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CCPS
Center for Chemical Process Safety

First Time in Pakistan

REGIONAL

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MEETING

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Safety Briefing

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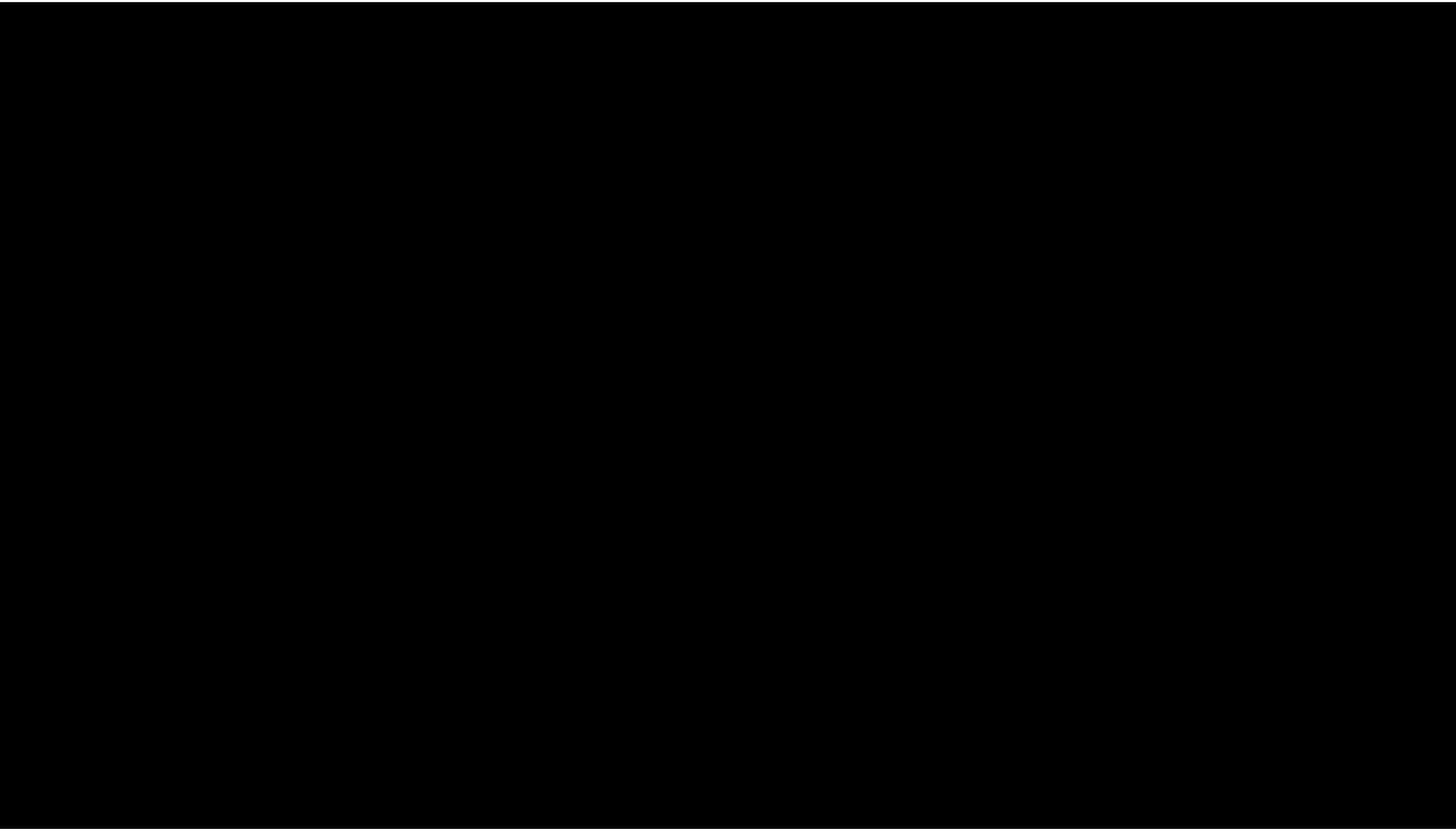

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Introduction with Delegates

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Shakeel H. Kadri

Executive Director,
CCPS, AIChE

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PEOPLE
PRESERVING
PLANET

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1st Pakistan CCPS Regional Meeting

Shakeel Kadri
Executive Director, CCPS

22 November 2018
Pearl Continental Karachi

Meeting HOSTS

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1st CCPS Regional Meeting in Pakistan

Personal Safety vs Process Safety

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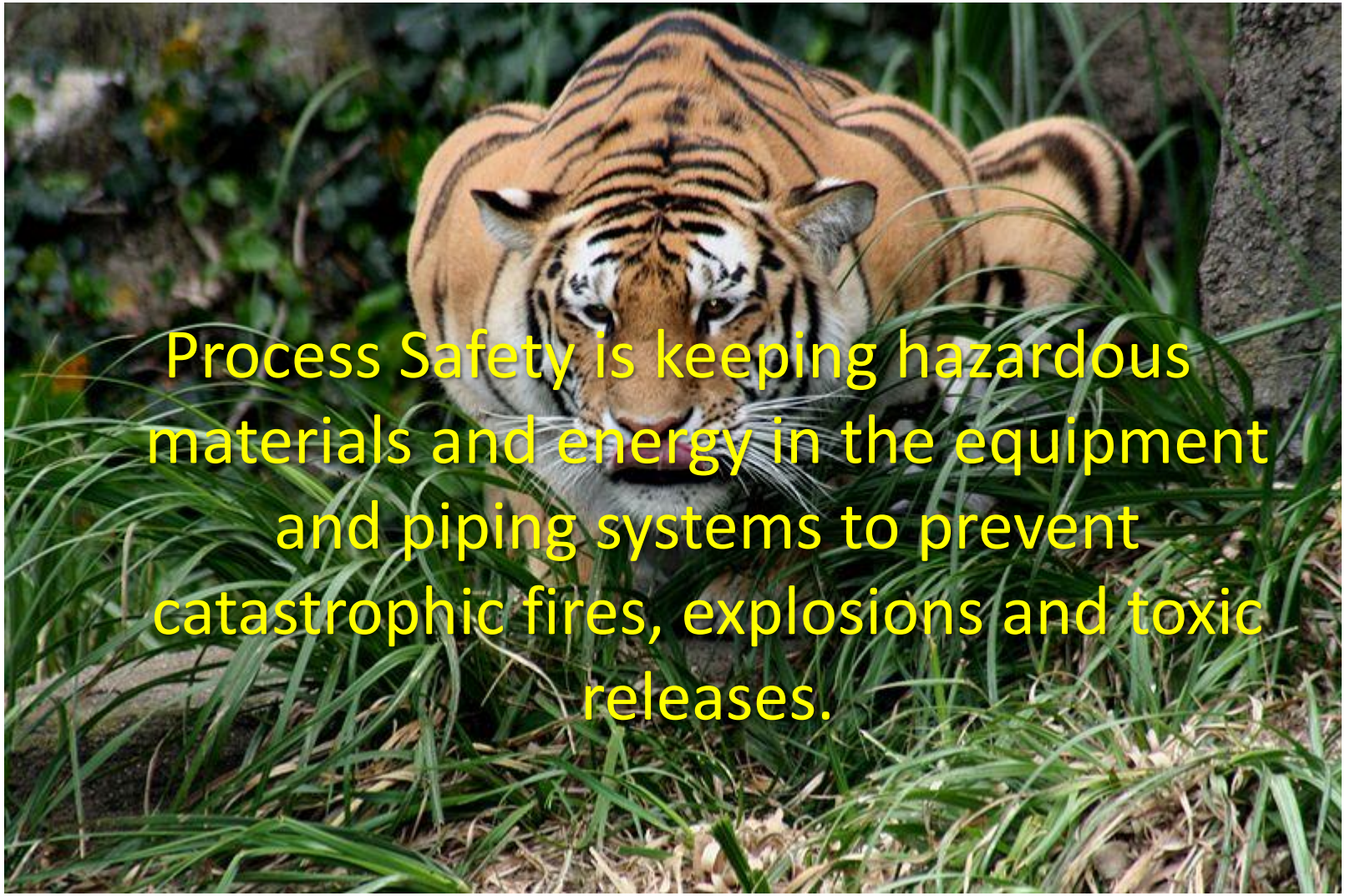
Process Safety



Why Process Safety?
Business Case

Qualitative Benefits

- Corporate Responsibility
  - Image, reputation, and brand
- Business Flexibility
  - License to operate
  - Increased business options

Quantitative Benefits

- Risk Reduction
  - Process safety prevents human injury
  - Process safety avoids significant losses and environmental damage
- Sustained Value
  - Process safety helps boosts productivity
  - It helps produce high quality products, on time, and at lower cost
  - It contributes to shareholder value

Process Safety Business Imperative

- **CCPS Member Companies collectively working together to address this Business Imperative**

AIChE
The Global Home of Chemical Engineers

Working with chemical engineers from Industry & Academia around the globe collaborating, innovating and creating the future.

Chemical Engineering & Process Safety

- What good we bring to the many?
- What harm we bring to some?
- The harm all remember…..

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What good we bring to the many?

“The Global Community Committed to Process Safety”

What harm we bring to some that we may not remember?

Flixborough, UK, 1974

What harm we bring to some that we may not remember?

Seveso, Italy, 1976

What harm we bring to some that we may not remember?

Piper Alpha, UK 1988

"The Global Community Committed to Process Safety"

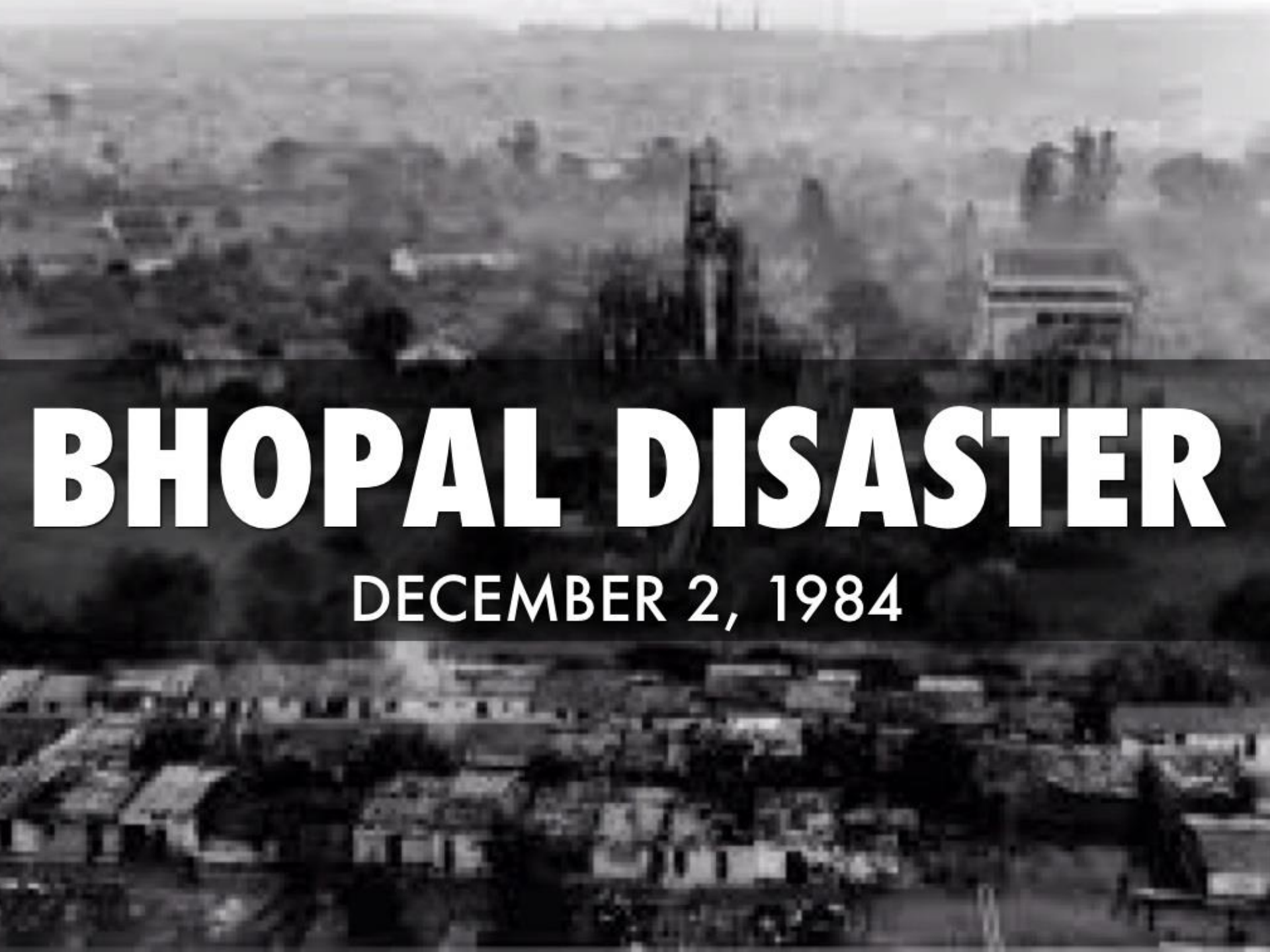
What harm we bring to some that we may not remember?

Pasadena, TX, 1989

What harm we bring to some that we may not remember?

Mexico City, 1984

The harm we all must remember…


BHOPAL DISASTER
DECEMBER 2, 1984

How well you know your facility?

- What is the worst process safety event that can happen at your facility?
- What systems are in place to keep them from happening?
- How do you know that preventive systems are working?
- What mitigation systems are in place to respond to such events?
- How do you know these mitigation systems are working?
- What is your role in making sure that these preventive and mitigation systems are working properly?
- Are you raising your concerns to your senior leadership; are these concerns being addressed?

Lessons Learned…..

- **Bhopal is the worst process safety incident that's ever occurred in the chemical industry**
- **It served as a bellwether event for the industry and a catalyst for a safety reform**
- **It has lead to improved process safety practices worldwide**
- **Global process safety improvement initiated**
- **AIChE was asked to create a Safety Center --- Center of Chemical Process Safety [CCPS] – to lead a collaborative effort to eliminate catastrophic process incidents**

The Bhopal Disaster

CCPS Formed on 23 March 1985

Formation of CCPS

- On February 26th of 1985, industry leaders* asked the American Institute of Chemical Engineers (AIChE) **to lead a collaborative effort to eliminate catastrophic process incidents**.
- On March 23, 1985, AIChE formed the **Center for Chemical Process Safety (CCPS)**;
- **CCPS** completed Guidelines for Hazard Evaluation Procedures a short time later.

Founding Leaders of CCPS

1. American Cyanamid
2. The Dow Chemical Company
3. Monsanto Company
4. Rohm and Haas Company
5. Stone and Webster Engineering Corp.
6. Air Products and Chemicals
7. Union Carbide Corporation
8. Great Lakes Carbon Corp.
9. Shell Oil Company
10. Factory Mutual Research

About CCPS

- Not for profit organization; part of AICHE
- Corporate supported – over 200 members
- Global scope and mission; 40% of members outside of USA
- Focus: preventing process incidents: fires, explosions, and toxic releases
- Petroleum production, refining, chemicals, pharma, food, chemical users, etc.
- Headquarter in New York City, with offices in Frankfurt, Mumbai, Singapore, Ningbo [China] and Houston.

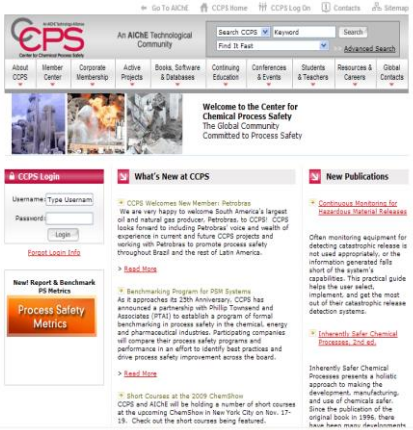
Leading Process Safety since 1985

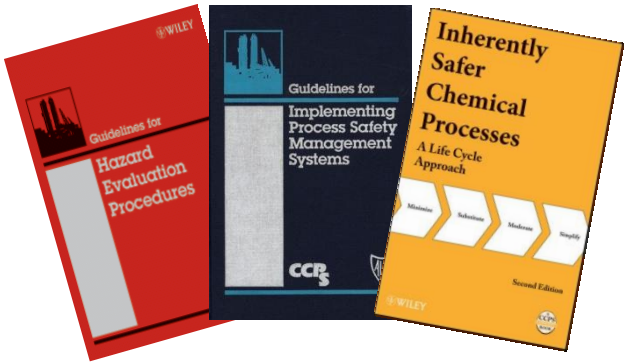
CCPS Certified **CCPSC**

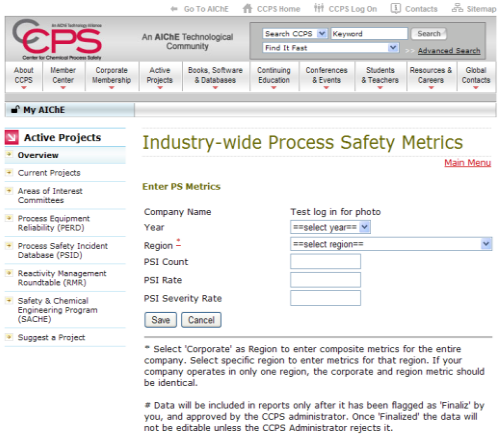
Creating Books and Publications

Creating Industry-wide Tools, Programs and Guidelines

Sharing Best Practices







Educating Educators

Process Safety Beacon

Conducting Global Conferences and Training

"The Global Community Committed to Process Safety"

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Center for Chemical Process Safety

Jahangir Waheed

Vice President Manufacturing
Engro Polymer & Chemicals

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Imran Anwer

CEO, Engro Polymer & Chemicals

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CCPS - Looking forward to 2018-19 and beyond

CCPS Global and Regional Plans

CCPS Projects activities

CCPS Key Initiatives

By

Shakeel H. Kadri

Executive Director,

CCPS, AIChE

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CCPS Business Update

- CCPS - Looking forward to 2018-19 and beyond
- CCPS Global and Regional Plans
- CCPS Projects activities
- CCPS Key Initiatives

CCPS Vision

"To protect people, property and the environment by bringing the best process safety knowledge and practices to industry, academia, the governments and the public around the world through collective wisdom, tools, training and expertise."

"The Global Community Committed to Process Safety"

CCPS Mission

Eliminate catastrophic process incidents globally by:

- Advancing global PS technologies, culture, and management practices
- Establishing Process Safety as foundation for responsible operation
- Serving as premier worldwide resource of Process Safety
- Fostering knowledge and understanding of Process Safety
- Promoting Process Safety as key societal value and expectation

2018 -- New CCPS Members

North America

- Inter Pipeline
- Intel Corporation
- Parkland Refining (BC) Ltd.
- Trinseo
- Syncrude
- United Natural Foods, Inc.

International

- Ambatovy
- Arlanxeo
- China Chemical Safety Assn.
- Deccan Fine Chemicals (I) Pvt. Ltd.
- Hengyuan Refining Co. Berhad
- Kuwait Oil Company
- Lloyd's Register Group, Ltd.
- Michelman Inc.
- Nghi Son Refinery and Petrochemical, LLC
- Promigas
- Sahara Petrochemicals Company
- Saudi International Petrochemical Co.
- Shenyang Research Institute of Chemical Industry Co., Ltd.
- Wanhua Chemical Group Co., Ltd.

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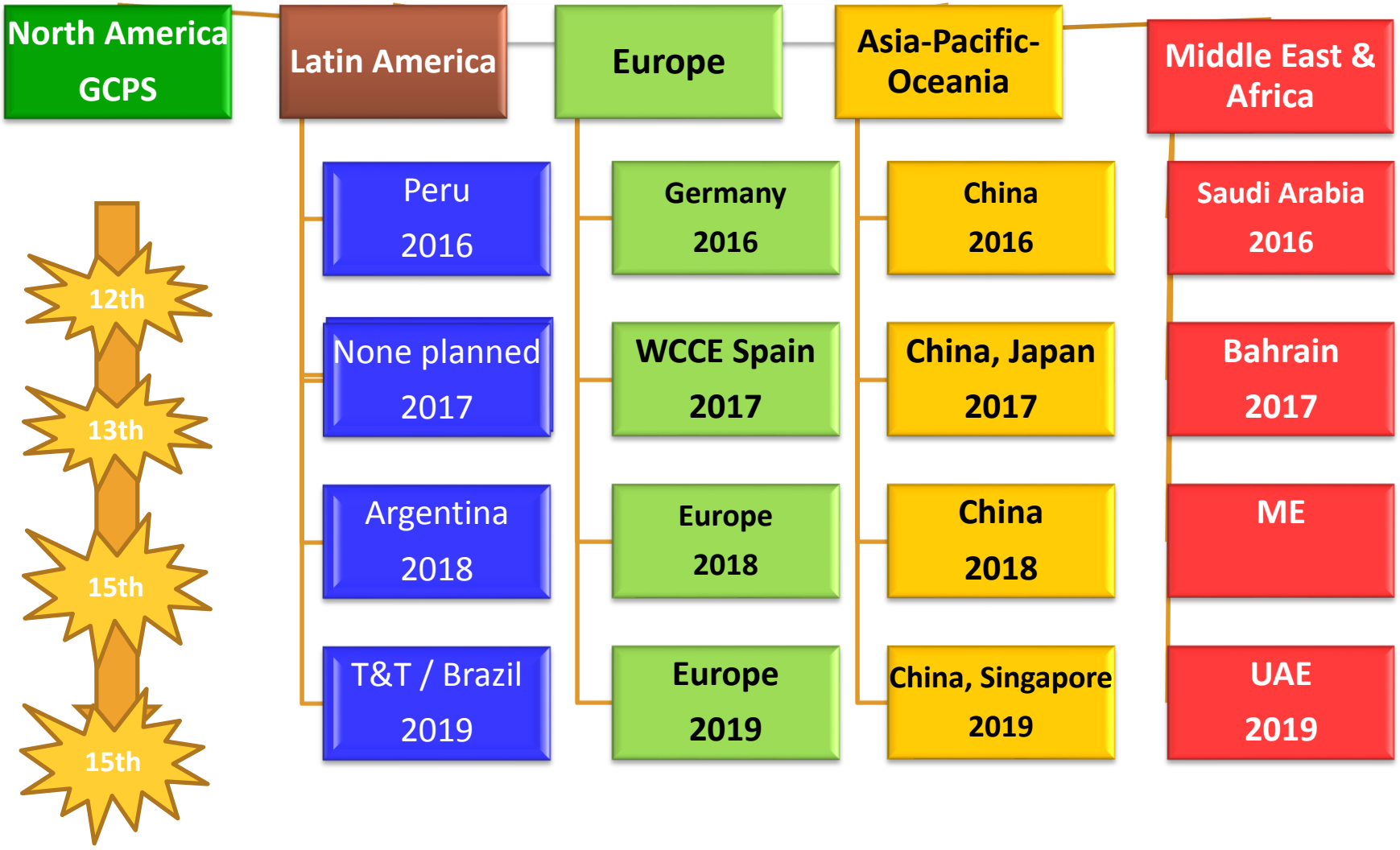
209 Global Corporate Members!

