechanical Integrity
Management of Change	Management of Change	Management of Change
Pre Startup Safety Review (PSSR)	Operational Readiness	Safety Reviews
Compliance Audits	Auditing	
Training	Training & Performance Assurance	Training
Hot Work Permit Process	Safe Work Practices	
Incident Investigation	Incident Investigation	Safety Events & Lessons Learned
Emergency Planning and Response	Emergency Management	Emergency Response
Contractors	Contractor Management	Contractor Management
	Management Review & Continuous Improvement	Appendix B
	Process Safety Culture	
	Conduct of Operations	
	Measurement & Metrics	
		Hydrogen Fuel Cell Experience

Benchmarking and Goal Setting for Successful Performance

- PSM culture should be analyzed (baseline)
 - Then monitored for status/improvement.
- Tools to monitor progress:
 - Periodic audits
 - Employee surveys are useful tools to monitor progress
- AcuTech uses a maturity scale
 - define relative performance of the entire system
 - set goals for improvement

Element Score	Description of Element Implementation & Functionality	Maturity Level
Above 90%	The element demonstrates best practice performance.	Leading
80% - 90%	The element is implemented and functional.	Integrated
60% - 80%	The element is implemented and partly functional.	Functional
Below 60%	The element is not implemented and not functional.	Informal

Safety Culture Warning Signs



Conflicting job priorities

Conflict between production and process safety goals

Strained communications between management and front- line workers

A lack of trust in field supervision

Important KPIs not monitored or not believed

Slow management response to process safety concerns

Allowing process information to become inaccurate/out-of-date

Overdue process action items

Inspection, testing and preventive maintenance chronically overdue

Normalization of deviance allowed to persist

When do you want to
collect employee
feedback on process
safety?

Conclusions

- Process safety management is **essential in hydrogen**
- Process safety **culture is an element of good** process safety management
- Good process safety management systems exist
- The perfect process safety management system for hydrogen is a work in progress
- Your safety culture improvement can begin today

Generative (Excellence)

Attitude: Safety is fully embedded in the organizational DNA.

Characteristics:

- Everyone takes ownership of process safety.
- Learning culture is robust and shared widely.
- PSM is a strategic priority aligned with business success.
- Adaptable and resilient systems that go beyond compliance.

Reminders:

Patience - Safety culture takes time to achieve high levels of performance

Clarify - Establish clear principles and policy, promote ownership

Persist - Maintain a sense vulnerability, adaptability and resilience (not just compliance)



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