Representing 35 Countries

Global / Regional Engagement... CCPS Conferences



2018 -- CCPS Conferences / Workshops

- ✓ 14th Global Congress in Process Safety held in Orlando, FL
- ✓ 8th CCPS Conference in Latin America, Buenos Aires, Argentina
- ✓ 6th China Conference, Qingdao, China
- ✓ 3rd Europe Process Safety + Big Data Conference, Frankfurt, Germany
- ✓ Process Safety Metrics - API-754 Metrics Implementation workshop, Jubail, Saudi Arabia [Hosted by SABIC]
- ✓ Process Safety Metrics - API-754 Metrics Implementation workshop, Al-Khobar, Saudi Arabia [Hosted by Saudi Aramco]
- ✓ Pre-workshop at the 6th China Conference, Qingdao, China
- ✓ Process Safety Metrics workshop, Buenos Aires, Argentina

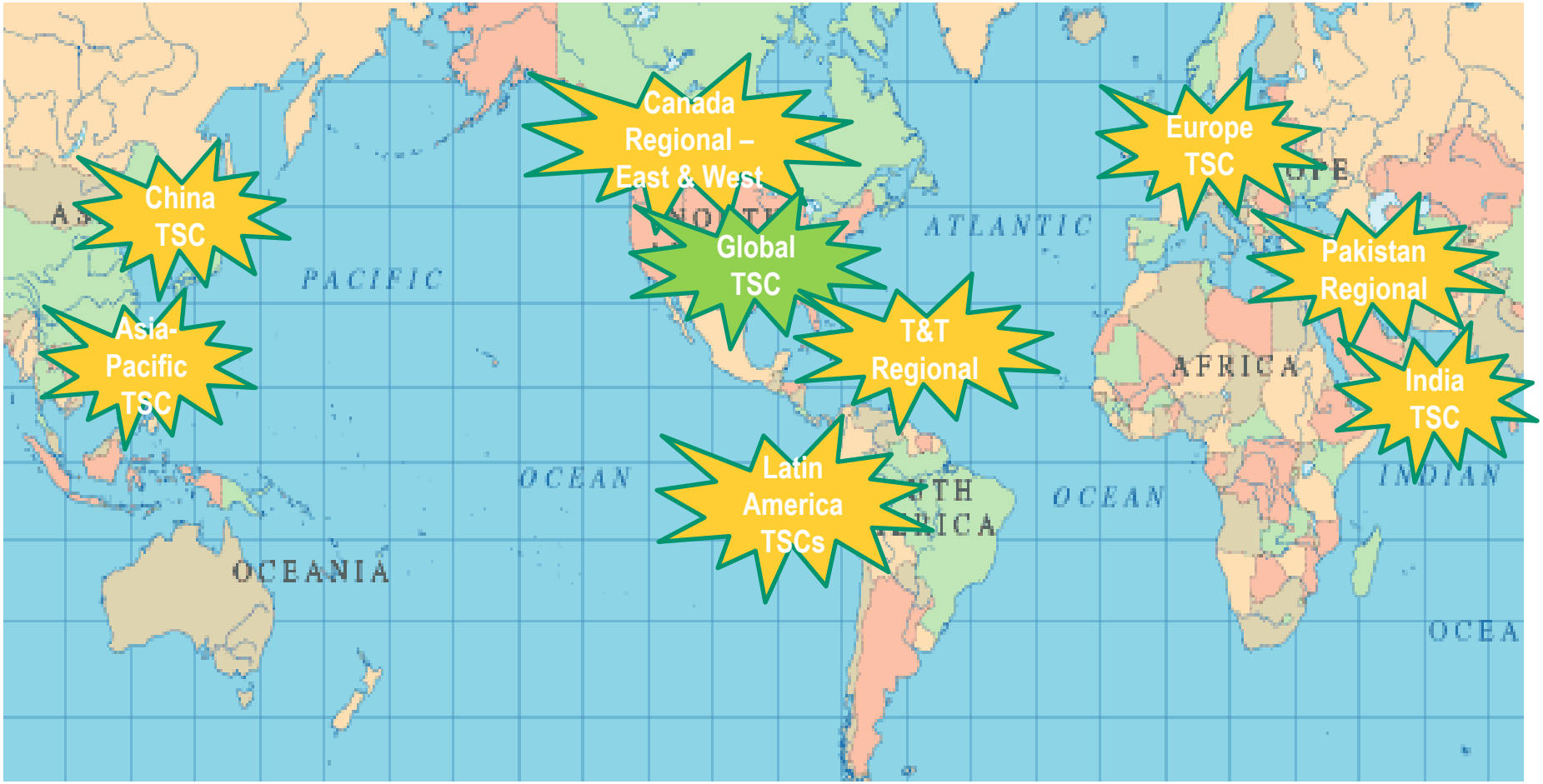
2019 CCPS Conference Plan

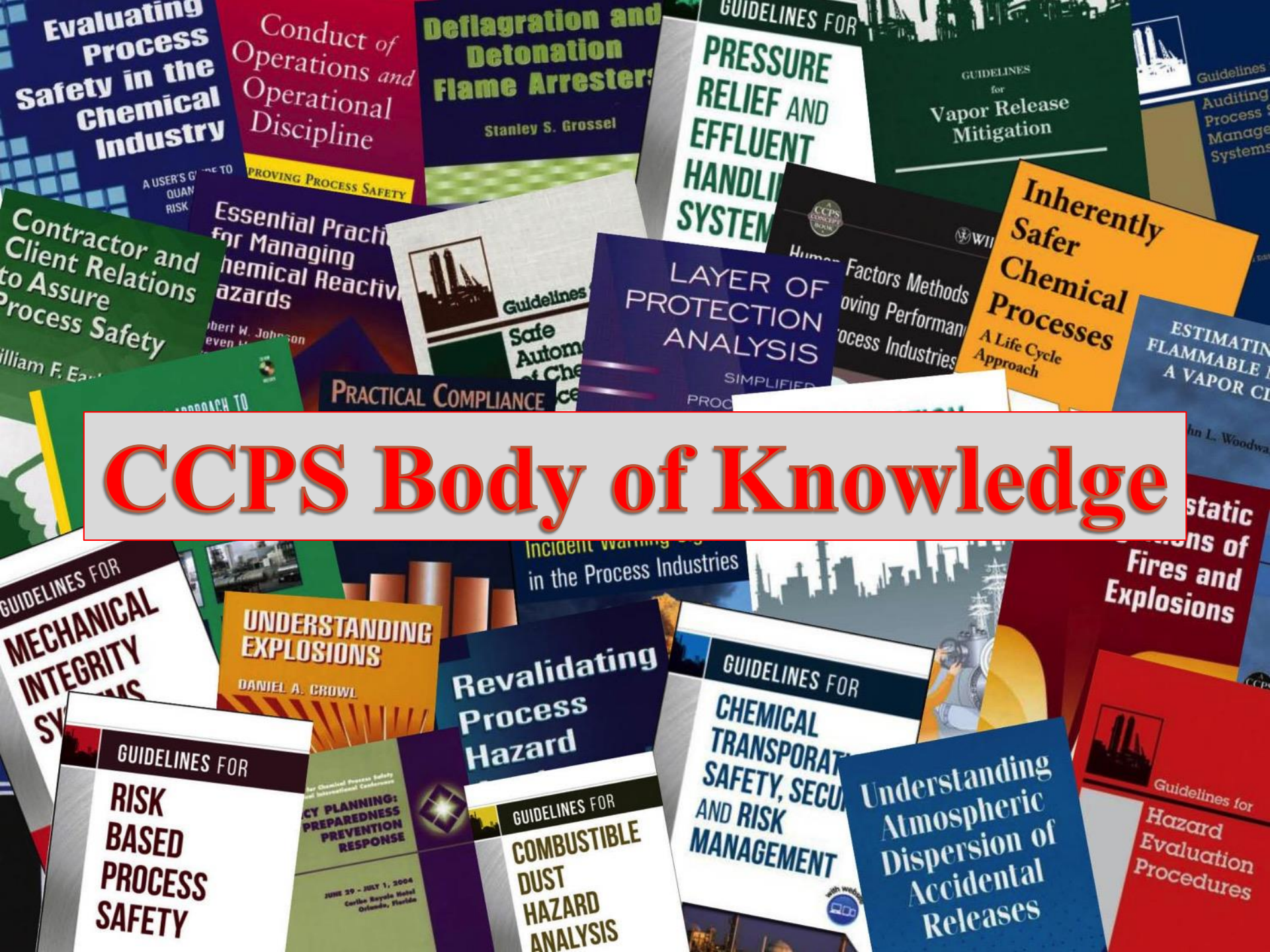
- 15th Global Congress in Process Safety to be held in New Orleans, Louisiana, USA – 1-3 April 2019
- 7th China Conference, China [Date TBC]
- 4th Europe Process Safety + Big Data Conference, 1-2 October 2019, Frankfurt, Germany
- 5th CCPS Global Summit, 22-23 October 2019, Singapore
- 3rd Middle East Process Safety Conference [MEPSC], ME [Date TBC]
- We will be deploying Process Safety Metrics - API-754 Metrics Implementation workshop at 2-3 locations during 2019

6th CCPS Global Summit
December 2020
India

2018 Regional Engagement…

Technical Steering Committee Meetings

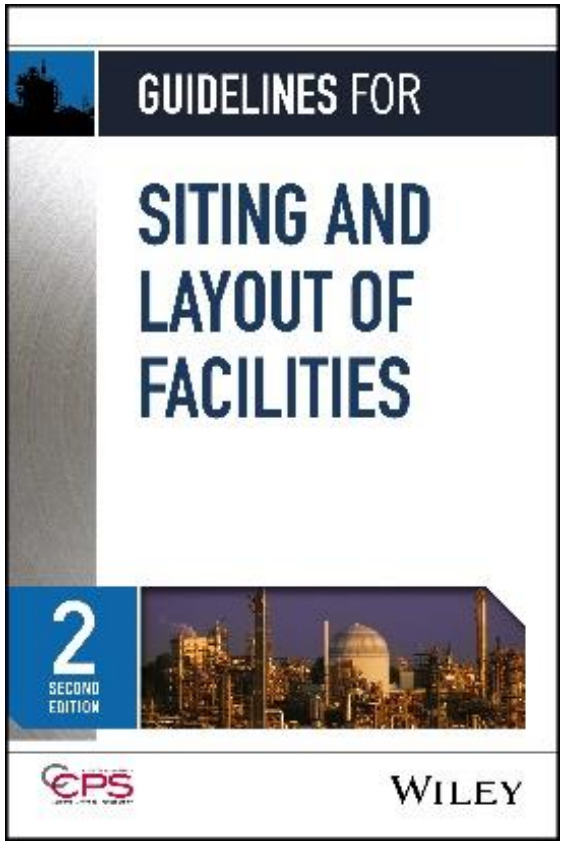


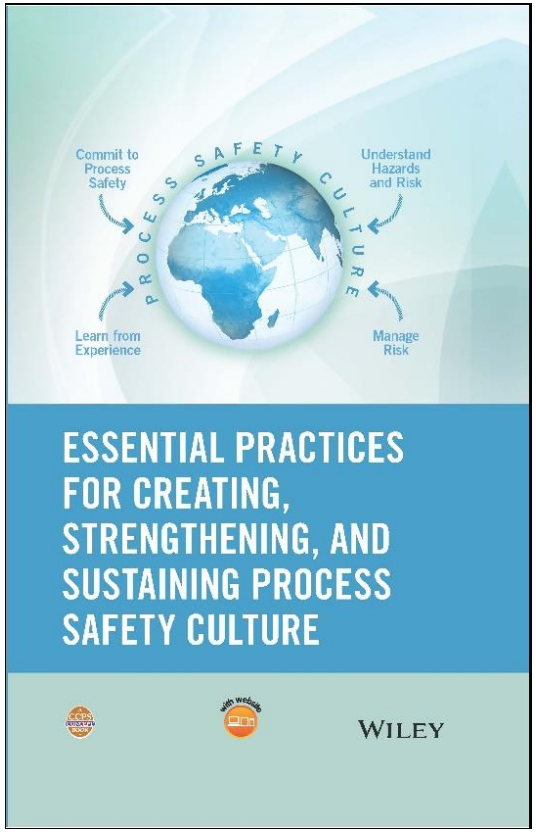


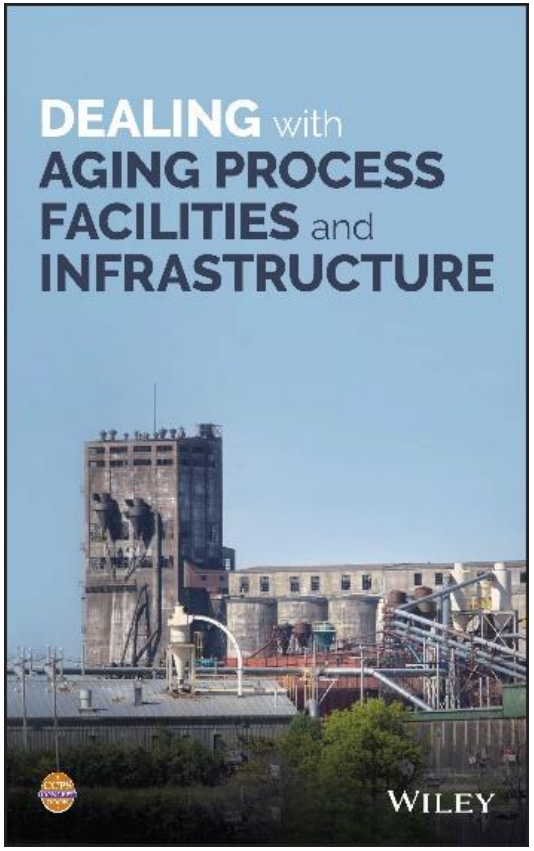
CCPS Body of Knowledge

2018 CCPS Books

PUBLISHED



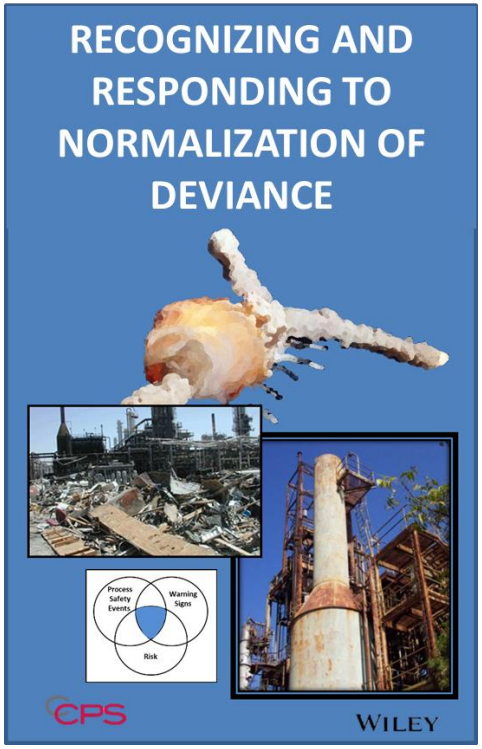


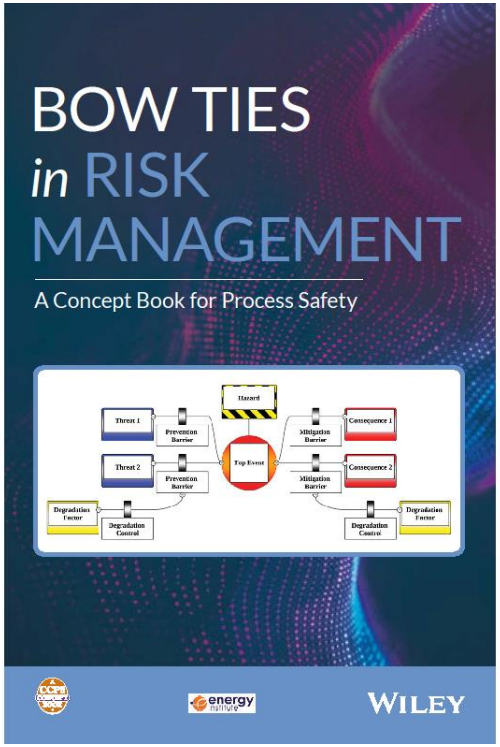


More 2018 Books…

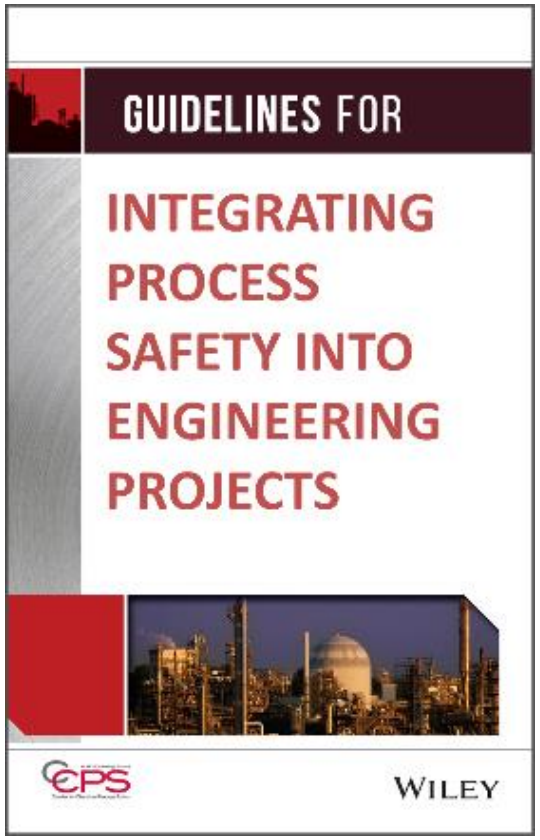
PUBLISHED

Sept 2018

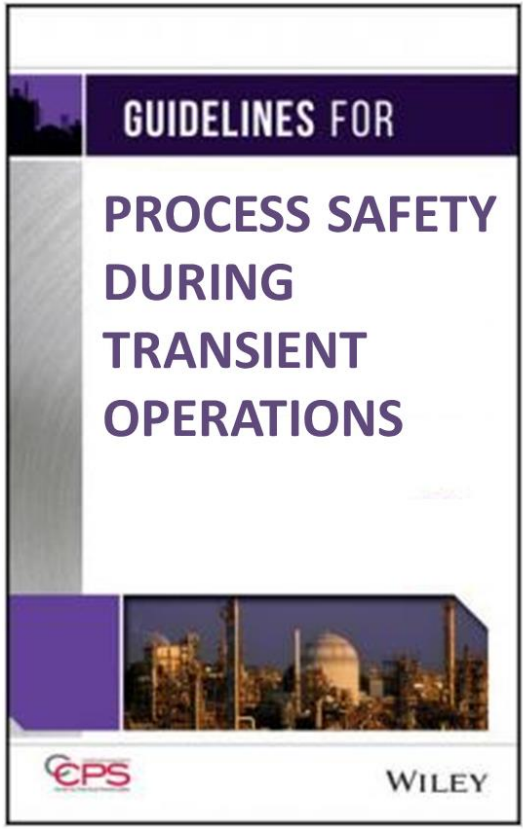




2018 Books: Work in Progress

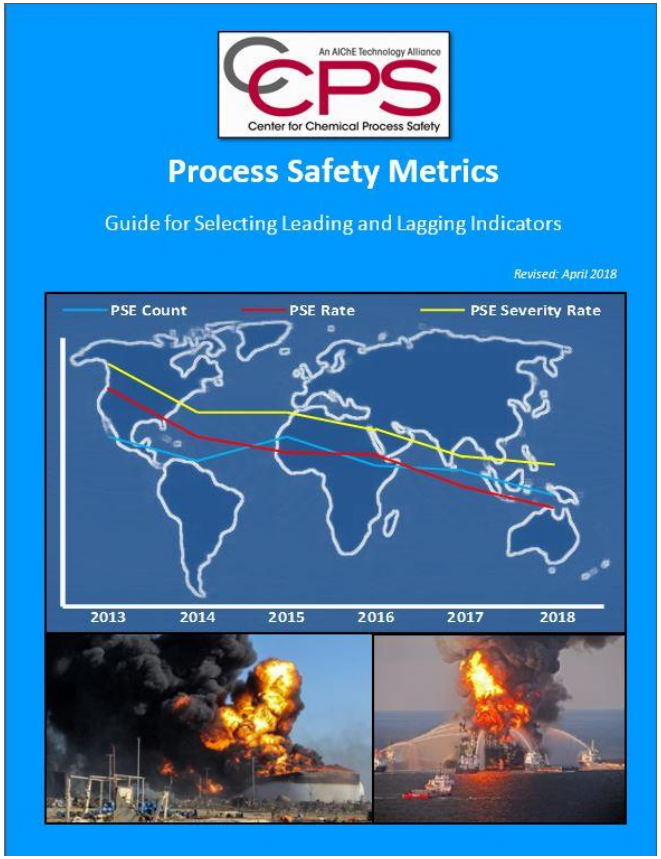


Early Nov. 2018

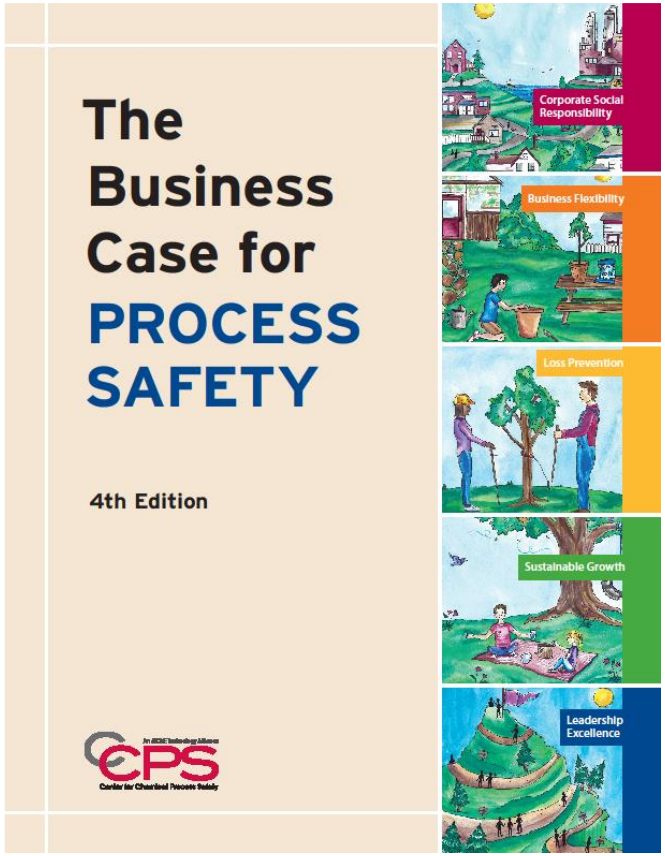


1Q 2019

2018 Non-Book Publications



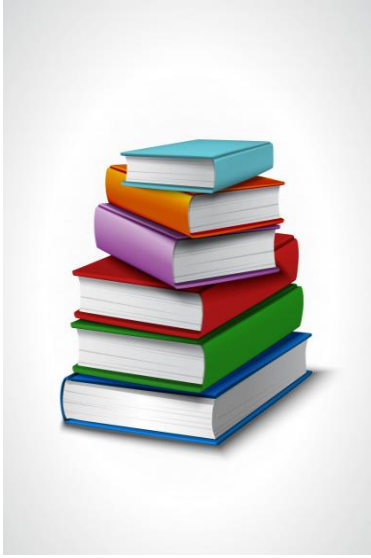
Guide Document



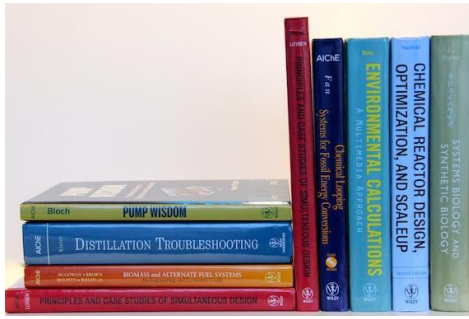
Monograph

2019 Publications Projection

- Process Safety Leadership from Board Room to Front Lines
- Guide to making Acute Risk Decisions
- Guidelines Process Safety in Pilot plant and Labs
- Guidelines for Inherently Safer Design 3rd Ed
- More Incidents that define Process Safety
- Incident Investigation 3rd Ed
- Guidelines for Process Safety in Upstream Industry
  - Might slip to 2020



Targeted for 2020



- P281 Human Performance in Process Safety
  - Scope document finalization next
- P283 PHA Revalidation 2nd Ed
  - Strong Survey feedback, completing book scope/layout
- P289 Golden Rules for Process Safety
  - Team leaning towards an ‘app’, not a book
- P292 Lessons Learned Years Later
  - Sub-Committee: 7 Volunteers. *NEED MORE*
- P290 Process Safety Toolbox
  - Need Volunteers
- P291 GL for Abnormal Situation Management
  - Team formation in progress

Process Safety Incident Database (PSID)

- Reopened in December 2017
  - Opened access to all CCPS members
    - Except government / regulatory entities
  - Over 800 incidents and expanding
  - Member benefit – no fees required
  - Company admin and user registrations required
    - User Approval: CCPS Operational admin or Company admin
- We encourage every PSID company to submit *at least* one incident every year
- For more information, please contact ccps_psid@aiche.org

Over 130 new registrations, representing more than 60 companies

Asia-Pacific TSC will work collaboratively to add incidents

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CCPS Center for Chemical Process Safety

Process Safety Beacon

Process Safety Beacon

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

Messages for Manufacturing Personnel

Sponsored by CCPS Supporters

Containment Dikes and Pads

June 2010

Most people recognize that containment dikes around storage tanks, and sloped containment pads for pumps, process buildings and structures, truck and rail car unloading areas, and other potential spill locations have an important environmental protection function – preventing contamination of soil and surface water. But, do you know that they often also have important safety functions? Some examples include:

- limiting the spread of a fire and preventing exposure of other equipment if a flammable material spills and is ignited
- preventing contact of incompatible reactive materials in case of leak or spill
- limiting the spread of spilled corrosive material and preventing contact with equipment which could be damaged by contact with the corrosive material

In 2001, the US Chemical Safety and Hazard Investigation Board (CSB) investigated a fire that destroyed a petroleum blending facility in Texas. Poor dike design and maintenance resulted in burning liquid spreading the fire from tank to tank, eventually engulfing the whole plant.

←Spill containment dikes for chemical storage tanks

A sloped containment pad directs any spills from a truck unloading facility to a chemical sewer trench →

What can you do?

- Periodically include containment dikes around storage tanks, sloped containment areas, and drainage trenches as part of your routine plant safety inspections. Look for physical damage, spilled material, accumulation of rain water in dikes, or blocked drainage. Look for debris, equipment, or anything which restricts flow of a spill.
- Make sure that your plant procedures include pumping out or draining rain water from containment dikes – if a dike is partly filled with rain water, it may not be able to contain a large spill.
- If you have any kind of valves or other piping to remove rain water from a containment dike, make sure these are closed or otherwise blocked when not being used.
- If you do any maintenance or construction work on a storage dike which results in damage to the integrity of the dike, make sure the damage is repaired before the job is finished.

The arrow shows a hole in a containment dike. More damage can be seen at the base and the top of the dike wall. Other examples of damage include cracks in dike walls or floors, holes where pipes have been installed passing through dike walls, and anything else which would allow spilled material to flow out of the dike area.

Inspect and maintain your containment dikes and pads!

The Beacon is usually available in Afrikaans, Arabic, Chinese, Danish, Dutch, English, French, German, Greek, Gujarati, Hebrew, Hindi, Hungarian, Indonesian, Italian, Japanese, Korean, Malay, Marathi, Norwegian, Persian, Polish, Portuguese, Russian, Spanish, Swedish, Tamil, Thai, Telugu, Turkish, Urdu, and Vietnamese.

- More than a million readers
- 31 languages
- Delivered monthly
- 80 + volunteer translators
- Nearly 17 years of volunteers led publication effort

"The Global Community Committed to Process Safety"

CCPS Credentialing - CCPSC

AIChE
The Global Home of Chemical Engineers

Outline

- CCPSC – what is it
- Why is it needed/important
- How it works
- Who is it for
- Summary & Q/A

What is CCPSC

The CCPS Credentialing Program

- Purpose: To evaluate and certify Process Safety Professionals
- Started in 2015
- Global Reach
- Modeled after the Professional Engineering Certification in the US

CCPS Certified

What is CCPSC

- The Definitive stamp of approval in Process Safety
- A mark of True Expertise in Process Safety
- Uniform and Consistent basis for assessing the *Body of Knowledge in Process Safety*
  - *Criteria: Range, Rigor, References*
    - *Range: Breadth of experience*
    - *Rigor: Depth of hands on experience*
    - *References: Recognition by peers and colleagues*
- Risk Based Process Safety (RBPS) at the core

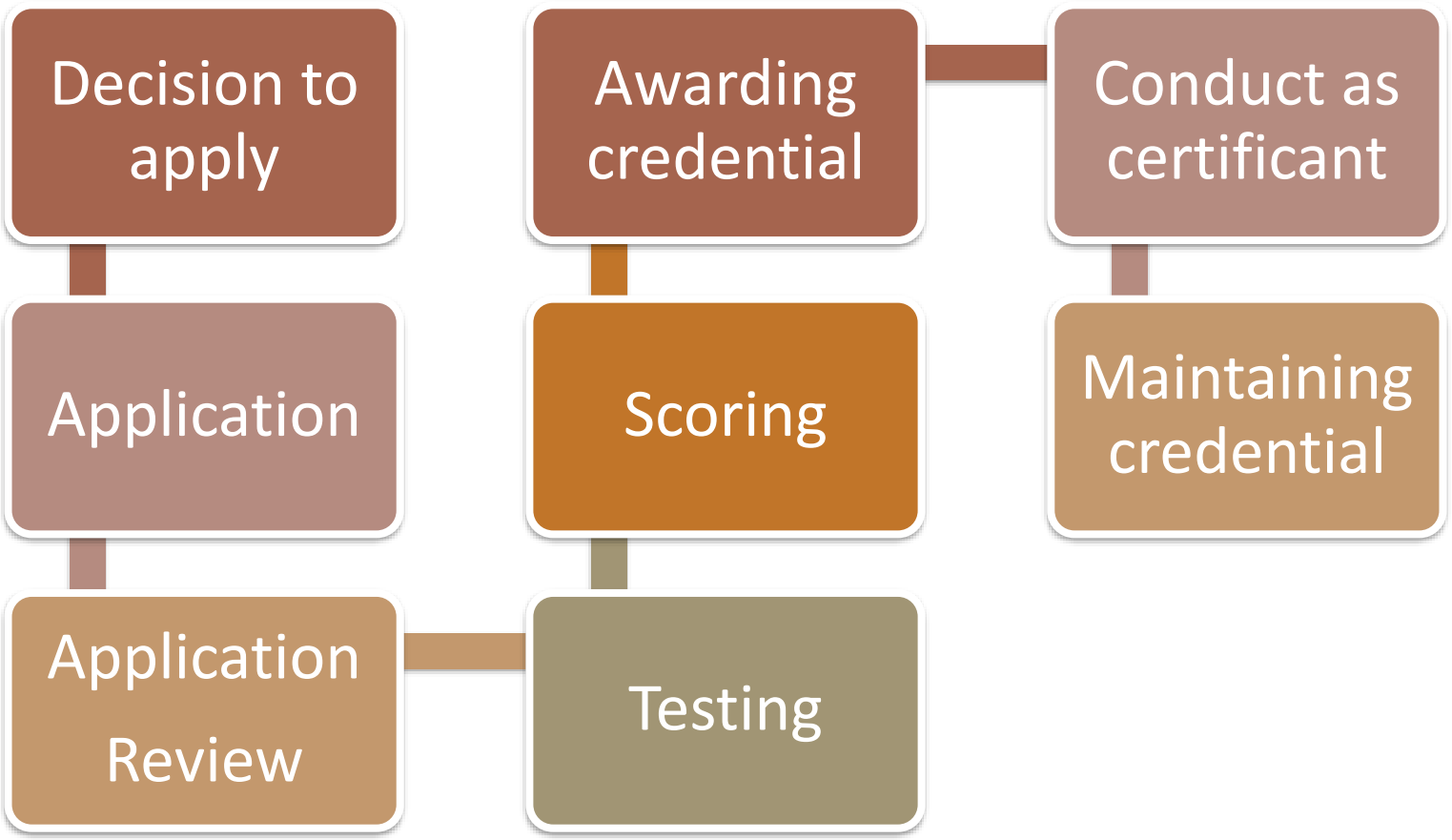
More at: www.aiche.org/ccps-certified

Why CCPSC

- Directly tied to the mission of CCPS
- Provide a global uniform standard for knowledge assessment
- Benefits:
  - Individuals: Distinguish your expertise
  - Companies: Know who can do what for you
  - Industry as a whole: Accurately recognize the expertise
- Overcome the clutter of various denominations that do not really focus on Process safety

Recognition with the CCPS brand

How CCPSC Works



How it Works - Requirements

- Education: A STEM degree
  - Science / Technology / Engineering / Math
- Experience: Minimum 5 years relevant
  - Additional 5 years may be substituted for education
- Hands on Knowledge of many elements of RBPS
  - With Familiarity with all 20 elements
- An ongoing commitment to Process Safety & personal development
  - Continuing Education requirements

How it Works

- Examination - Typically 2 or 3 times a year
  - 4 hours, continuous, open book, individualized
- Conducted Online
- Multiple Choice questions
  - 120 questions covering the 20 elements of RBPS
- Essay questions
  - Descriptive answers required for situation analysis
- Examination is in English
  - Careful consideration is given to avoid confusion for applicants whose first language is not English

Who Should Apply

- All individuals globally with some responsibility for Process Safety
- Chemicals, Oil & Gas, Petrochemicals
- Food, Mining, Pharma, Other Manufacturing
- Consulting, Academia, Government

Summary

- CCPSC – a definitive recognition of Process Safety Expertise
- Globally available
- Wide interest and growing rapidly

For more information or to get started, visit www.aiche.org/ccps-certified

CCPSC Update

- ~ 150 Certified [CCPSC] Individuals as of November 2018
- Exam software stability issues fixed
  - Zero data loss in July, September and November 2018 exams
- Actions planned – looking ahead
  - Significant marketing push to popularize the credentialing - Globally
  - Deep dive in to the processes & procedures begun
  - Opportunities:
    - Reduce Manual effort, Automate several tasks; Critical for volume expansion
    - Leverage existing AIChE processes including the customer service team
    - Simplify processes for the applicant – Application, References, etc.

Process Safety Journey to Excellence

PSM Incident / Severity Rate →

Standards and Procedures

- Standards
- Technical requirements
- Safety emphasis
- Compliance

Process Safety Management Systems

- Integrated MS
- Reporting
- Assurance
- Competence
- Risk Management

Process Safety Risk Based Approach

- Visible Leadership
- Learning Process
- Risk Quantification
- "Risk" Process
- External View

- Behaviour
- Visible leadership
- Personal accountability
- Shared purpose & belief
- Aligned performance & commitment

Strong PSM Culture

Standards Based	Systems Based	Risk Based	Culture Based
What must I do?	How must I do?	How can I improve?	How can I Lead?

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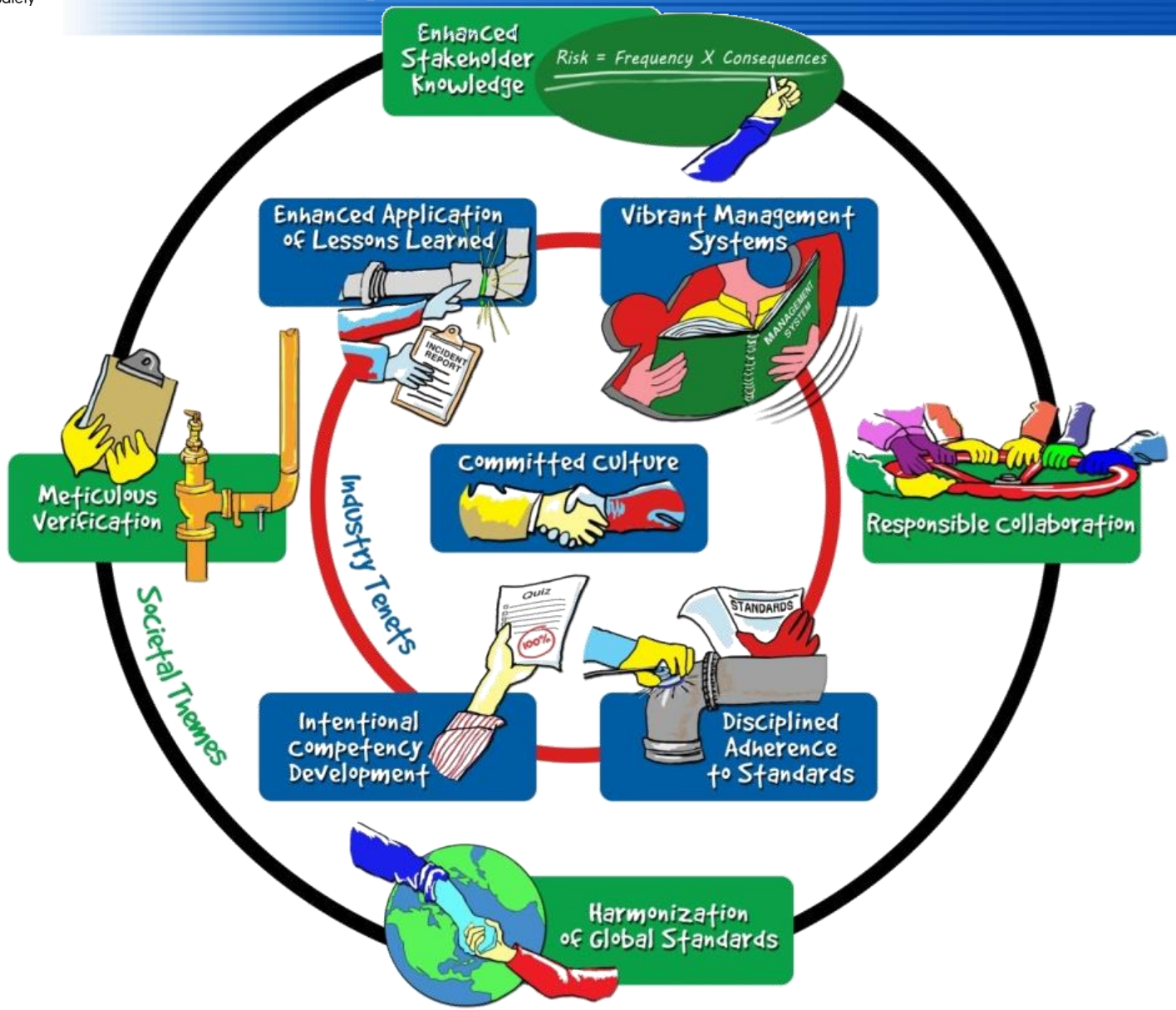
Vision 20/20



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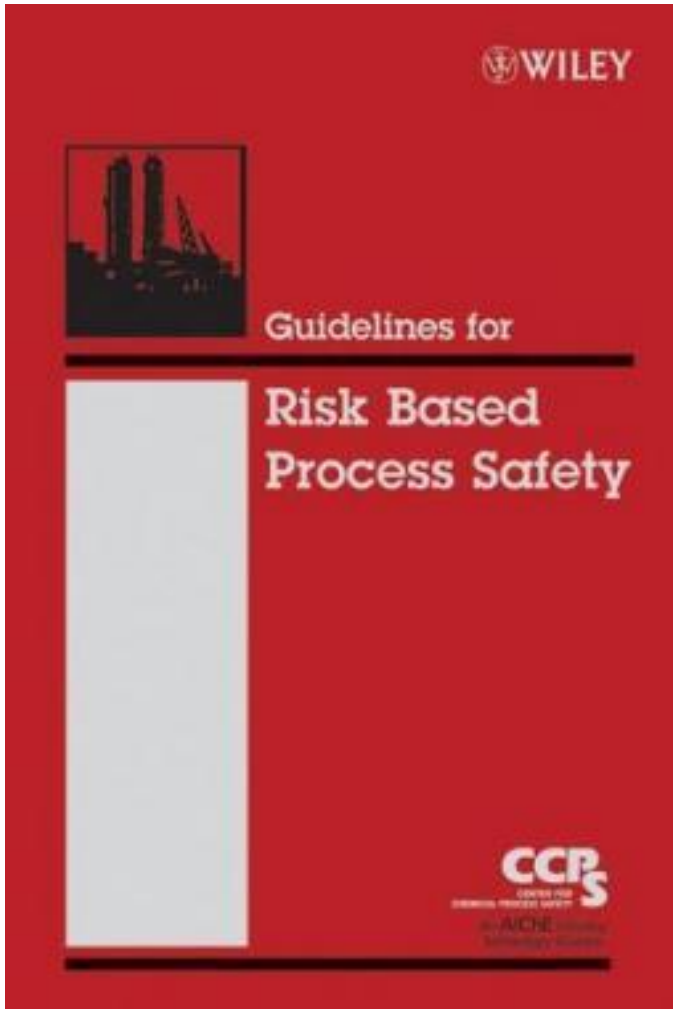
CCPS Center for Chemical Process Safety

Responsible Collaboration

Organization	Collaborating activity
Energy Institute [EI]	Bow Tie Guideline + Human Performance
Society of Petroleum Engineers [SPE]	Process Safety for Upstream Guideline Book
American Chemical Council [ACC]	Enhancing Process Safety effort
Japan Society for Safety Engineering [JSSE]	4th Global Summit, Okayama, Japan
European Process Safety Center [EPSC]	Europe PS + Big Data Conference, Frankfurt
EPSC + Dow Chemicals	RAST [Risk Analysis Screening Tool]
IChemE, MKO, EPSC and WPLP	2017 WCCE-10 Barcelona PSM Track
Singapore Chemical Industry Council	MOU signed; 6th Global Summit [2019]
PERTAMINA University [Indonesia]	MOU signed
Universiti Teknologi Petronas [UTP] University [Malaysia]	2nd Global Summit
OSHA	CCPS Risk Based Process Safety elements as best practices reference on the OSHA Web Tool
Chemical Safety Board [CSB]	Potential CCPS-CSB collaboration on developing video modules using CCPS content

Risk Based Process Safety

- CCPS "Risk Based Process Safety [RBPS]" Guideline Book was published in 2007; it is our highest selling Book
- We are seeing a large number of companies globally following this Risk Management approach
- It has provided companies with guidelines and tools to establish a strong process safety risk management program



WHY DO WE NEED *Risk Based Process Safety*?

- All hazards and risks in a facility are not equal
- Using same practices to manage every hazard is inefficient use of resources
- Risk-based approach reduces potential for assigning an undue amount of resources to manage lower-risk activities, thereby freeing up resources for tasks for higher-risk activities

Goal: Match effort to potential risk.

Objective of the Risk Based Process Safety

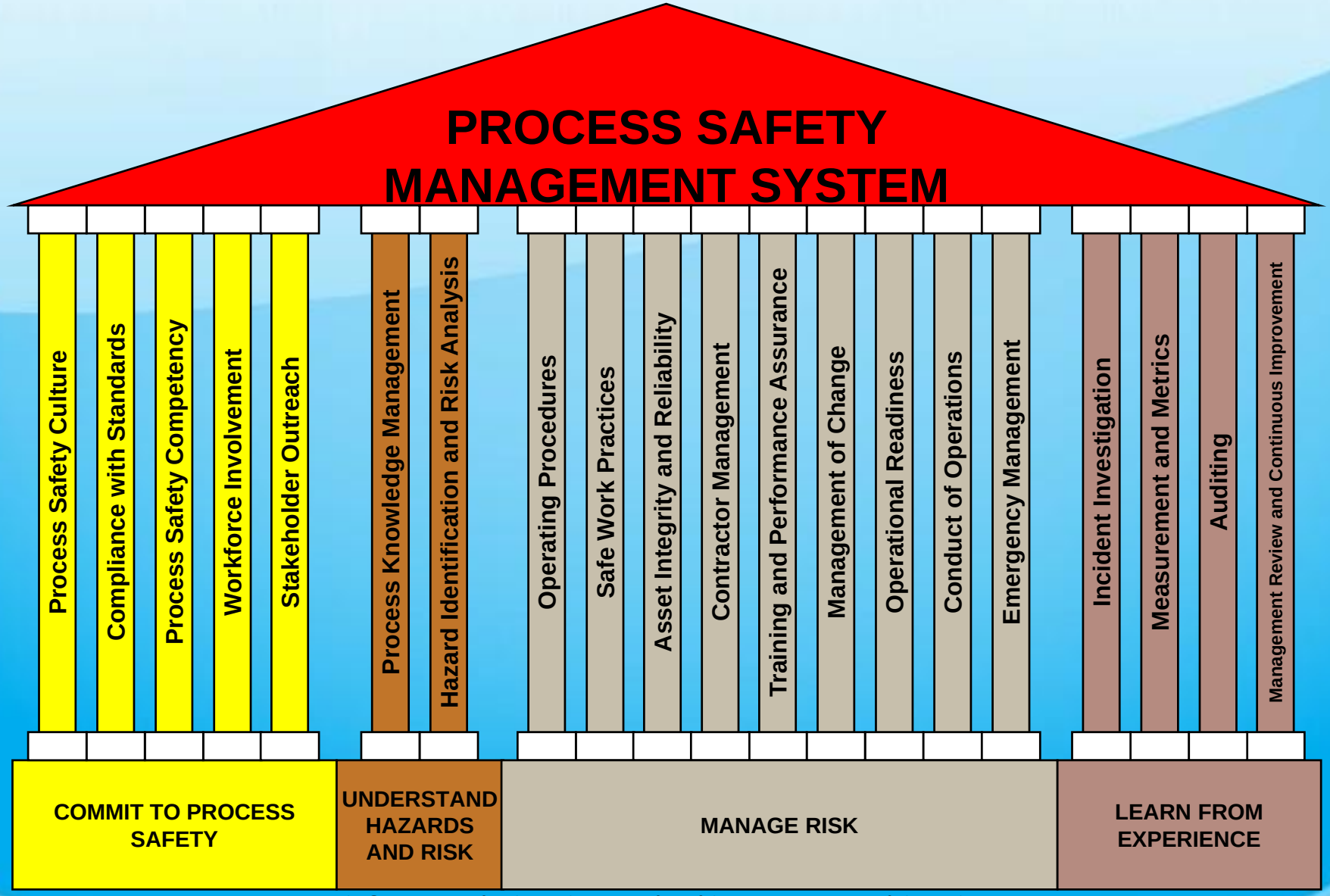
- Approach accident prevention form compliance-based to risk-based strategy.
- Improve management system effectiveness.
- Employ process safety for non-regulatory processes using risk based design.
- Integrate the process safety into an organization's business processes.
- Focus their resources on higher risk activities

CCPS Risk Based Process Safety

Four major process safety incident prevention principles:

1. **Leadership commitment to process safety** is the key building block for pursuit of process safety excellence. Leaders "walking the talk" will send a consistent message to do "the right things, in the right ways, at the right times – even when no one is looking."
2. **Understanding hazards and evaluating risk** is necessary for an organization to know where to apply its limited resources to help ensure that accidents do not occur.
3. **Managing risk:** Involves a focus on - operating and maintaining processes that pose the risk, controlling changes to those processes to avoid inadvertent risk increases; and preparing for, responding to, and managing incidents that do occur.
4. **Learning from experience:** In spite of our best efforts, things don't always work out as planned, so organizations must be ready to turn its mistakes – and those by others – into opportunities for improvement.

Risk Based Process Safety



Thanks to David Guss, Nexen Inc.

OSHA PSM Regulation Elements vs. CCPS RBPS PSM Elements

OSHA PSM

14 Key Elements

1. Employee Participation
2. Process Hazards Analysis
3. Training
4. Pre-startup Safety Review
5. Hot Work Permit
6. Incident Investigation
7. Compliance Audit
8. Process Safety Information
9. Operating Procedures
10. Contractors
11. Mechanical Integrity
12. Management of Change
13. Emergency Planning
14. Trade Secrets

CCPS RBPS PSM

20 Key Elements

- 1.0 Commit to Process Safety
  - 1.1 Process Safety Culture
  - 1.2 Compliance with Standards
  - 1.3 Process Safety Competency
  - 1.4 Workforce Involvement
  - 1.5 Stakeholder Outreach
- 2.0 Understanding Hazards & Risks
  - 2.1 Process Knowledge Management
  - 2.2 Hazard Identification & Risk Identification
- 3.0 Manage Risk
  - 3.1 Operating Procedures
  - 3.2 Safe Work Practices
  - 3.3 Asset Integrity & Reliability
  - 3.4 Contractor Management
  - 3.5 Training & Performance Assurance
  - 3.6 Management of Change
  - 3.7 Operational Readiness
  - 3.8 Conduct of Operations
  - 3.9 Emergency Management
- 4.0 Learn from Experience
  - 4.1 Incident Investigation
  - 4.2 Measures & Metrics
  - 4.3 Auditing
  - 4.4 Management Review & continuous Improvement

CCPS Elements for Which There is No Matching OSHA Element

1.1 **Process Safety Culture**

1.2 Compliance with Standards (not an OSHA element but implied by OSHA 1910.119 (d)(3)(ii))

1.3 **Process Safety Competency**

1.5 Stakeholder Outreach

3.8 Conduct of Operations

4.2 **Measures & Metrics**

4.4 Management Review & Continuous Improvement

Questions?

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Coffee Break

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Center for Chemical Process Safety

First Time in Pakistan

REGIONAL

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MEETING

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Center for Chemical Process Safety

Evolution of Process Safety at Engro

By

Jahangir Piracha

CEO, Engro Vopak

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Evolution of Process Safety at Engro

1st Pakistan Regional CCPS Meeting

Speaker:
Mr. JAHANGIR PIRACHA
Chief Executive Officer
Engro Vopak & Elengy Terminal Limited

our vision

to be the premier pakistani enterprise with a global reach, passionately pursuing value creation for all stakeholders

engro in a snapshot

Revenue
$1,219 million

Market Cap of
$1,308 million with
4 Listed Entities

Pioneer in Thar
Coal Mining &
Power Generation

Pakistan's premier
business conglomerate

Operating in Fertilizers, Power Generation,
Petrochemicals, Mining, Dairy,
LNG and Chemical Storage

First LNG Terminal
in Pakistan

Sole Manufacturer of
PVC in Pakistan

Connects with 12
Million Customers

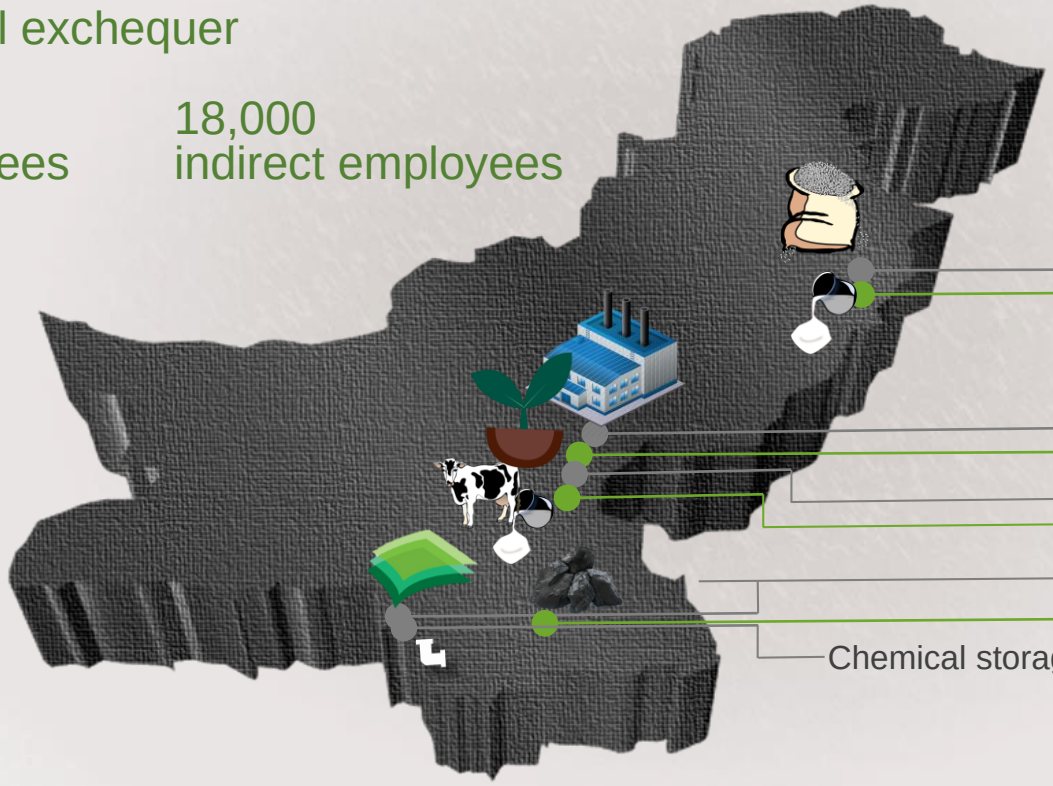
Import Substitution
~$850 Mn per year

our footprint in pakistan

USD 400 million contribution to national exchequer

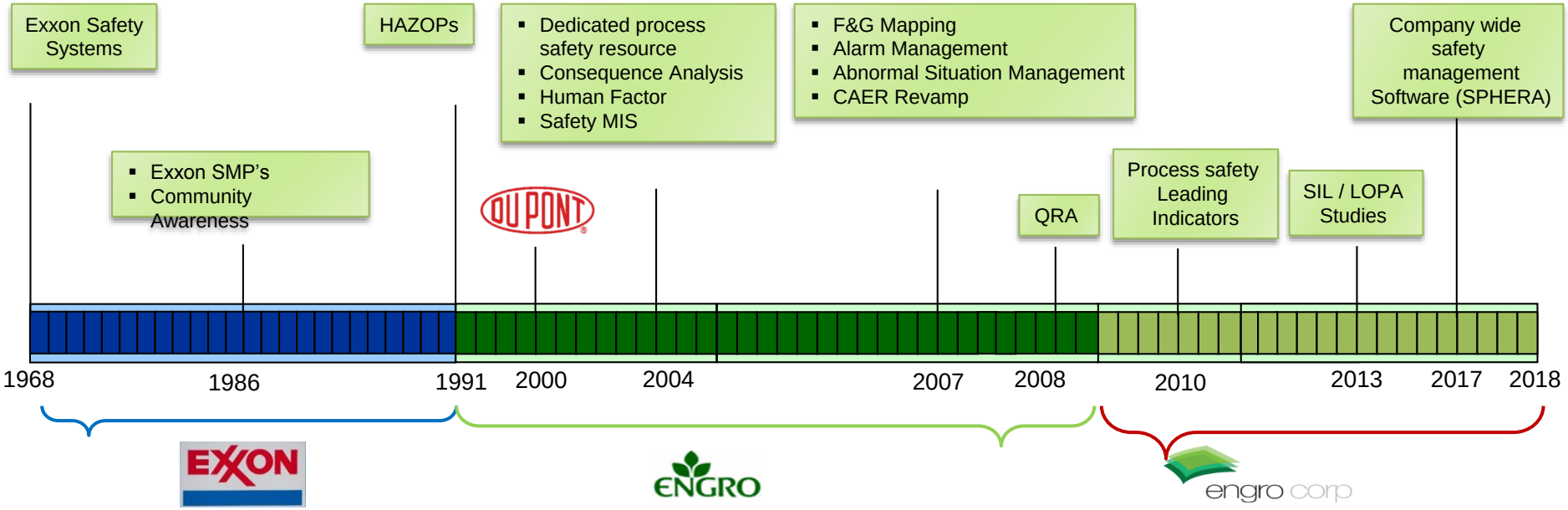
3,500 employees

18,000 indirect employees



evolution of process safety management at engro

Rise of Process Safety at Engro



- Conversion from Exon Model to DuPont Model helped engro in aligning themselves with world best safety practices
- SPHERA : Platform for Process Safety Management – Web based application with feature of automated reminders for action items
- Quantitative Risk Assessment studies helped engro in recognition and mitigation of major process safety related risks at engro

Design Changes / Upgrades – In lieu of process safety evolution

Year	Process Safety Study	Design Upgrades / Changes
1991 - 2018	Design / Cyclic PHAs	Design Changes / Modifications
2000	FMEA	Triple Modular Redundancy ESD System
2007	QRA	- Double Walled Ammonia Storage Tank - Blast proof Centralized Control Room / Safe Heavens - F&G Detection System at enVen Plant
2009	PHA	Flare System at new Plant
2012	QRA	Double Walled Ammonia Storage Tank
2013 onwards	SIL / LOPA Studies	Inherently Safer / Reliable Complex Control Loops

Challenges in Implementation of Process Safety

Challenges		Solutions
Technology	• Obsolescence • Implementation Difficulties	▪ Upgrade / Replace ▪ Innovate
Technical Capabilities	• Risk assessment expertise • Risk Assessment Softwares	▪ Resources development ▪ ASP/CSP certifications ▪ Participation in Conferences
Return on Investment	• Funds availability for upgrades • Do ability	▪ For safety related projects, ROI's are never looked at
Communities	• Emergency Response • External communities • Weak Government infrastructure	▪ CAER Program ▪ Joint drills with Government

CAER – Community Awareness & Emergency Response Program

Step 1: Engagement With Locals

- School visits
- Meeting with notables
- Social projects & health facilities
- Plant visit by school students

Step 2: Awareness and Training

- Volunteers for Civil Defense
- Emergency handling trainings
- Quiz competitions schools

Step 3: Joint Emergency Drills

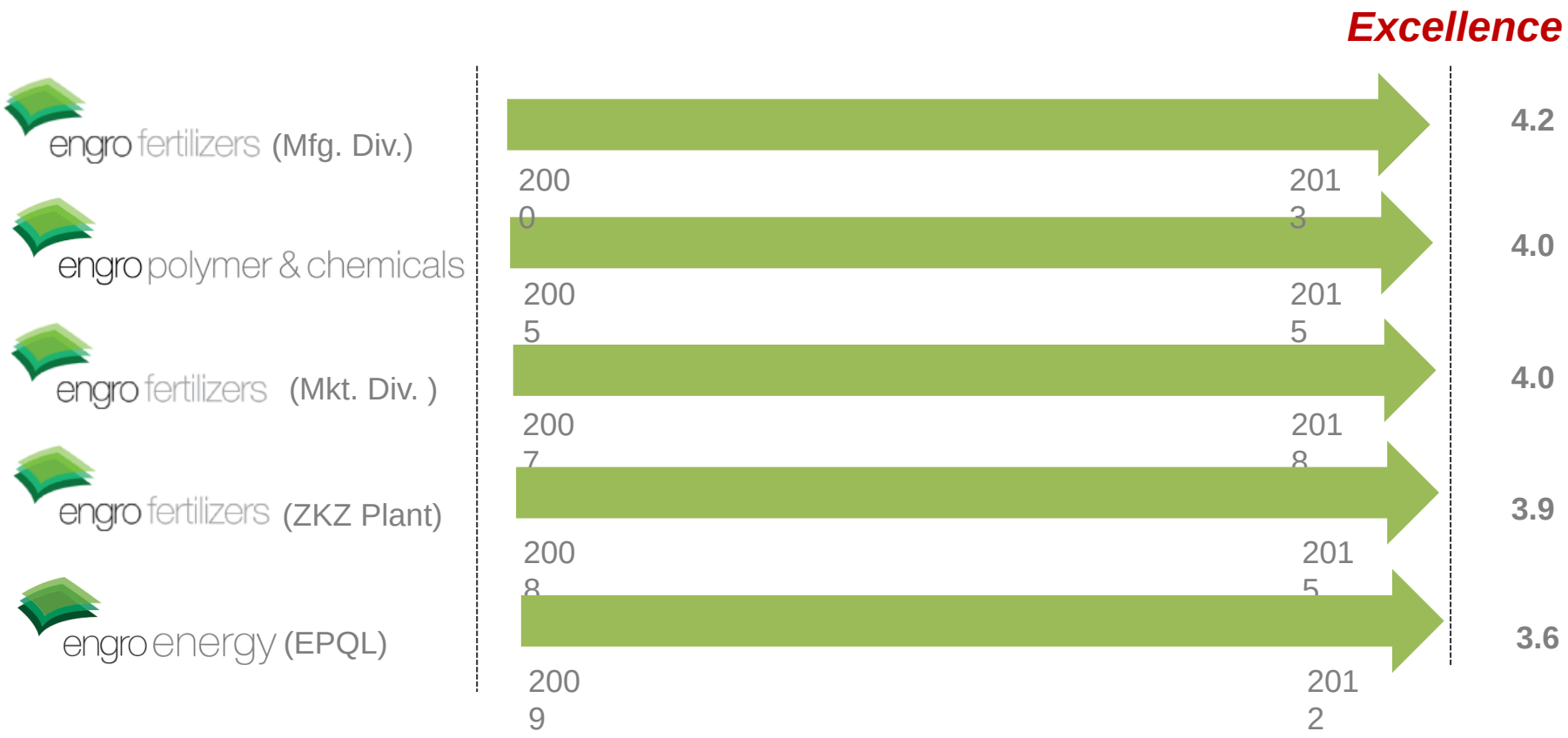
- Formation of Crisis Management Centre
- Fire drills / Drill with NDMA

Process Safety Management - Leading Indicators

- Process Safety Action Items (PSSR, PHA, Incidents)
- Process Safety Studies (PHA's, MOC's)
- Resources Development (Training)
- Mechanical Integrity
- Safety Instrumentation System Failure

KPI Dimnension	Affiliate- 01	Affiliate- 02	Affiliate- 03	Affiliate- 04	Affiliate- 05	Affiliate- 06	Affiliate- 07	Affiliate- 08	Aggregate numbers for Engro Corp
Process Safety Lagging Indicators									
Asset Damage Incidents									0
Environmental Incidents									11
Process Fire Incidents									0
Process Safety Incidents									10
Cultural Elements									
MSAs Index									81%
Safety Talks Index									86%
Reporting Index									80%
Leading Indicators									
Behavioral Safety LIs									85%
Process Safety LIs				NA	NA				83%
Environmental KPIs									84%
Health KPIs									87%

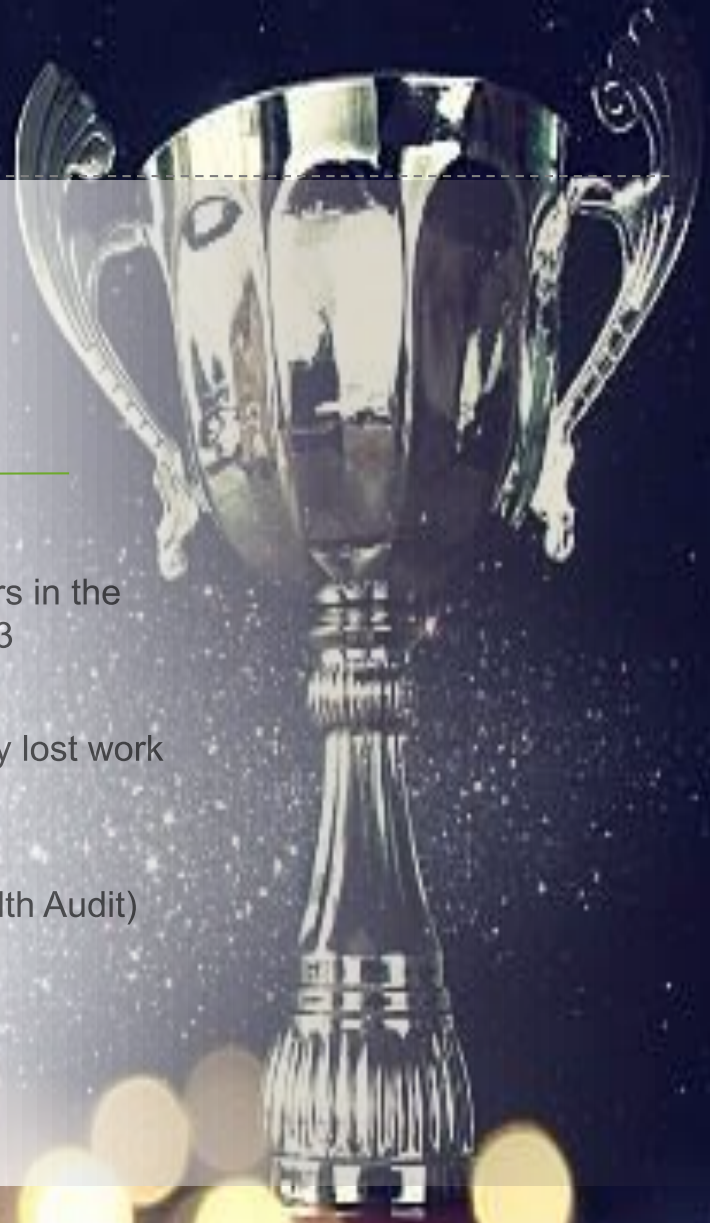
Process Safety Management Journey in Engro Affiliates



recognized globally & locally

safety awards

- DuPont Safety and Sustainability Award won by Engro Fertilizers in the category of “Stakeholder Engagement for Sustainability” in 2013
- Engro Vopak completed 20 years of safe operations without any lost work injury in 2017
- Engro Vopak secured 98% score in 2016 in THA (Terminal Health Audit) which is currently highest score globally in the VOPAK World




thank you

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CCPS

Center for Chemical Process Safety

Learning from Incident at Engro Polymer & Chemicals Ltd.

By

Mati-ur-Rabi Siddiqui

HSE Manager,

Engro Polymer & Chemical

INSPIRING

PEOPLE

PRESERVING

PLANET

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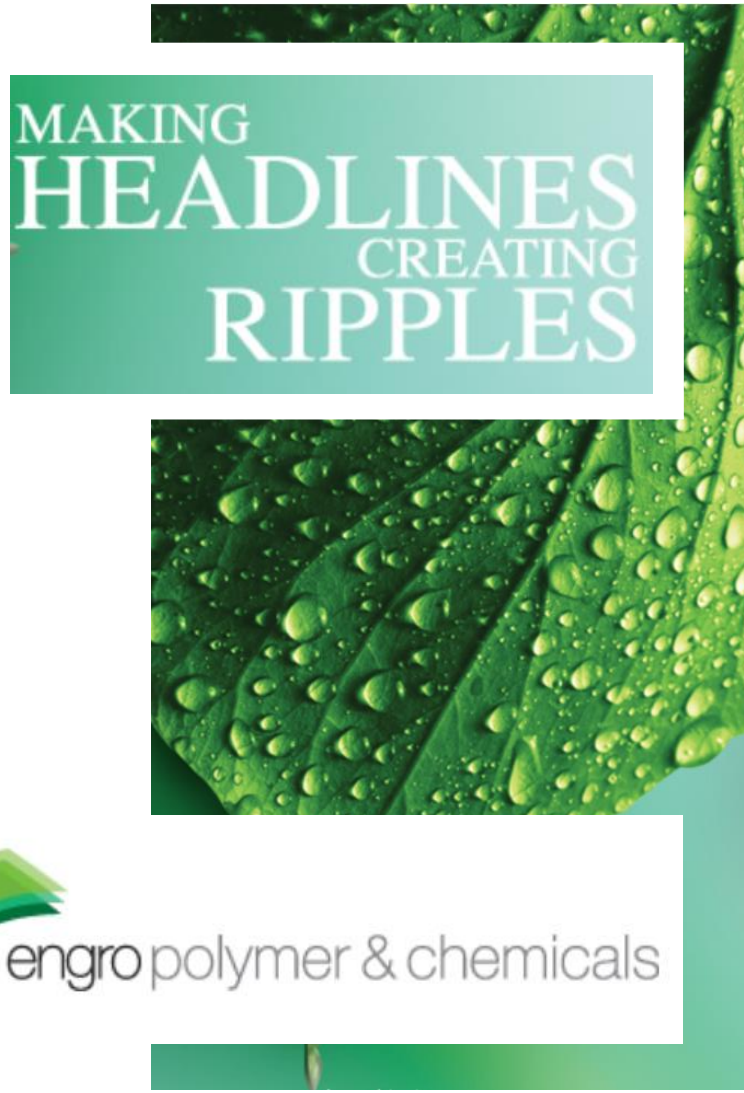
LEARNING FROM AN INCIDENT

Presented by
Mati ur Rab Siddiqui



PRESENTER INTRODUCTION

engro polymer & chemicals

Chemical Engineer by education

Over 6 years experience in Safety and Risk Management

Over all 21 years experience in Fertilizer/Petrochemicals

Exposure to all walks in Manufacturing facilities

Developed various safety programs within EPCL, Fatima Group(PFL) & SAFCO KSA for both personnel and Process Safety

COMPANY PROFILE

engro polymer & chemicals

Established in 1997 as PVC manufacturing Plant

First & the Only fully integrated Chlor-Vinyl Chemical Complex in Pakistan

PVC
195 kTA

Caustic Soda
117 kTA

Sodium Hypochlorite
20 kTA

Hydrochloric Acid
66 kTA

Hydrogen
3 kTA

ACCREDITATIONS

engro polymer & chemicals

	ISO-9001: Continual improvement of Quality Management system	**2018**
	ISO-14001: Environmental Management system	**2018**
	OHSAS-18001: Occupational Health & Safety Management systems	**2018**
	PSM – Level 4.2 Personal Safety Management	**2015**
	PSRM – Level 4.0 Process Safety & Risk Management	**2015**
	WWF Green Office Compliant	**2017**
	OHIH – Level 3.5 Occupational Health and Industrial Hygiene	**2018**
	Lean Six Sigma Operational Excellence	**2012**
	CCPS Membership	**2010**

CASE STUDY:

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FURNACE FIRE

VCM PLANT IN PAKISTAN

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- VCM plant at this site is relocated plant from Formosa Plastics Corporation, USA.
- It is Pakistan's 1st VCM plant
- VCM is raw material of PVC, which is a growing industry in this region

PROCESS DETAILS

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- In VCM plant there are two identical cracking furnaces which are operating in parallel
- Dry purified EDC fed to Cracking Unit where it decomposes into VCM and hydrochloric acid
- These furnaces were installed between 1984 and 1987 during EDC/VCM plant debottlenecking project.
- In 2007 back integration project EDC/VCM, both furnaces were relocated from Formosa Plastics Corp. USA.

$$C_2H_4Cl_2 \rightarrow C_2H_3Cl + HCl \qquad \Delta H = -30{,}500\,\frac{BTU}{lb\ mol}$$

EQUIPMENT INFORMATION

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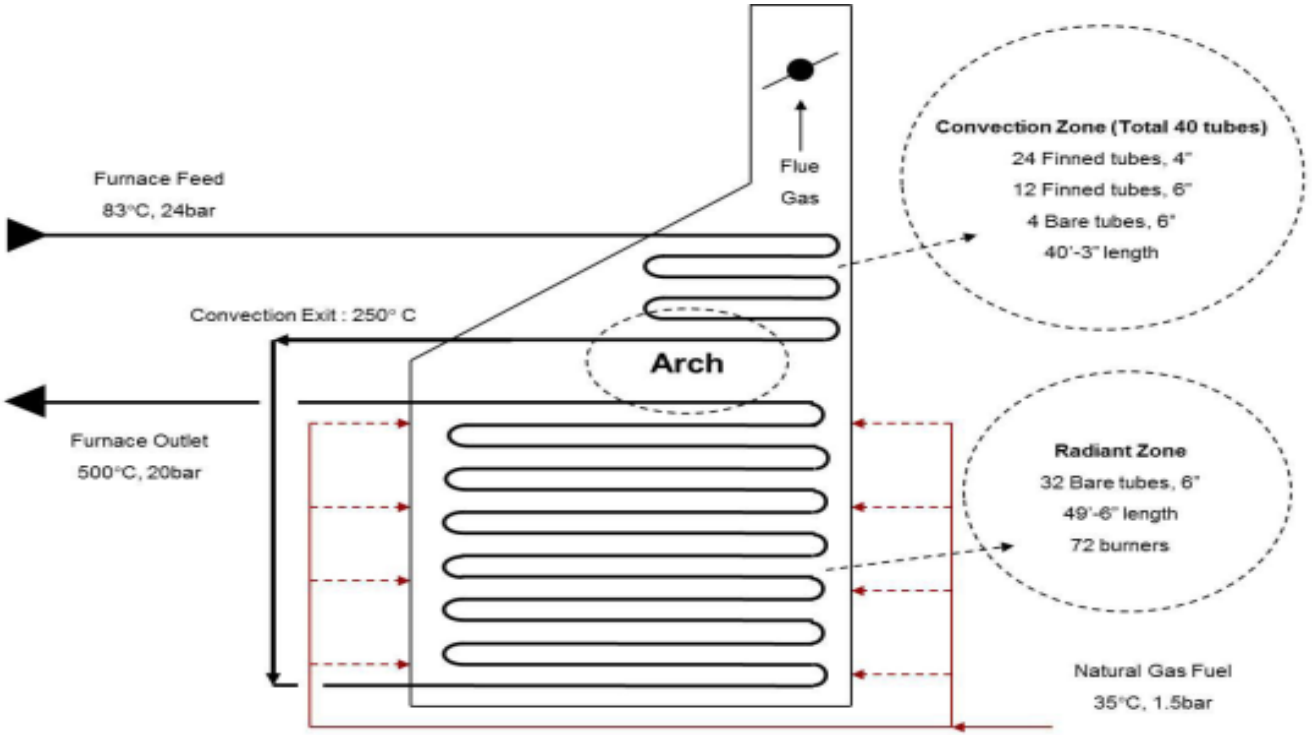

THE INCIDENT

- On May 04, 2011 , EDC Cracking Furnace B (HF-301 B) caught fire as a result of EDC leakage from the first inlet bend on the convection section tube bank of the furnace
- Emergency response was very good and a major fire was controlled within 15 minutes of the arrival of the fire squad at site and the VCM plant was shutdown safely
- The fire lasted for more than 4 hours, despite the fact that the fuel source had been cut.
  - The hydrocarbons is present in tubes, controlled burning took place and finally the fire was completely extinguished
- Luckily, no fatality/injury was observed however there was major damage to the furnace

IMPACT

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Cultural Impact

- Puts Question mark on overall HSE system (Plant MI) in the organization

Financial Impact

- An approximate loss of US $ 5 Million
- A production loss of nearly 45 days

FACTS AND FINDINGS

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- Comprehensive history of furnace inspection done at FPC was not available
- Furnace B had completed over 130,000 hrs. and Furnace A had completed 138,000 hrs.
- Recommended life for tube replacement is 100,000 hrs.
- The inspection regime to ensure mechanical integrity of convection tubes was inadequate.
- The impact of chlorides attack on the furnace tube is expected to be much higher in convection zone where temperatures are less and since feed is introduced from top, there are chances of condensation resulting in stress corrosion cracks in presence of HCl.

FACTS AND FINDINGS

- There was no structural analysis done for the complete furnaces before relocating them to Pakistan
- Stainless Steel 347 H has low resistance against Stress Corrosion Cracking (SCC)
- Furnace B compared to furnace A has some key differences:
  - During commissioning, two tubes leaked in hydro test and were blocked at Furnace B on the convection section
  - Furnace B had 32% more shutdowns and startups than A (25 vs 17)
  - There had been 4 hot starts of Furnace B while A had none
  - There had been 33% more incidents of emergency feed cut to Furnace B
  - Furnace B had seen 4 instances of high moisture while Furnace A had 3

CONCLUSION

- Immediate cause – Stress Corrosion Cracking at bends
- Root Cause – Gaps in Site Mechanical Integrity Program including:
  - Inspection and monitoring regime
  - Quality Assurance Regime during plant relocation
  - Loop holes in Hazard Analysis & Risk Assessment Program

All in all a general gap observed in how things are perceived while evaluating risks and decisions taken

RECOMMENDATIONS

- Revise emergency procedure in case of furnace convection tube and radiant tube failure
- Develop matrix for periodic inspection and testing of the deluge system on quench. Review and upgrade metallurgy of the tubes for the convection section to withstand the high chloride environment.
- Provision of furnace trip logic on low O2.
- Non destructive testing method to be evaluated for the radiant tubes. Based on this testing, life expectancy should be established

RECOMMENDATIONS

- Develop protocol to control plant personnel movement on the furnace platforms especially during checking of the damper opening
- Site reliability program to be structured in such a manner that dedicated task force are assigned for specific equipment reliability enhancement like; Furnaces, Incinerators, Oxy Reactor, Electrolyzes.
- Ensure availability of critical spares like radiant and convection tubes on site.
- Inspection section need to be reinforced for a few years so that they are able to develop a base line MI picture of the plant
- Develop training plan especially for Process and Inspection groups on common failures on the VCM plant.

STEPS TAKEN

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Emergency Handling

- Fire Emergency scenarios for all critical equipment were developed and made part of the emergency drills.
- Periodic inspection and testing plan was developed and implemented for the deluge system on quench.

Maintenance/Inspection

- Comprehensive inspection plan was developed after benchmarking with Oxy-Vinyl & Petrochemia (LRUT & Destructive testing also made part of inspection with VT, DPT, RT).
- Material is improved in top two rows (8 tubes & bends) of convection tubes and bends with Alloy 800 for better resistant against SCC.
- Liaisons for Best Industrial Practices (AKCC, OxyVinyl, Ineos) on furnaces and other high risk areas.
- Furnace-B All convection and radiant tube banks replaced.
- Later on Furnace-A both tube banks were also replaced.
- Run length regime for Furnaces is defined and implemented.

STEPS TAKEN

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Investment In People

- Process Hazard Analysis Training by DuPont for all levels
- SIL, LOPA & ALARP Training by foreign experts
- Fire Fighting & Rescue Training by Pakistan Navy School for Nuclear, Biological & Chemical Disasters (NBCD)

Reliability Improvement

- Unit/Critical Equipment specific forums were developed for reliability improvement.
- Plant reliabilities issues/ learnings are stewarded in reliability forums.
- Inspection & Process Monitoring Plan was revised and implemented.

"An incident is just the tip of the iceberg, a sign of a much larger problem below the surface."

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CCPS

Center for Chemical Process Safety

Chemical Plant Safety – A Global Perspective

Gawie Venter

Process Safety Consultant

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VINYLS PSSR

Gawie Venter – 22 November 2018

PURPOSE (WHY)

To ensure that new or modified plants as well as plants on mayor maintenance turnaround or shutdown can be safely commissioned and operated.

PSSR (TOOL)

Pre-Start-up Safety Review is a tool that will confirm that the construction, modification or maintenance actions are completed in accordance with design specifications and that all safety (PSM Standards), operating, maintenance, reliability and emergency procedures are adequate and in place **and understood by all employees involved.**

VINYLS PSSR

Gawie Venter – 22 November 2018

PSSR (FOR)

Required for following		Part Existing Systems
▪ New Plants	-	Part of Business Track
▪ Modifications to Existing Plants	-	MOC Procedure
▪ After Mayor Plant Shutdown	-	Shutdown Plan (CFO)

PSSR (WHEN)

The PSSR is as a Ready for Commissioning (RFC) hold point

▪ New Plants	-	Prior to Commissioning
▪ Modifications to Existing Plants	-	Prior to Commissioning
▪ After Mayor Plant Shutdown	-	Prior to Start-up

VINYLS PSSR

Gawie Venter – 22 November 2018

TEAM (WHO)

A qualified team should be assembled to conduct each PSSR. This team, at a minimum, should include individuals with design and process safety expertise.

Internal participants

- Internal SHERQ representative
- Technical & Operations representative
- Human resource (Training)

External participants

- DESCON – Risk Group
- EPCL – Technology Groups
- Technology Partners – USA

VINYLS PSSR

Gawie Venter – 22 November 2018

TEAM (WHO)

Roles and Responsibilities:

Line Management :

To ensure that no new projects, modifications or equipment on mayor maintenance turnarounds are commissioned before a PSSR has been carried out.

Project Manager :

To ensure that the PSSR takes place prior to Ready For Commissioning (RFC)

The PSSR Team leader :

Consider the significance of review team findings recommending whether start–up may safely proceed or not.

VINYLS PSSR

Gawie Venter – 22 November 2018

TEAM (WHO)

Roles and Responsibilities:

General Management

- Issue a declaration of support for PSM that includes PSSR.
- Shall oversee the development and implementation of the PSSR implementation plan based on the requirements as per standard
- Shall sign the PSSR review report to authorise commissioning or start-up activities, subject to completion of the review recommendations and with due regard for QMS 360 and specific pertinent site procedures.

VINYLS PSSR

Gawie Venter – 22 November 2018

TEAM (WHO)

Roles and Responsibilities:

PSSR Team Leader

- Ensure that the requirements of the relevant PSSR checklist are met for safe start-up.
- A PSM PSSR champion is required to coordinate the plan and network with other PSM champion elements
- The PSM PSSR champion is required to update and revise the facility procedure for this element.

VINYLS PSSR

Gawie Venter – 22 November 2018

PSSR (WHAT)

The pre-start-up safety review team shall ensure that all relevant PSM elements have been appropriately addressed.

by reviewing the PSM elements against specific checklist

- Process Safety Information
- Process hazard analysis
- Operating procedures and safe work practices
- Mechanical integrity
- Management of change
- Training
- Incident investigation:
- Emergency planning and response
- Auditing

VINYLS PSSR

Gawie Venter – 22 November 2018

PSSR (DOCUMENTATION)

- PSSR documentation includes a checklist of items reviewed and the resulting action plan for addressing short comings
- A graded approach to conducting PSSR's should be used. For simple processes, it may be adequate to complete a form with appropriate authorization blocks indicating that the plant is ready for startup
- This documentation, with the appropriate approvals, must be maintained on file to indicate the equipment was constructed according to the design specifications and was properly installed and tested..
- A system shall be established and controlled by the operations manager to ensure review recommendations are resolved (including documentation) before hazardous substances are introduced to the facility.

VINYLS PSSR

Gawie Venter – 22 November 2018

PSSR Vinyls

Required for following		Part Existing Systems
▪ Modifications to Existing Plants	-	MOC Procedure
▪ After Mayor Plant Shutdown	-	Shutdown Plan (CFO)

The PSSR is as a Ready for Commissioning (RFC) or Start-up

▪ Modifications to Existing Plants	-	Prior to Commissioning
▪ After Mayor Plant Shutdown	-	Prior to Start-up

VINYLS PSSR

Gawie Venter – 22 November 2018

PSSR (MOC)

Modifications to Existing Plants:

- The PSSR - After Punching - Before RFC of the Modification.
- Meeting will be arranged by TSG Project Manger
- Meeting will have a PSSR Team Leader (different Project Manager)
- Meeting will Consist of Operations, SHERQ and TSG members
- Meeting will Compete a PSSR Checklist.
- Meeting will agree on the categorization of outstanding actions
  - Before RFC
  - Before RFO
  - After BO
- The Checklist will form part of Modification Pack – and actions will be signed off on the checklist in the Modification pack.

VINYLS PSSR

Gawie Venter – 22 November 2018

PSSR (MOC)

Modifications to Existing Plants:

- The PSSR – Actions must be completed and signed off before modification closure.

Findings and Categorization of Outstanding actions (as per PSSR Checklist) – will support the General Manager's decision to sign RFC. The checklist can not authorize RFC – only supporting documentation.

VINYLS PSSR

Gawie Venter – 22 November 2018

PSSR (Checklist will Audit)

Plant Design Integrity **:**

Plant is designed & constructed under sound engineering practices.

Occupational Safety :

Plant is save to move around in by employees and focus more on mechanical and electrical risks.

Process Safety

Actions and interactions of the operation personnel with the plant, does not pose additional risks.

Maintenance Safety

Actions and interactions of the maintenance personnel with the plant, does not pose additional risks.

Incident Management

if a incident occur that it is effectively manage to reduce the impact

Commissioning Readiness **–Additional activities associated with the safe first time start-up of a plant are adhered too.**

VINYLS PSSR

Gawie Venter – 22 November 2018

PSSR (Clearance for Operations - CLO)

After Shutdown of 48hr or when work was done specific equipment.

- The CLO – Before the close-out of Shutdown Actions:
- Meeting will be arranged by **Shutdown Coordinator**
- Meeting will have a Maintance Manager (not shutdown coordinator)
- Close-out per discipline - Mechanical, Electrical , Instrumentation)
- Meeting will consist of Operations, SHERQ and TSG members and Maintenance Team Leaders
- Meeting will agree on the categorization of outstanding actions
  - Before RFC
  - Before RFO
  - After BO
- The CLO - checklist will form part of Shutdown plan –Actions will be signed off on the Shutdown plan.

VINYLS PSSR

Gawie Venter – 22 November 2018

PSSR (CLO)

Plant Shutdown: > 48Hr or specific equipment (Table)

Findings and Categorization of Outstanding actions (as per CLO Checklist) – will support the General Manager's decision to sign RFO.

The checklist can not authorize RFO – only supporting documentation.

VCM PSSR

Gawie Venter – 22 November 2018

CLO (Checklist will Audit)

Mechanical Work Integrity **:**

Specific Questionnaire. To be drafted by the Mechanical Team

Instrumentation Work Integrity :

Specific Questionnaire. To be drafted by the Instruments Team

Electrical Integrity

Specific Questionnaire. To be drafted by the Electrical Team

Vibration Integrity

Specific Questionnaire. To be drafted by the Machinery Team

Rotation Equipment Integrity

Specific Questionnaire. To be drafted by the Machinery Team

Not all discipline checklist are required for all specific equipment maintenance activities

Discipline checklist will be rolled out separately

Develop a action plant for Vendor (Need to sign and receive training)

VINYLS PSSR

Gawie Venter – 22 November 2018

EQUIPMENT FOR CLO- EXAMPLES (MC, IC, EC)

- **VCM :**

  Business assigned Mechanical, Instrumentation and Electrical person must complete the CLO for the required equipment.

DC Reactor	*MC, IC,*
Oxy Reactor	*MC*
Fridge Compressor	*MC, EC, IC*
Cracker Decoking	*MC, IC*
Specific Work Radio Active Sources	*IC, APC*
DCS Emergency Shutdown Modes	*IC*
DCS Re-load or Download	*IC, APC*

VINYLS PSSR

Gawie Venter – 22 November 2018

EQUIPMENT FOR CLO (MC, IC, EC)

- **PVC :**

  Business assigned Mechanical, Instrumentation and Electrical person must complete the CLO for the required equipment.

Autoclaves	*MC, IC, EC*
Initiator Pumps	*MC, IC*
Stirrers	*MC*
VCR	*MC, IC*
Specific Work Radio Active Sources	*MC, IC, APC*
MCC Work	*EC*
DCS Re-load or Download	*IC, APC*

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Center for Chemical Process Safety

Safety in Design During Engineering

by

Rasim Mahmood Qureshi

QAPCO [Qatar Petrochemical Company]

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SAFETY IN DESIGN DURING ENGINEERING PHASES

Nasim M. Qureshi

HSSE Support Manager (HSE, Process Safety & Training)

QAPCO

PROCESS SAFETY HISTORY

- The Flixborough disaster was an explosion at a chemical plant close to the village of Flixborough, UK, on 1 June 1974. It killed 28 people & injured 36

- BHOPAL Incident where 20,000 people lost their lives and Union carbide in the region went out of business, it occurred in 1984. First Process Safety standard issued in 1983 by OSHA 29CRF1926.64

- Piper Alpha 1988, 161 people lost their lives.

- 1989 Pasadena incident, 23 killed and over 400 injured due to heavy HC leak during maintenance.

PROCESS SAFETY HISTORY

- 1992 OSHA again issued Process Safety Standard 29 CFR 1910.119, adopted by multinational oil companies etc.
- In the early 1990 focus was on Process Safety
- During the late 1990 and early 2000 trend indicates that the focus shifted back to behavior based safety and occupational safety.

BP Deep Water Oil Spill Accident Mexico

- BP Texas incident in 2004
- Buncefield Accident in 2005
- BP Mexico spill in 2010.

BP TEXAS Refinery incident

Buncefield incident, UK

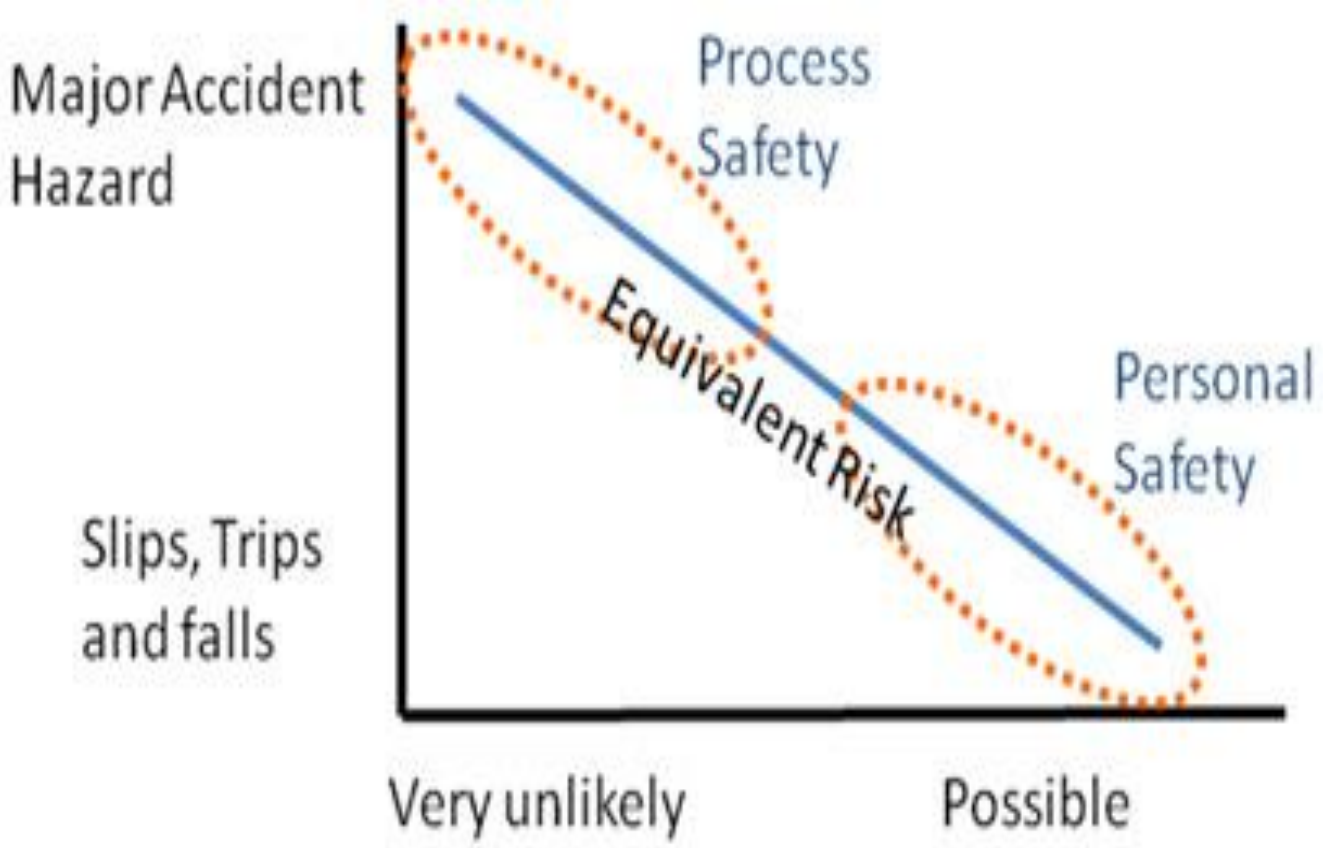
DEFINITIONS

Safety is the condition of being safe; freedom from danger, risk, or injury

Occupational safety is a cross-disciplinary area concerned with protecting the safety and welfare of people engaged in work or employment. The goal of OS programs is to foster a safe work environment

Process Safety is a disciplined framework for managing the integrity of hazardous operating systems and processes by applying good design principles, engineering and operating practices.
It deals with the prevention and control of incidents that have the potential to release hazardous materials or energy.
Such incidents can cause toxic effects, fire or explosion and could ultimately result in serious injury or death(s), property damage, lost production and environmental impact.
(2007, CCPS)

PROCESS SAFETY VS. OCCUPATIONAL SAFETY



STANDARDS / ACTS / LAWS

- OSHA 29 CFR 1910.119 (Process Safety Management)
- OSHA 29 CFR 1926.64 (PSM for construction industry)
- NFPA (National Fire Protection Association)
- API (American Petroleum Institute)
- EPA 40 CFR 68 Sub-Part B (Risk Management Plan)
- CCPS (Center for Chemical Process Safety) USA
- OGP International association for Oil & Gas producers
- FHSA (Federal Hazardous Substance Labeling Act 1960- USA)
- HMTA (Hazardous Material Transportation Act 1977-USA)
- TSCA (Toxic Substance Control Act 1986 –USA)
- CERCLA (Comprehensive Env. Reso. Comp & Liability Act 1980)
- EPCRA (Emergency Planning & Community Right to Know Act)

REFERENCES / PUBLICATIONS

- Chemical Process Safety by DANIEL CROWL
- Chemical Process Safety learning through accidents by ROY SANDERS
- Case histories of accident in chemical industry
- Plant design for safety by TENVOR A.KLETZ
- What went wrong by TENVOR A.KLETZ
- Loss Prevention in the Process Industry by FRANK P.LEES
- Managining change in the chemical plants by ROY SANDERS
- Publication and safety bulletins by CCPS
- Publication from American Society of Safety Engineers
- European center for chemical process safety
- SFPE Handbook of Fire Protection Engineering
- Lees Loss Prevention in the Process Industry by SAM MANNAN

PROCESS SAFETY MANAGEMENT ELEMENTS

CCPS four pillars of PSM include

Commit to process safety Understand hazards and risk

Manage risk Learn from experience

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
8. Operating procedures
9. Safe work practices
10. Asset integrity and reliability
11. Contractor management
12. Training and performance assurance
13. Management of change
14. Operational readiness
15. Conduct of operations
16. Emergency management
17. Incident investigation
18. Measurement and metrics
19. Auditing
20. Management review and continuous improvement

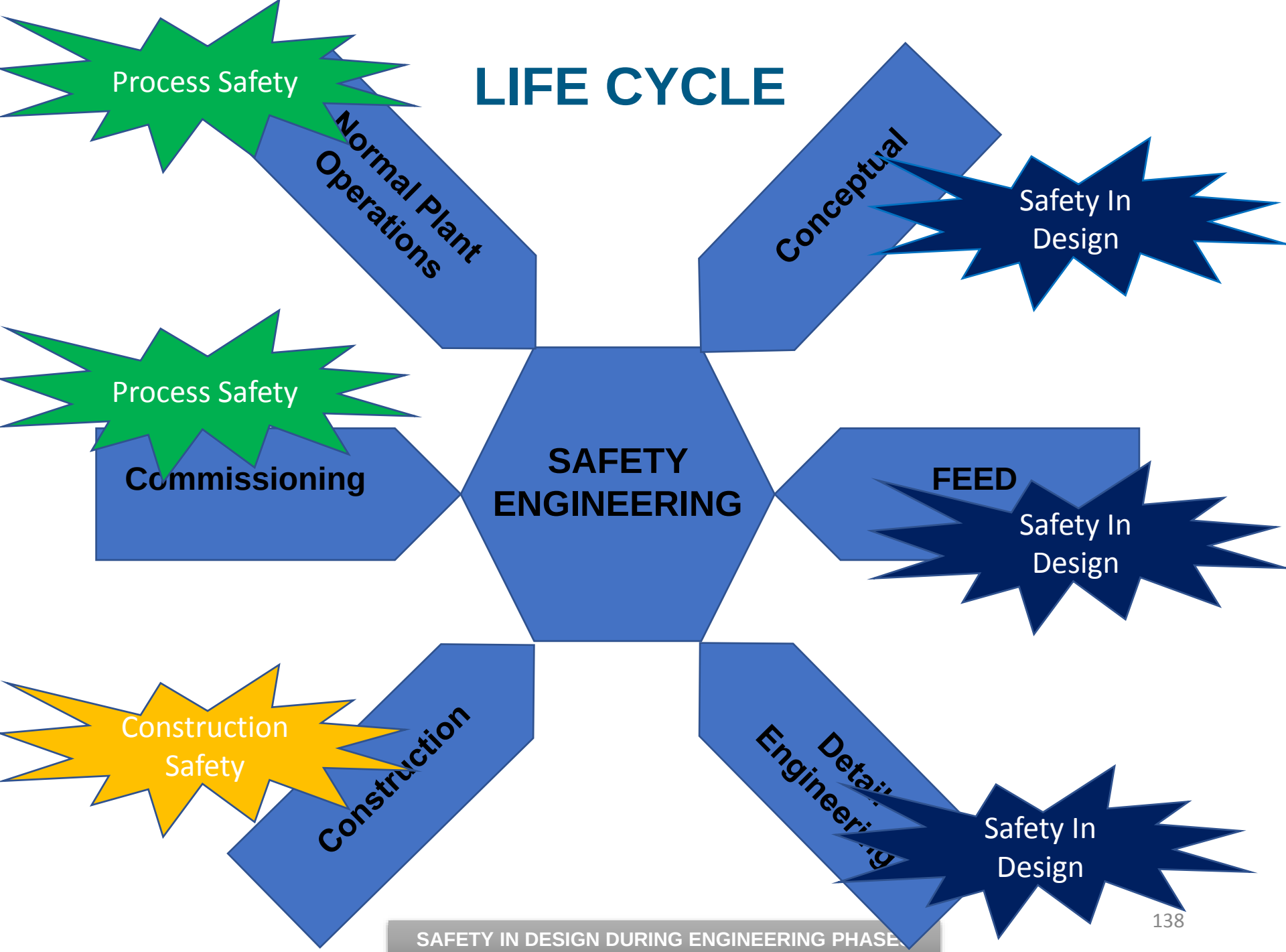
SAFETY ENGINEERING MANTRA

WE GO OVER EVERY INCH SO YOU CAN COVER EVERY MILE.

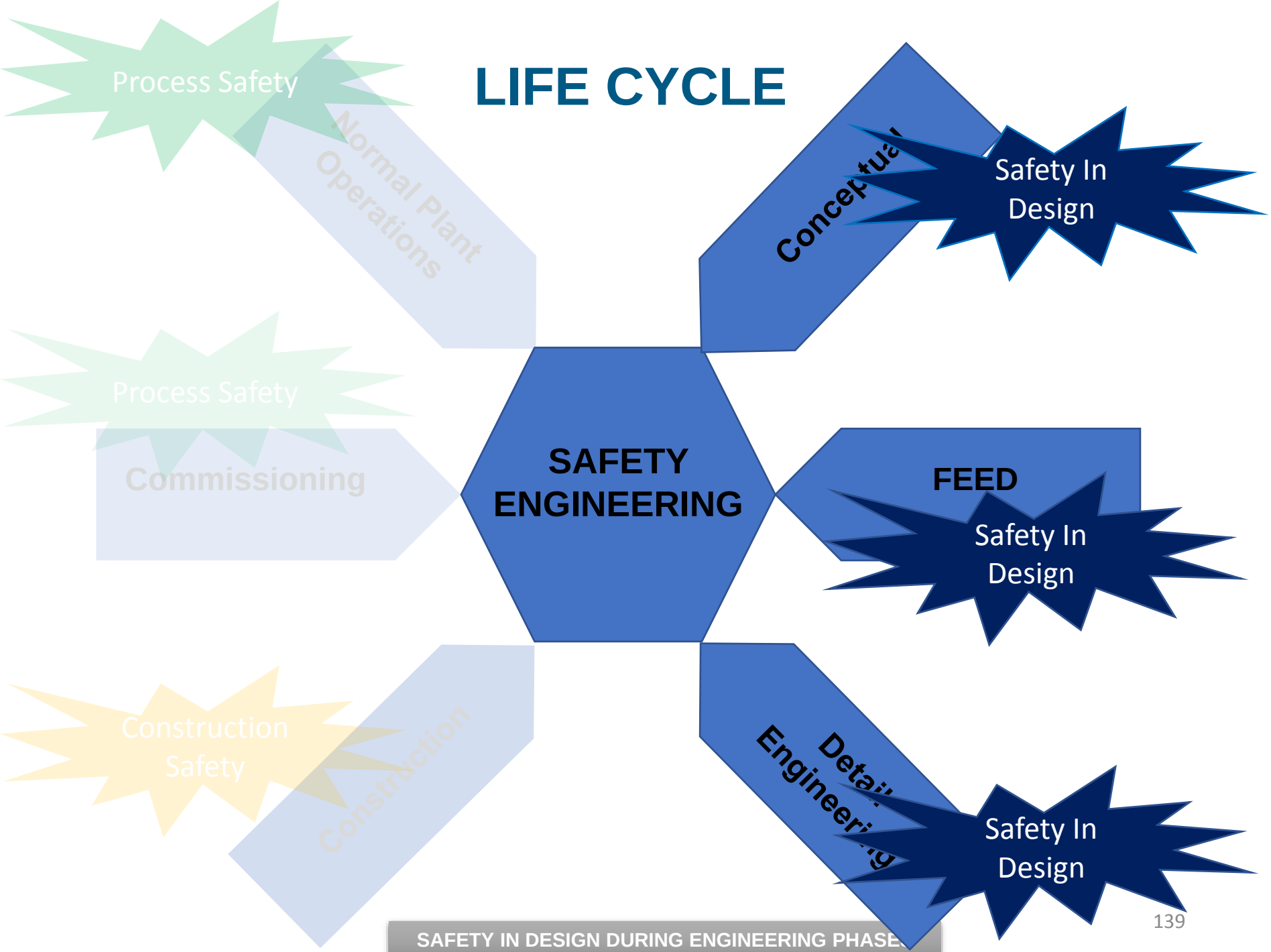
SAFETY ENGINEERING MANTRA

SAFETY ENGINEERING COVERS EVERY RISK SO YOU CAN OPERATE RISK FREE

LIFE CYCLE


Process Safety
Normal Plant Operations
Conceptual
Safety In Design
Process Safety
Commissioning
SAFETY ENGINEERING
FEED
Safety In Design
Construction Safety
Construction
Safety In Design

LIFE CYCLE


Process Safety
Normal Plant Operations
Process Safety
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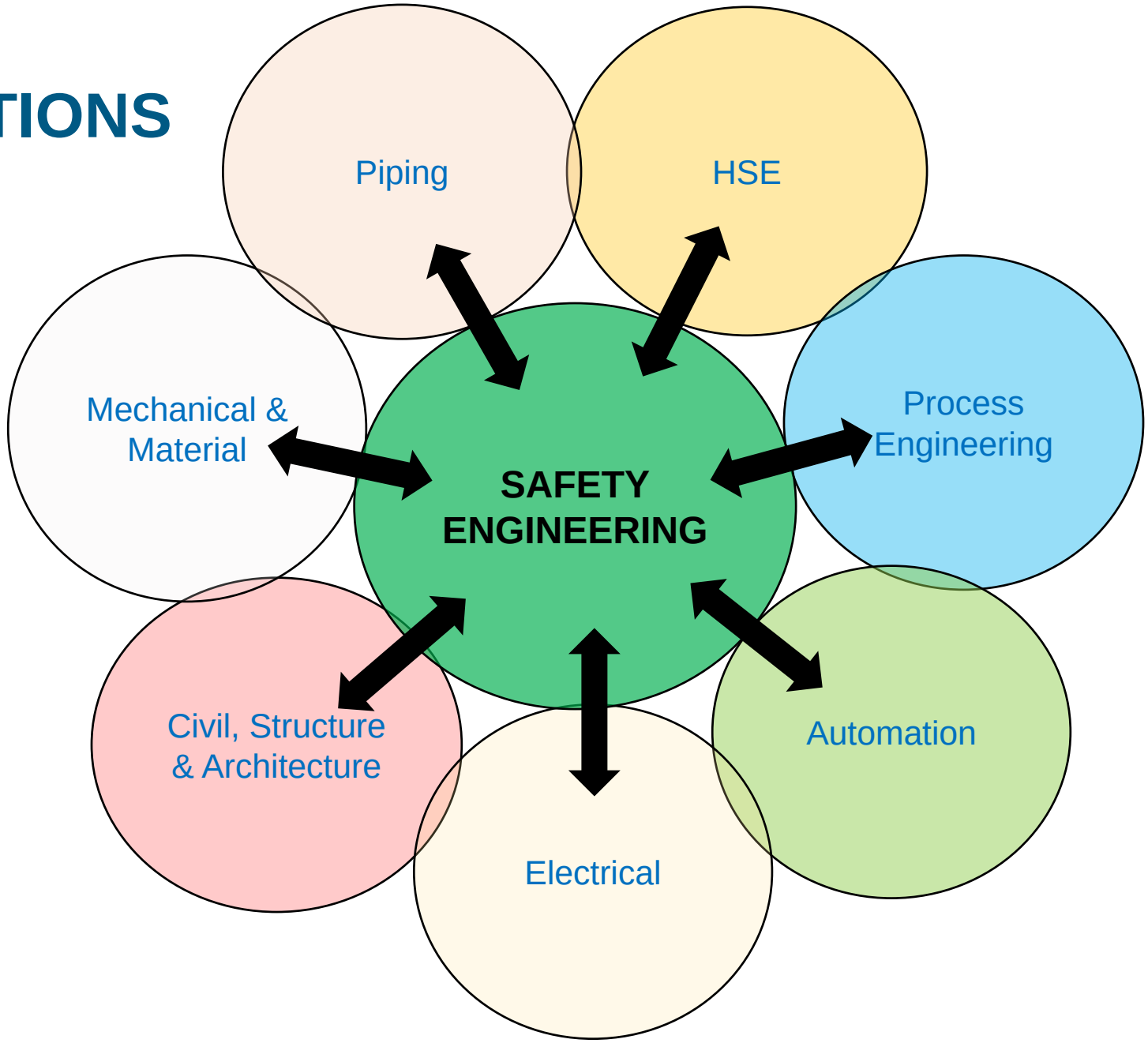
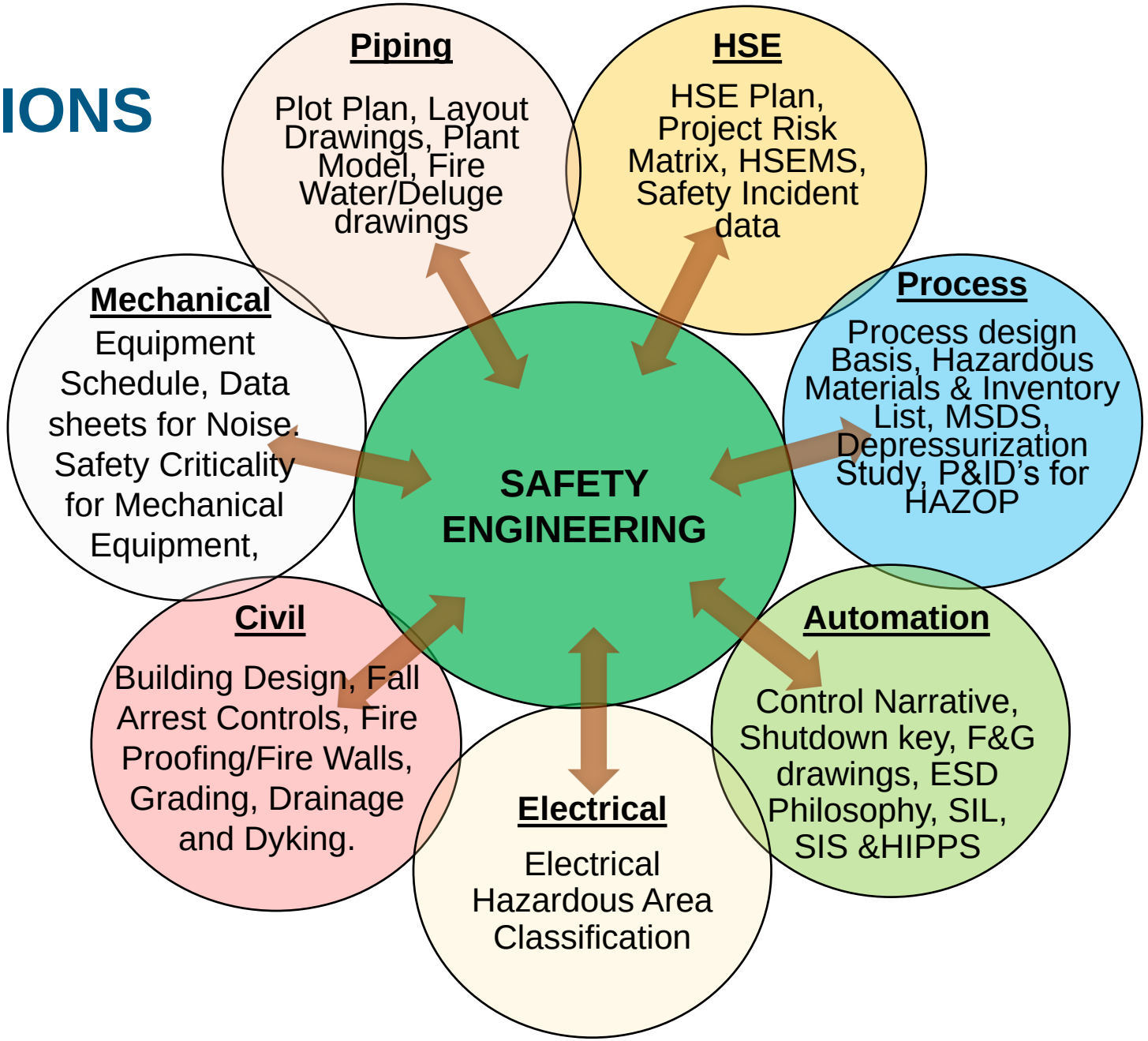
SAFETY ENGINEERING
Safety In Design
FEED
Safety In Design
Safety In Design

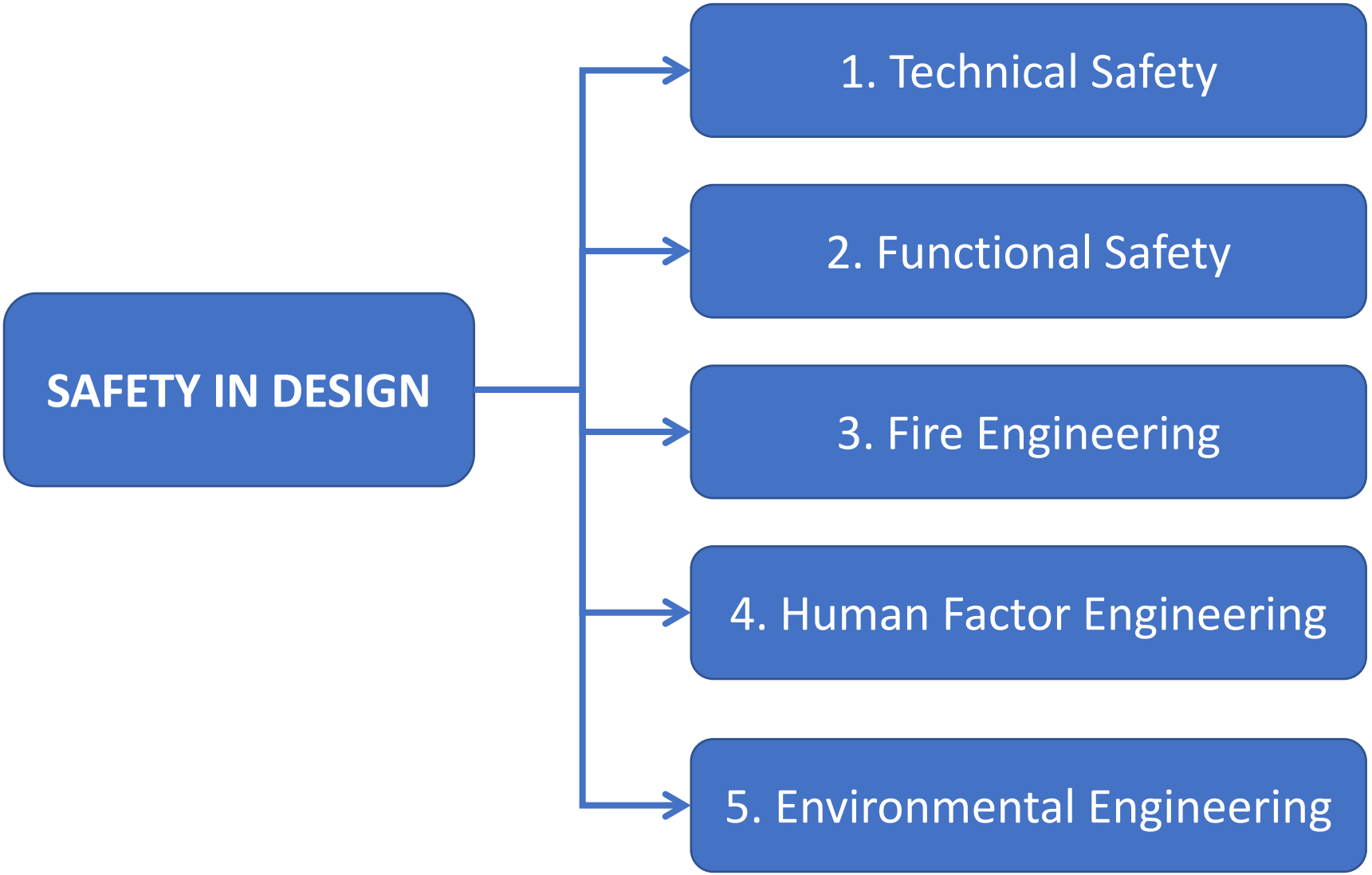
INTERACTIONS



INTERACTIONS



ELEMENTS OF SAFETY IN DESIGN



ELEMENTS OF SAFETY IN DESIGN

1. Technical Safety

- Technical safety philosophy (design basis)
- Process Hazard Analysis (HAZID/ENVID/OHID)
- Layout safety review / Facility sitting
- Safety engineering equipment schedule
- Consequence analysis / Frequency analysis
- COMAH (Control of Major Accident Hazards)
- QRA (Quantitative Risk Assessment) / Bow-Tie analysis
- HSECES (HSE Critical Equipment and Systems) analysis
- EERA (Escape, Evacuation & Rescue Analysis) / Building risk assessment
- HAZOP (Hazard and Operability) / Hazardous area classification
- Traffic study (Ignition sources) / Process safety training

ELEMENTS OF SAFETY IN DESIGN

2. Functional Safety

- Fire & Gas detection philosophy
- LOPA (Layers of Protection Analysis)
- SIL (Safety Integrity Level) assessment
- SIL (Safety Integrity Level) validation
- Fire & Gas mapping
- HSE critical equipment performance standards

ELEMENTS OF SAFETY IN DESIGN

3. Fire Engineering

- Fire protection philosophy
- FHA (Fire Hazard Analysis)
- FERA (Fire & Explosion Risk Assessment)
- Fire zoning study
- Fire protection equipment mapping
- Fire water demand study
- Fire water hydraulics analysis
- Fire envelope drawing / Fire proofing study
- Foam system requirement analysis / drawings
- Deluge system requirement analysis / drawings
- Fire equipment data Sheets / drawings

ELEMENTS OF SAFETY IN DESIGN

4. Human Factor Engineering

- Human factors philosophy
- Human factors risk assessment
- Layout and spacing design review
- Accessibility design review
- Illumination analysis
- 3D model reviews for ergonomics

ELEMENTS OF SAFETY IN DESIGN

5. Environmental Engineering

- Environment Base Line Study (EBS)
- Gas dispersion modeling
- EIA (Environment Impact Assessment)
- Waste management study
- Fugitive emission analysis
- Noise study and abatement analysis

ENGINEERING PHASES

Technical Safety	CONCEPTUAL	FEED	DETAIL ENGINEERING
Technical safety philosophy (design basis)	-	Y	Y
Process Hazard Analysis (HAZID/ENVID/OHID)	Y	Y	Y
Layout safety review / Facility sitting	Y	Y	-
Safety engineering equipment schedule	-	Y	Y
Consequence analysis / Frequency analysis	-	Y	Y
COMAH (Control of Major Accident Hazards)	-	Y	Y
QRA (Quantitative Risk Assessment) / Bow-Tie analysis	-	Y	Y
HSECES (HSE Critical Equipment and Systems) analysis	-	-	Y
EERA (Escape, Evacuation & Rescue Analysis)	-	Y	Y
Building risk assessment	-	Y	-
HAZOP (Hazard and Operability)		Y	Y
Traffic study (Ignition sources)	-	-	Y
Hazardous area classification	-	Y	Y

ENGINEERING PHASES

Functional Safety	CONCEPTUAL	FEED	DETAIL ENGINEERING
Fire & Gas detection philosophy	-	Y	Y
LOPA (Layers of Protection Analysis)	-	Y	Y
SIL (Safety Integrity Level) assessment	-	Y	Y
SIL (Safety Integrity Level) validation	-	-	Y
Fire & Gas mapping	-	-	Y
HSE critical equipment performance standards	-	-	Y
Shutdown philosophy	-	Y	Y

ENGINEERING PHASES

Fire Engineering	CONCEPTUAL	FEED	DETAIL ENGINEERING
Fire protection philosophy	-	Y	Y
FHA (Fire Hazard Analysis)	-	Y	Y
FERA (Fire & Explosion Risk Assessment)	-	Y	Y
Fire zoning study	-	Y	Y
Fire protection equipment mapping	-	Y	Y
Fire water demand study	-	Y	Y
Fire water hydraulics analysis	-	-	Y
Fire envelope drawing	-	Y	Y
Fire proofing study	-	Y	Y
Foam system requirement analysis / drawings	-	-	Y
Deluge system requirement analysis / drawings	-	-	Y
Fire equipment data Sheets / drawings	-	-	Y

ENGINEERING PHASES

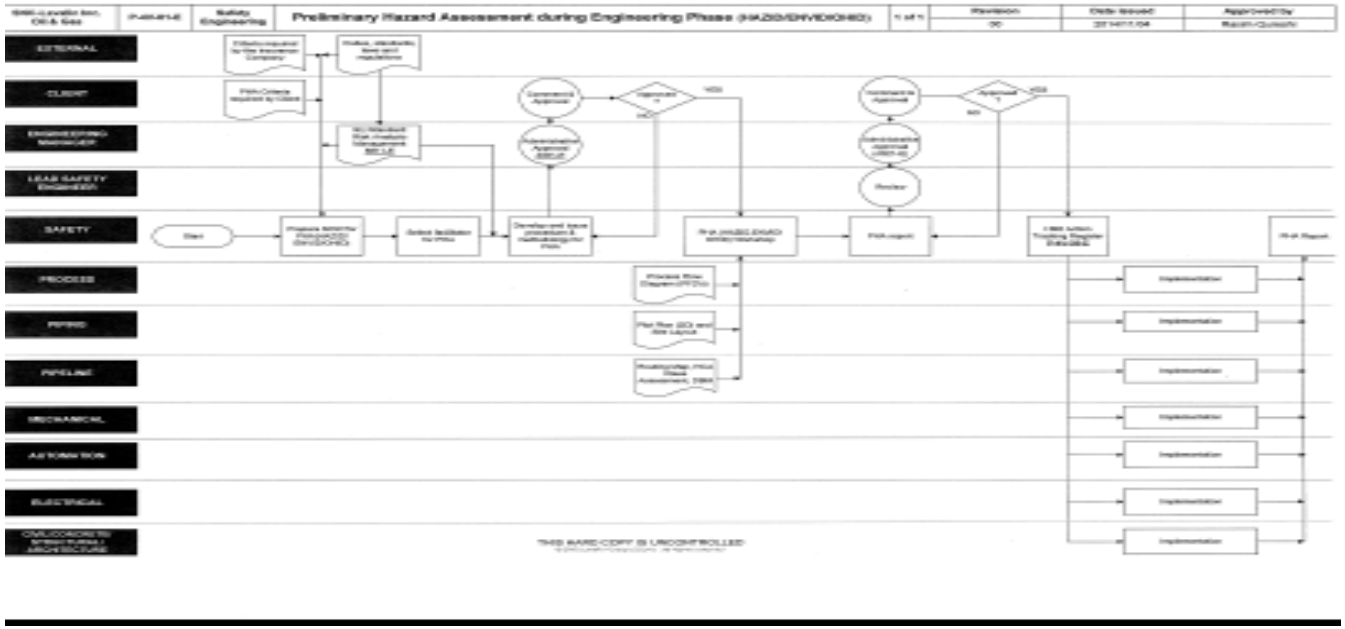
Human Factor Engineering	CONCEPTUAL	FEED	DETAIL ENGINEERING
Human factors philosophy	-	Y	Y
Human factors risk assessment	-	Y	Y
Layout and spacing design review	Y	Y	Y
Accessibility design review	-	Y	Y
Illumination analysis	-	-	Y
3D model reviews for ergonomics	-	Y	Y

ENGINEERING PHASES

Environmental Engineering	CONCEPTUAL	FEED	DETAIL ENGINEERING
Environment Base Line Study (EBS)	-	Y	Y
Gas dispersion modeling		Y	Y
EIA (Environment Impact Assessment)	Y	Y	Y
Waste management study	-	Y	Y
Fugitive emission analysis	-	-	Y
Noise study and abatement analysis	-	Y	Y

SAFETY IN DESIGN PROCESSES

A systematic approach to address the inputs and outputs of a system



RESOURCES & LIMITATIONS

- Newly emerging field
- Limited experienced resources available
- No one stop solution available in the market
- Safety engineering software's available but expensive
- Not all the companies have access to all the software
- Community of Practice for safety engineering not yet a strong forum
- Safety engineering standards vary widely from company to company
- Not all companies have access to available safety engineering standards
- Very few safety engineering analysis requested in project SOW documents

THANK YOU

Lunch Break

An AIChE Technology Alliance

CCPS

Center for Chemical Process Safety

Learning from Incident at ORPIC

by

Sohail Rabbani

ORPIC [Oman Refinery Company]

INSPIRING

PEOPLE

PRESERVING

PLANET

engro polymer & chemicals

Lessons Learnt in Orpic's Process Safety Journey

We put health, safety and the environment first

We work together with integrity, commitment and engagement

We empower our people to maximize their potential

We serve Oman and customers with pride

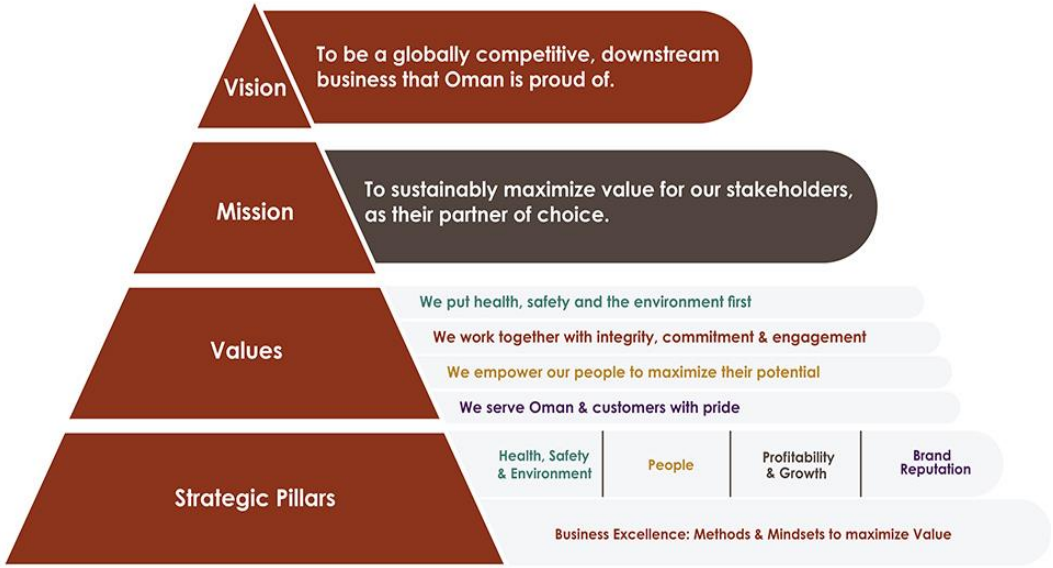
Sohail Rabbani – Head of Process Safety

MSc (SHE), CFSE, CSP, CMIOSH

Contents

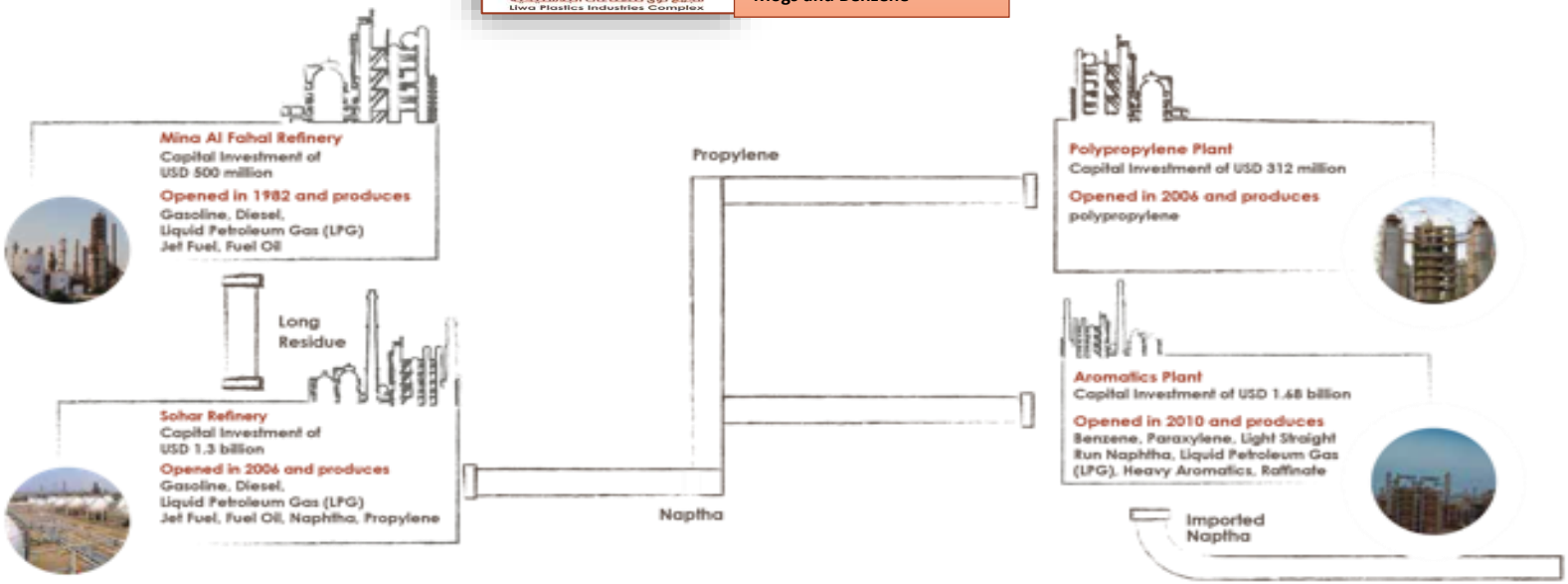
The Company


IRAN
QATAR
UAE
Sohar
Muscat
SAUDI ARABIA
OMAN
YEMEN
Salalah


Vision
To be a globally competitive, downstream business that Oman is proud of.
Mission
To sustainably maximize value for our stakeholders, as their partner of choice.
Values
We put health, safety and the environment first
We work together with integrity, commitment & engagement
We empower our people to maximize their potential
We serve Oman & customers with pride
Strategic Pillars
Health, Safety & Environment
People
Profitability & Growth
Brand Reputation
Business Excellence: Methods & Mindsets to maximize Value

The Plants

838 KTA HDPE/LLDPE
215 KTA of Polypropylene
Mogs and Benzene



Plant	Capacity
Mina Al Fahal Refinery	106,000 barrels per day
Sohar Refinery	116,000 barrels per day
Polypropylene Plant	350,000 metric tonnes of polypropylene per annum
Aromatics Plant	818,000 metric tonnes of paraxylene per annum 198,000 metric tonnes of benzene per annum

PSM Implementation – Orpic Approach

Case for change

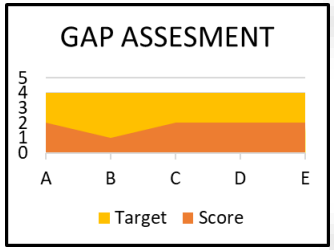
- Young organization, made with integration of four industries
- Serious Cultural Differences
- Various Reliability issues and subsequent shutdowns
- Significant streak of Tier 1 & 2 Process Safety Incidents

Response

- CEO and Board of Directors took initiative.
- 'Process Safety & Reliability Improvement Journey' initiated led by CEO.
- Took the learnings from the BP Texas Incident and CCPS guidelines.

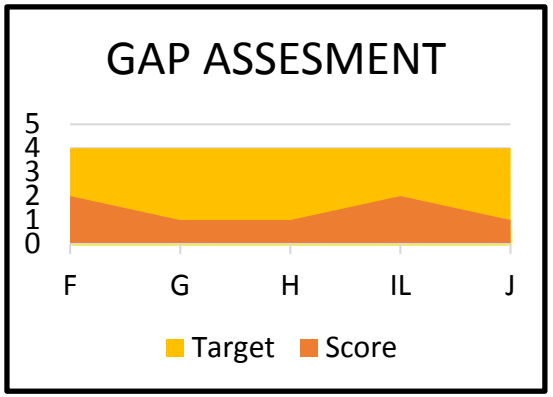
PSM Implementation – Orpic Approach

	Item	Expectation	Scoring/Gaps
A	Process Safety Leadership	•Effective Leadership from Management & BoD •Expectations and Verifiable objectives are set.	
B	Process Safety Management	•An Integrated and comprehensive PSM system established and implemented. •Continuous identification, reduction / management of Process Safety risks.	
C D	Process Safety Knowledge & expertise	•Appropriate level of process safety knowledge and expertise. •Competence assurance system for the organization and its contractors. That includes incident investigation and process hazard analysis techniques, and awareness training.	
E	Process Safety Culture	•Positive, trusting, and open process safety culture developed. •Proper reporting of Unsafe acts and conditions, and their use to improve the way things are done.	
	Clearly define expectations & accountability	•Compensation of managers and supervisors linked to Process safety performance indicators and objectives. •Development of an assessment tool to Emphasize and strengthen ownership of the area managers.	

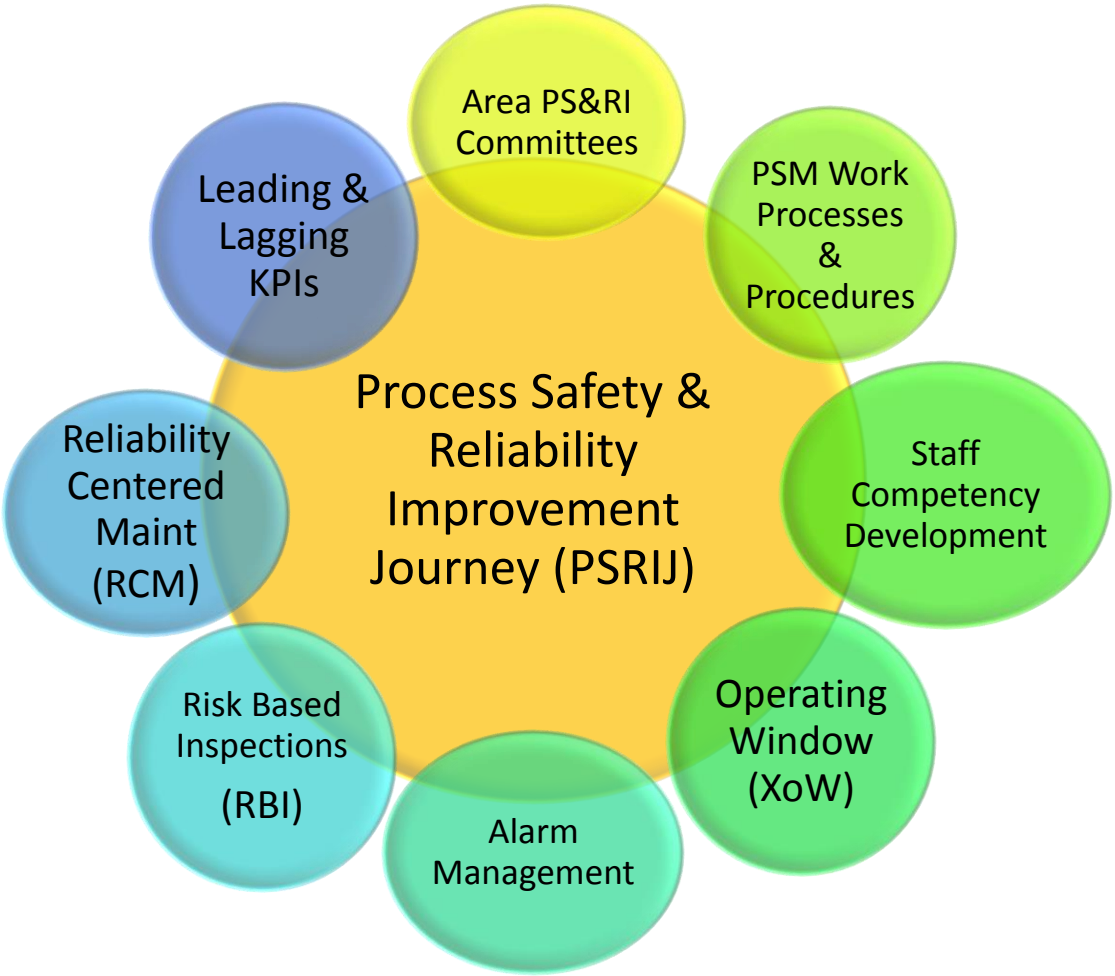


PSM Implementation – Orpic Approach

	Item	Expectation	Scoring/Gaps
F	Support the Line Management	•Sufficient support for line management regarding Process Safety.	
G	Leading & Lagging Process Safety Indicators	•Effective performance monitoring through an integrated set of leading and lagging performance Process Safety indicators.	
H	Process safety auditing	•Effective implementation of auditing for process safety performance. •Periodic auditing through independent team. •Timely verification of remedial measures completed.	
I	Board monitoring	•An Independent observer to monitor the implementation of the recommendations and the ongoing process safety performance.	
J	Industry leader	•Use of experience to transform the company into a recognized industry leader in process safety management.	



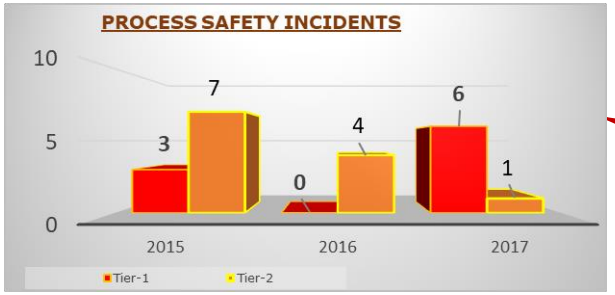
PSM Implementation



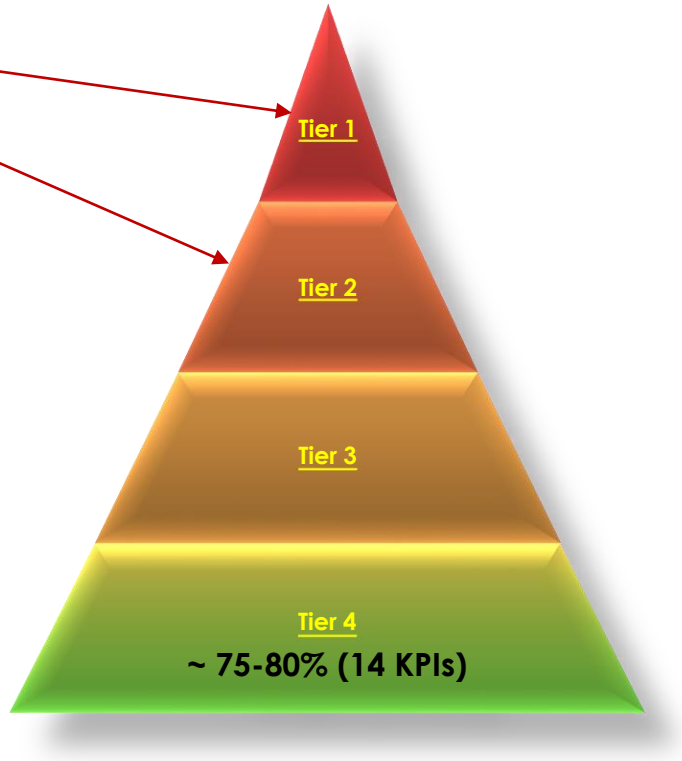
Tier 1, 2 & 3 Incidents
Tier 1 Incident
Tier 2 Incident
Tier 3 Incident
Tier 3 Performance Indicators
Small LOPC
Safe Operating Limit Excursions
Activation of SIL Loops / ESD
Failure on Demand (ESD/SIL Loops)
Pressure Relief Valve failed during testing
No. of Repeated Incidents
High Potential Near misses

Tier 4 Performance Indicators	
PS KPI	Target
Process Safety Securities override	< 10
No. of Temporary MOC overdue	< 5
%age of Pressure Relief Valve tested against planned	100%
%age RCA (Tier-1 & 2) completed	100%
%age H & HH Recommendations completion (Action Tracking)	≥ 95%
%age SOPs updated vs planned	≥ 90%
%age Hot work Permit Compliance	100%
%age PSSR compliance	≥ 95%
%age MOC compliance	≥ 95%
%age Override Compliance	≥ 95%
Fire Water Capacity Available	100%
%age PS Competency assessment	≥ 95%
%age SCE PM Compliance	100%
Alarm Count / Panel / hr	6

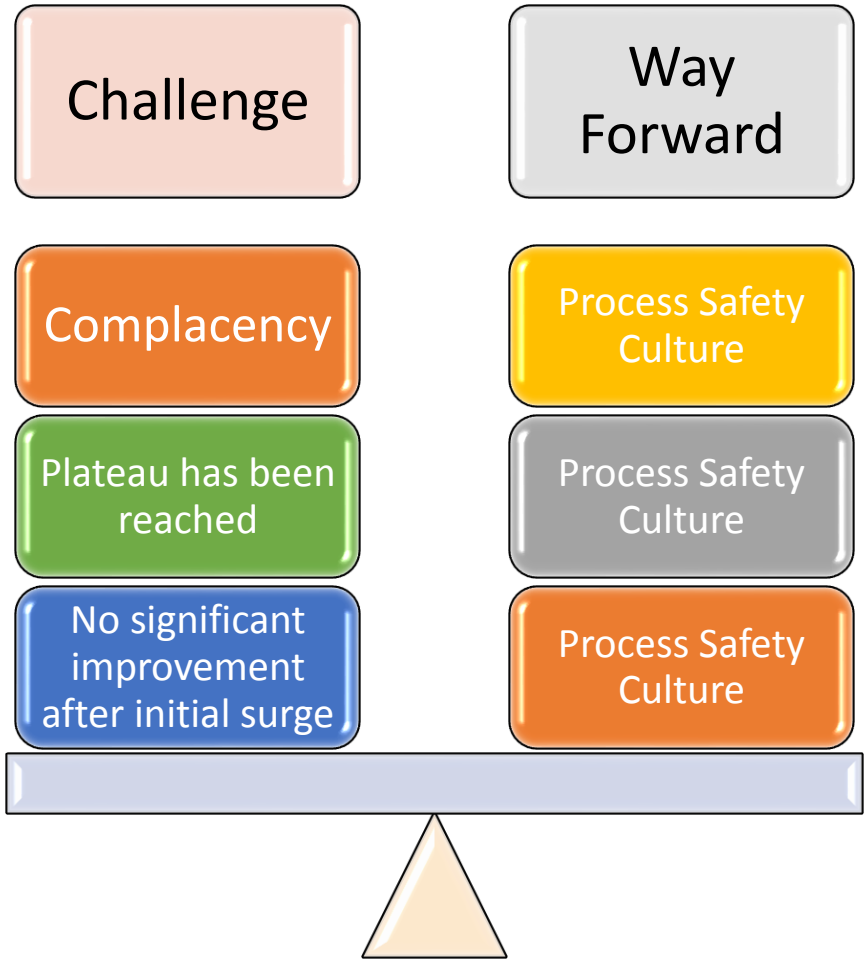
PSM Key Performance Indicators

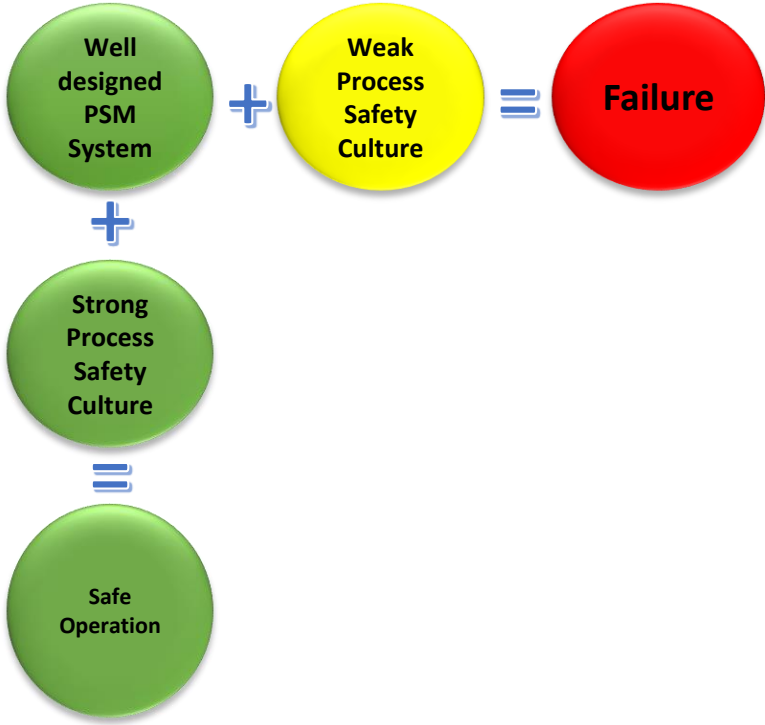


- Insufficient SOPs, or its awareness/implementation
- Improper implementation of MoC
- Insufficient Risk Assessment
- Insufficient implementation of PTW
- Overriding of Barriers without adequate mitigation



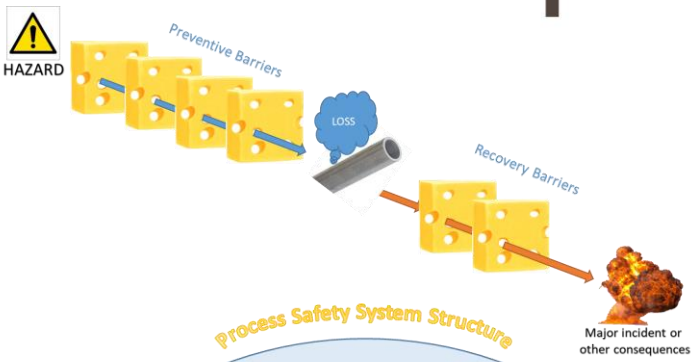
Challenges

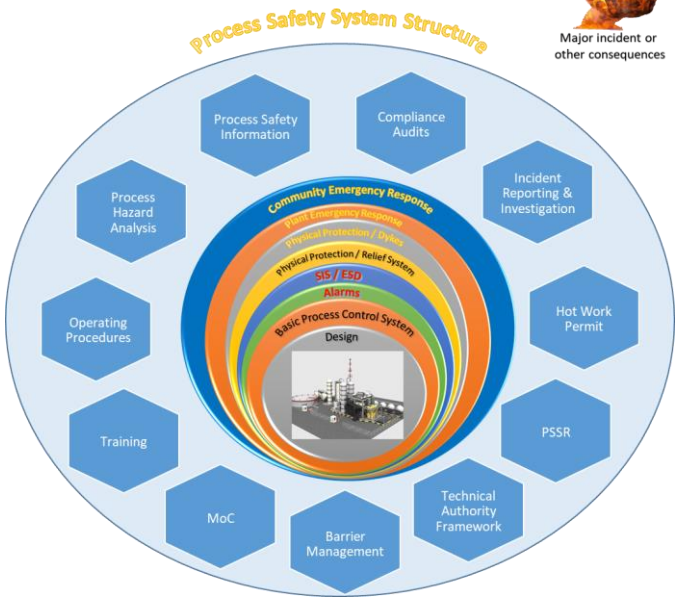

Challenge
Way Forward
Complacency
Process Safety Culture
Plateau has been reached
Process Safety Culture
No significant improvement after initial surge
Process Safety Culture


Well designed PSM System
Weak Process Safety Culture
Failure
Strong Process Safety Culture
Safe Operation

Process Safety Culture

- Create & Sustain the Sense of Vulnerability
- Leadership Commitment & Visibility
- Focus on People and Change Management
- Develop Barrier Thinking Mindset





Process Safety Culture

- Process Safety Learnings from Incidents
- Barrier Thinking Training & Campaign
- Staff Competency Assessment

Competence

- Process Safety Audits
- Process Safety Workshops to involve users and to get their ownership

Compliance

- Process Safety Barrier Surveys (KPI)
- Leadership Process Safety Walks (KPI)
- Rewards & Recognition

Culture

Corporate KPIs	**10% linked to Process Safety Lagging Indicators**
Function KPIs	**10% linked to Process Safety Leading Indicators**
Personal KPIs	**5% linked to Process Safety Barrier Surveys (12 surveys / employee)**

Process Safety Culture → Process Safety Rules

- To create and develop healthy Process Safety Culture, Company Rules and Values play an important role.

- These rules define Process Safety Values, that should be complied at all times, to ensure safe operation.

Process Safety Rules

Always take mitigating measures for overrides or if Process Safety Barriers are not functioning.

Assure mechanical completion and tightness.

No hose connections (utilities, flushing) without Risk Assessment / MOC / Procedure & backpressure protection.

Follow Startup and Shutdown procedures and sign off every step.

Walk the Line, Field check for correct lineup.

Always use 2 barriers for vents and drains of chemicals and hydrocarbons.

Verify Positive Isolation and pressure/gas free before starting the work.

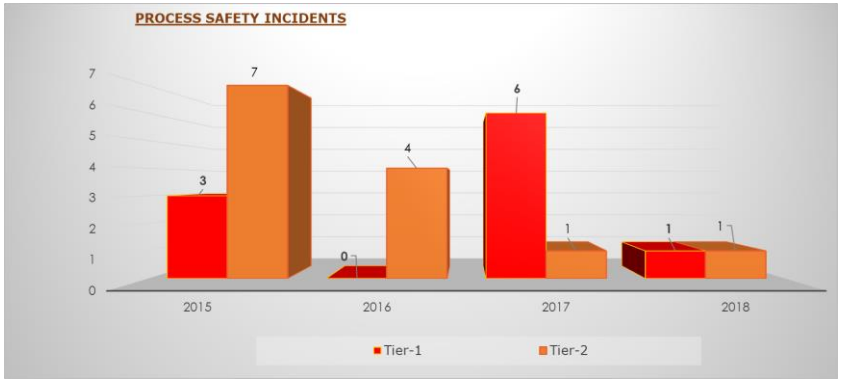
No Change without MOC.

Never leave draining unattended.

Core Principals for Process Safety Culture

Establish an Imperative for Process Safety	Production not possible without Process Safety
Providing Strong Leadership	Leaders Inspire other to Process Safety Excellence and Walk the Talk
Foster Mutual Trust	Everyone does what they say and says what they mean
Ensure Open & Frank Communication	Communications channels are open and encouraged. Messengers not blamed.
Maintain a Sense of Vulnerability	Healthy level of respect for hazards and risks of facility and company.
Understand & Act Upon Hazards / Risks	Hazards and Risks analyzed and controlled with appropriate safeguards
Empower Individuals to Fulfill their Process Safety Responsibilities	Workers have Authority and Resources to perform assigned Process Safety roles
Defer to Expertise	Technical Knowledge related to Process Safety valued and opinions accepted
Combat the Normalization of Deviation	No Tolerance for Deviations from approved Rules & Standards
Learn to Assess and Advance the Culture	Learnings used to maintain and enhance Process Safety Culture.

Progress So far in 2018



Some Useful Basics;

- Keep it Simple – focus on the basics
  - Consider your Customers. Use Change Management Practices.
  - Involve workforce in Procedure development /updates. Create ownership
  - Develop Barrier Thinking Mindset.
  - Knowledge and competency development.
  - Visible leadership and visible leaders
  - Action Management – close the loop
  - Work on development of PS Culture by using 10 core principals

Thank You

شكرا

An AIChE Technology Allaince
CCPS
Center for Chemical Process Safety

First Time in Pakistan

REGIONAL

An AIChE Technology Allaince
CCPS
Center for Chemical Process Safety

MEETING

engro polymer & chemicals

An AIChE Technology Alliance

CCPS

Center for Chemical Process Safety

Process Safety Undergraduate Education in Pakistan

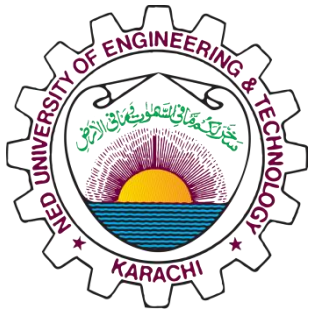
by

Dr. Junaid Akhlas

Assistant Professor
Department of Polymer & Petrochemical Engineering
NED Department of Engineering & Technology, Karachi

INSPIRING
PEOPLE
PRESERVING
PLANET

engro polymer & chemicals



NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

Undergraduate Education on Process Safety in Pakistan

Dr. Junaid Akhlas
Assistant Professor
Department of Polymer & Petrochemical Engineering
NED University of Engineering & Technology, Karachi

Overview

- **Current Status**
  - Institutes
  - Salient Course Features
  - Benchmarking
  - Gap Analysis
- **Process Safety Education Plan**
  - Outcome Based Education
  - Industrial Contribution to Academia

Institutes

- **Institutes offering Process Safety Education at Undergraduate Level in Chemical & Process Engineering**
  - NED University of Engineering & Technology, Karachi
  - Dawood University of Engineering & Technology, Karachi
  - Ghulam Ishaq Khan Institute of Engineering Sciences and Technology, Swabi
  - University of Engineering & Technology, Lahore

Salient Course Features

- **Objectives**

  Understand and appreciate the

  - Importance of safety and the occupational health related to chemical industries
  - Plant safety by risks identification, control, and management
  - Significance of reduced and controlled impact on the environment
  - International standards

Salient Course Features

- Plant Safety
- Process Plant Hazards
- Toxicology
- Accident Analysis and Prevention
- Accident Investigation and Case Histories
- Regulations for Industrial Safety (OSHA)
- Safety Management
- Hazard and Risk Assessment (HAZOP)
- Ergonomics

Benchmarking

- **According to HEC NCRC for Chemical Engineering, a Process Safety Management course must include**
  - Plant Safety
  - Accident Analysis and Prevention
  - Regulations and Standards
  - Safety Management
  - Hazard and Risk Assessment
  - Safety Equipment
  - Environmental Impacts
  - Quality Standards

Benchmarking

- **According to HEC NCRC for Chemical Engineering, a Risk Management and Safety course must include**
  - Risk and Hazard Identification
  - Fire and Explosion Modeling
  - Human Factors in Risk Analysis
  - Risk of Chemical Reactions
  - Emergency Planning and Responses
  - Storage and Transportation of Hazardous Materials
  - Introduction to International Safety Standards

Benchmarking

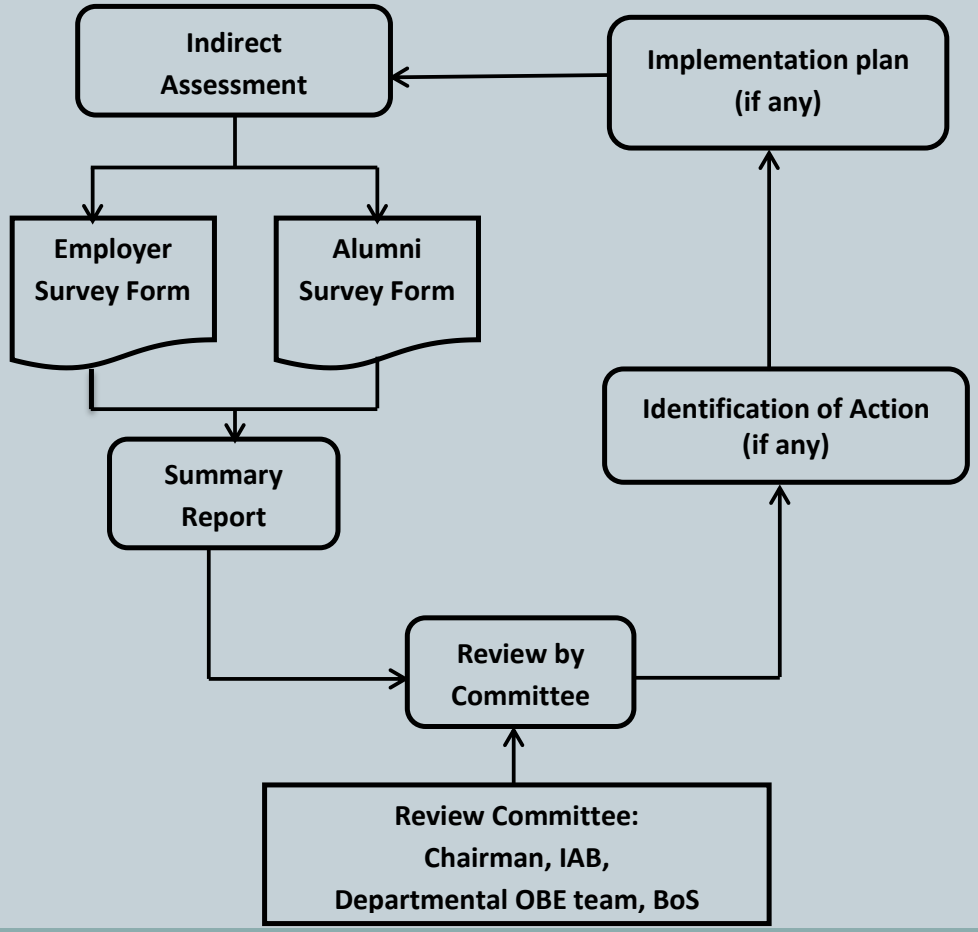
- **According to AIChE – CCPS**
  - Process Safety and its Importance
  - Hazard identification
  - Hazard Modeling
  - Risk Modeling
  - Risk Mitigation
  - Inherently Safe Design
  - Mechanical Integrity
  - Emergency Response Planning

Gap Analysis

- **One compulsory course dedicated to Process Safety**
- **One optional course dedicated to Process Safety & Risk Management**
- **HEIs offering Process Safety courses may modify their course contents to include or enhance the following topics:**
  - **Risk and Hazard Assessment**
    (Risk Modeling, Hazard Modeling, Fire and Explosion Modeling)
  - **Emergency Response Planning**
  - **Mechanical Integrity**
  - **Environmental Impacts**

Process Safety Education Plan

- Outcome Based Education



Process Safety Education Plan

- **Industrial Contribution to Academia**
  - Process Safety Management Systems
  - Risk Management Systems
  - Incident Reports and Case Studies
  - Engineering Practices for Safe Operations
  - HAZOP Analyses

Thank You

Dr. Junaid Akhlas

22nd November 2018

An AIChE Technology Alliance

CCPS

Center for Chemical Process Safety

AIChE / CCPS Undergraduate Process Safety Education Initiative

By

Shakeel H. Kadri

Executive Director,

CCPS, AIChE

INSPIRING

PEOPLE

PRESERVING

PLANET

engro polymer & chemicals

Process Safety — Start Them Young

Shakeel Kadri

Executive Director, CCPS

22 November 2018

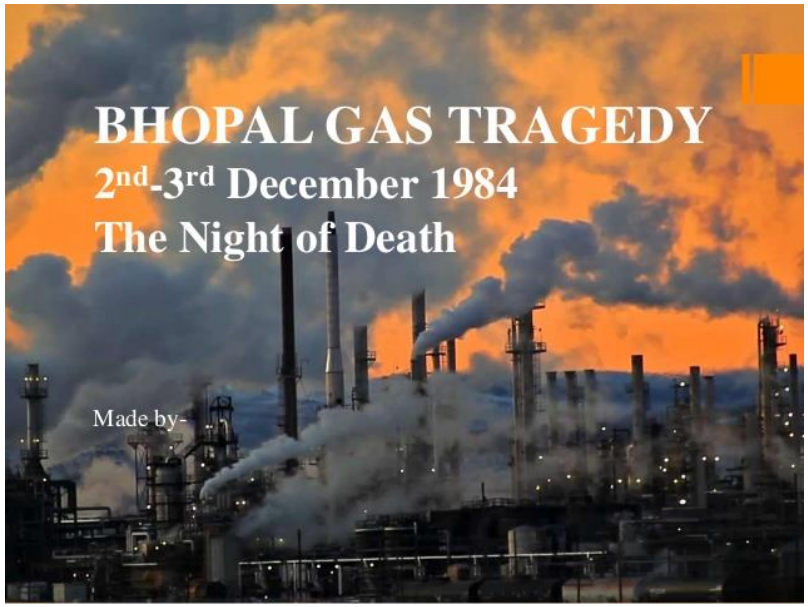
Presentation at the 1st Pakistan CCPS Regional Meeting

1970's

Process Safety Awareness

Flixborough [1974]

1980's



Process Safety Awareness

Bhopal [1984], Piper Alpha [1988]

Process Safety Education [1970's]

Process Safety Education
1980's and 1990's

Process safety Education [2000 +]

- A few universities started offering the program

Annual graduations of ChEs

The question is: How are they going to get Process Safety Education?

Process Safety Course requirement non-mandatory

Knowledge vs Competency

- **Knowledge**
  - Information what is known; provides the means to catalog, store, and retrieve information so that it can be accessed on request

- **Competency**
  - Ability of a person to do a job properly. It is the strategy a professional would apply in practice to apply his/her knowledge if given the opportunity.

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CCPS

Center for Chemical Process Safety

T2 Lab Explosion

T2 Laboratories Explosion

Key Overarching Lessons & Actions

- ❖ Lack of process safety knowledge
- ❖ Lack of process safety competency
- ❑ Include process safety in undergraduate ChE program

Undergraduate Process Safety Education [UPSLI]

- In 2010, CSB asked AICHE [parent of CCPS] to include process safety in ChE curriculum
- AICHE worked with the US **Accreditation Board for Engineering and Technology** [ABET] and the ChE curriculum was updated in 2012 to include process safety
- In 2015, CCPS launched an initiative to develop / implement the **Undergraduate Process Safety Education** program to accommodate the ABET requirements

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VISION for Process Safety in ChE Education

In 8-10 years, all graduating BS ChE's anywhere in the world will have learned the process safety basics necessary to have a successful and safe career, on a sustainable basis.

DOING A WORLD OF GOOD

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CCPS
Center for Chemical Process Safety

The Background

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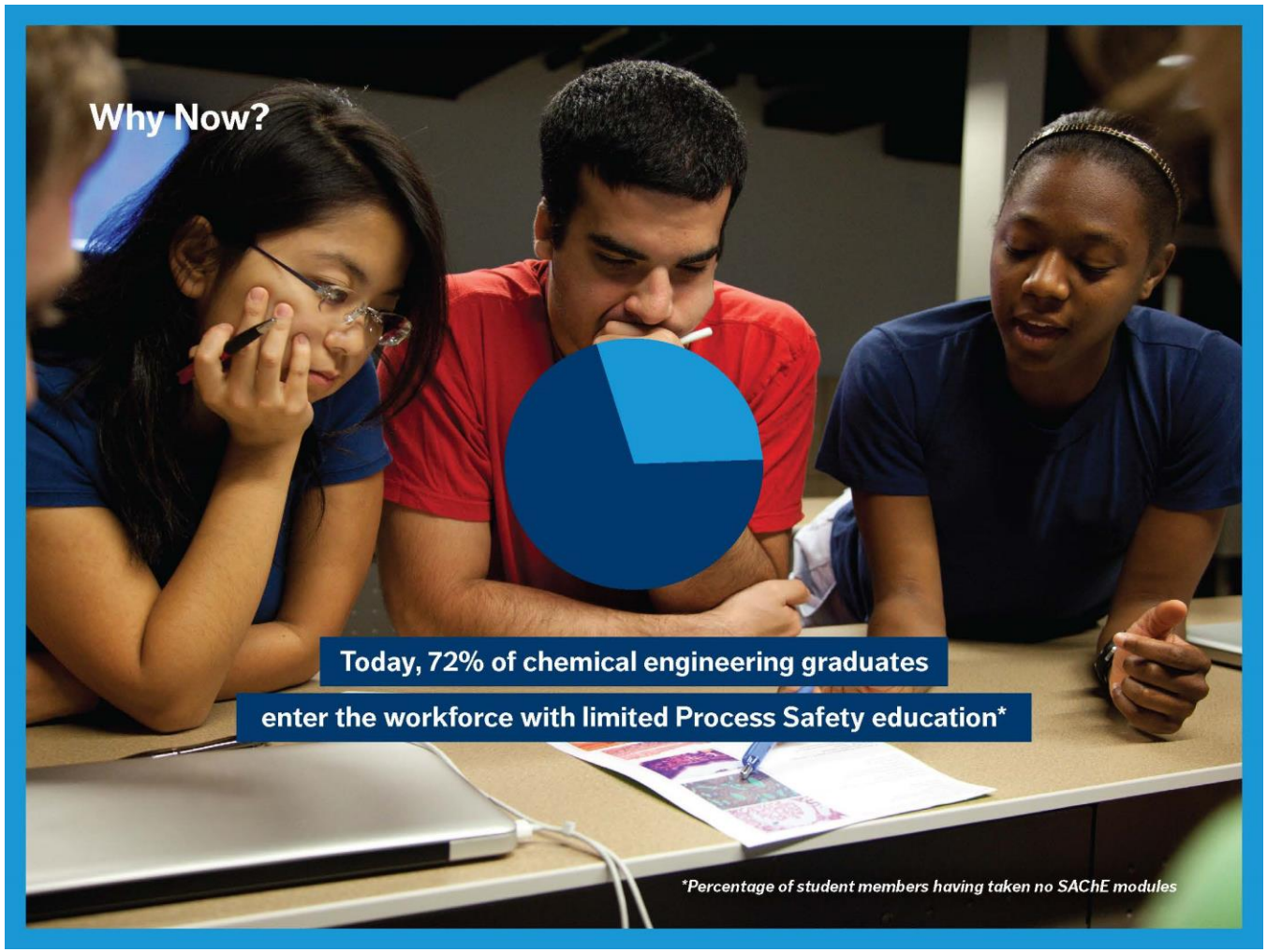
DOING A WORLD OF GOOD

In 2014, CCPS Advisory Board recognized a major industry challenge.

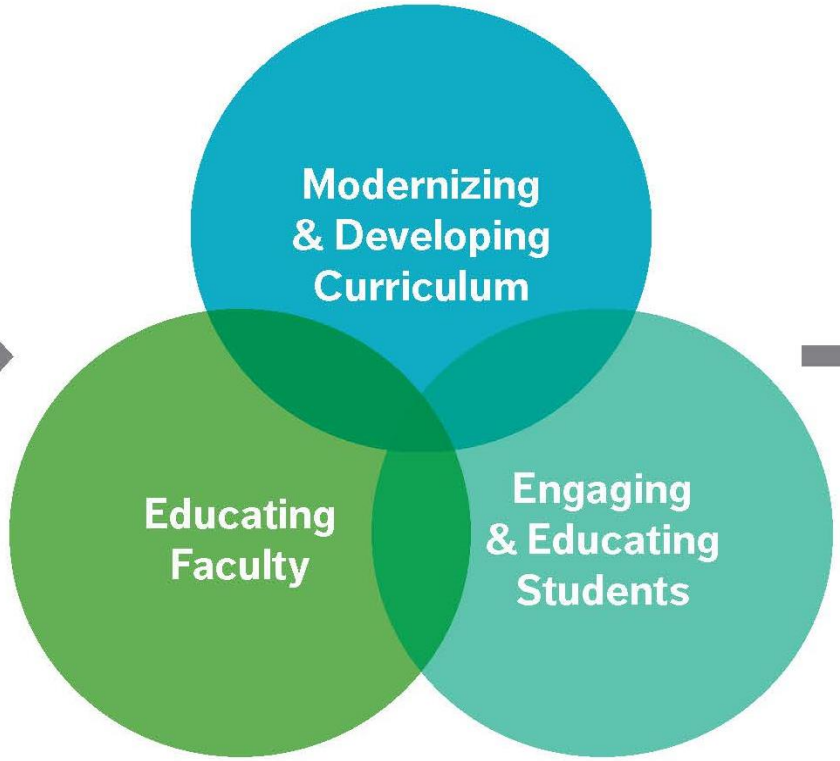


Program Overview

The Undergraduate Process Safety Learning Initiative includes 3 major elements:

Collaboration

- Community
- Industry
- Academia



Results

- Decreased incidents
- Enhanced public perception
- Improved skilled hires
- Direct cost benefits

Industry & University Collaboration

Accelerating the Program

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DOING A WORLD OF GOOD

Less than 28% students have taken SAChE modules

100% new hires with rigorous process safety training

Reduction in catastrophic process safety incidents

Prior to Launch

By 2024

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Level 1 (4) | Level 2 (14) | Level 3 (~18)

Process Safety Curriculum

The Importance of Process Safety	Hazard Recognition	Identifying & Minimizing Process Safety Hazards	An Introduction to Managing Process Safety Hazards
Understand Hazards and Risk	Process Safety at a Personal Level	Hazard Assessment/Source Models – 1	Hazard Assessment/Source Models – 2
Fire Hazards	Explosion Hazards	Chemical Reactivity	Toxicological Hazards
Management of hazards and risk - Background	Management of hazards and risk – Emergency Relief [ER]	Management of hazards and risk – Safeguards other than ER	Management of hazards and risk – Hazard ID Techniques
Safe Design & Operation / Equipment Hazards	Hazard Assessment/Atmospheric Dispersion - 1	Hazard Assessment/Atmospheric Dispersion - 2	Material Hazards
Inherent Safer Design Safety Systems and How they work Equipment Hazards Damage Mechanism Reactor Pressure Relief Facility Siting	Quantitative Methods and Hazard Assessment LOPA Adv Dispersion & Consequence Modeling Adv Proc Haz Analysis	Risk Based Process Safety Management Commit to Proc Safety Understand Hazards & Risk Manage Risk Learn from Experience	Nitrogen Hazards Dust Explosions Biological Hazard Toxicity & Flammability Hazards of Common Chemicals

Additional detailed courses build on concepts presented in Level 2 courses

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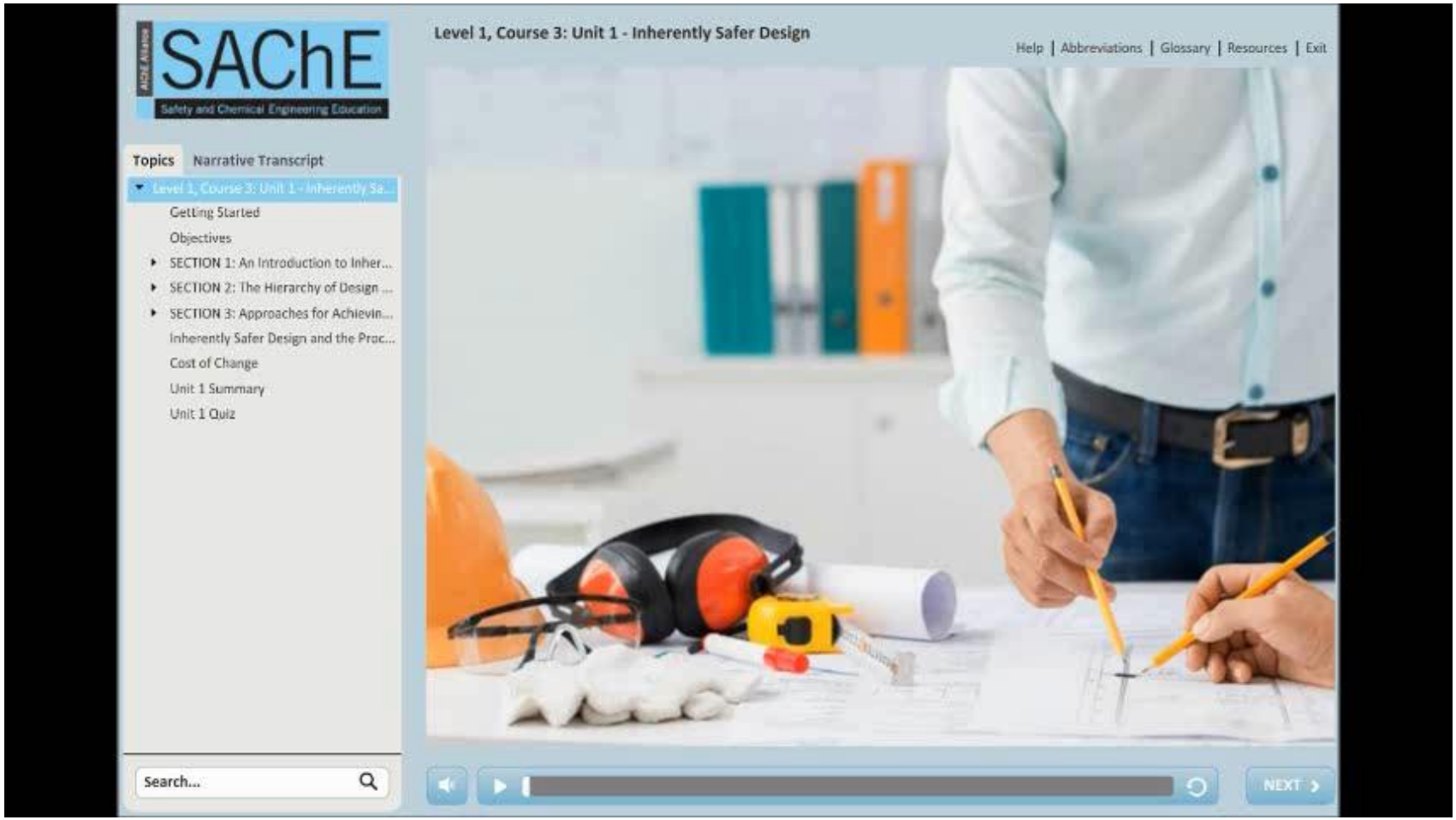
New SACHE Module



Faculty Workshops
Educating the Educators

2016 Faculty Workshops

Dow - Freeport, TX June 20 – 23, 2016

Archer Daniels Midland - Decatur, IL, July 25-28, 2016

Cargill - Blair, NE, August, 15 – 18, 2016

Chevron - Richmond, CA, August 21 -24, 2016

UPSLI Update 2018

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New SACHE Modules

- Eight new SACHE modules are in process of getting completed

Faculty Workshops

1. LyondellBasell
2. Dow
3. Chevron
4. BASF
5. Chemours
6. Covestro - AIChE Annual Meeting

Students PS Boot Camps

1. University of Michigan
2. Colorado School of Mines
3. North Carolina State University
4. Mississippi State University
5. University of Tennessee-Knoxville
6. Ohio State University

The Impact

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DOING A WORLD OF GOOD

26,700

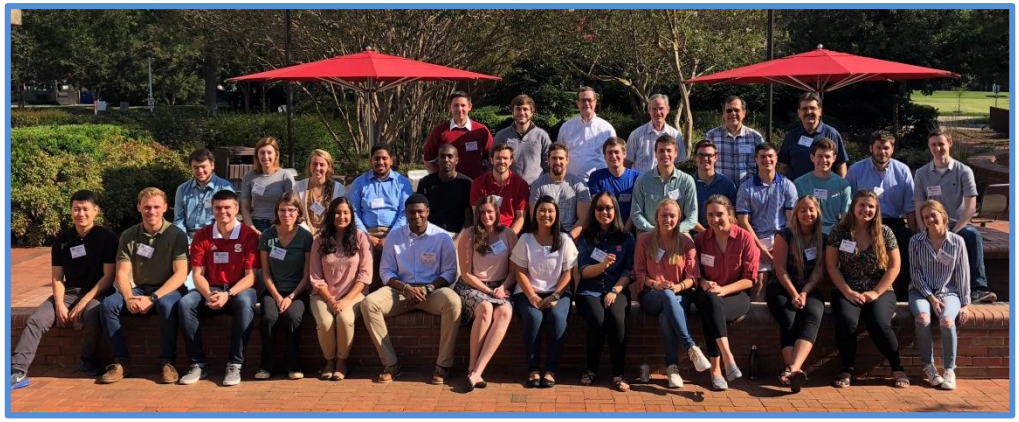
STUDENTS
using SAChE modules
since 2015

389

NEW FACULTY MEMBERS
educated on process safety
since campaign launch

416

UNIVERSITIES PARTICIPATING
in Undergraduate Process
Safety Learning Initiative
curriculum



85,000+

SAFETY CERTIFICATES
awarded to students
since 2015

17 Faculty Workshops

since 2015

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2016

- Archer Daniels Midland – Decatur, IL
- Cargill – Blair, NE
- Chevron – Richmond, CA
- Annual Meeting – San Francisco, CA

2017

- Dow – Freeport , TX
- WACKER – Charleston, TN
- Archer Daniels Midland – Decatur, IL
- Chevron – Richmond, CA
- Reliance Industries – India
- Annual Meeting – Minneapolis, MN

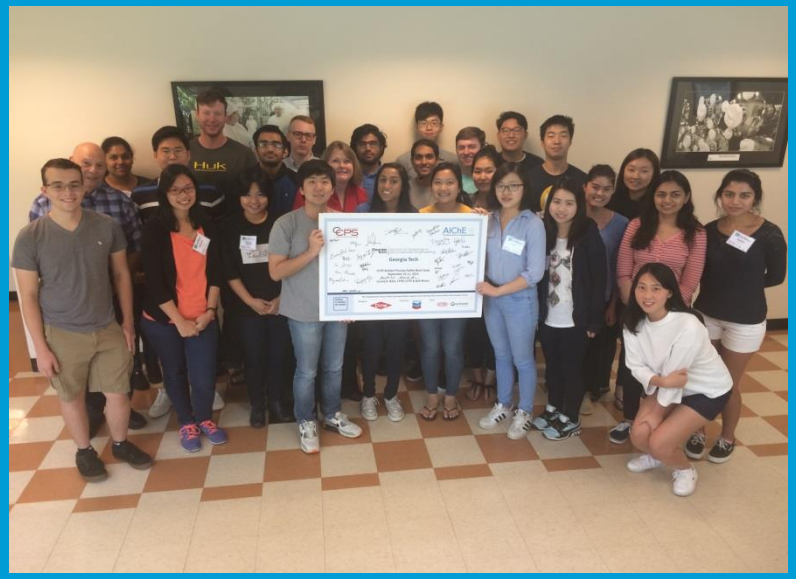
2018

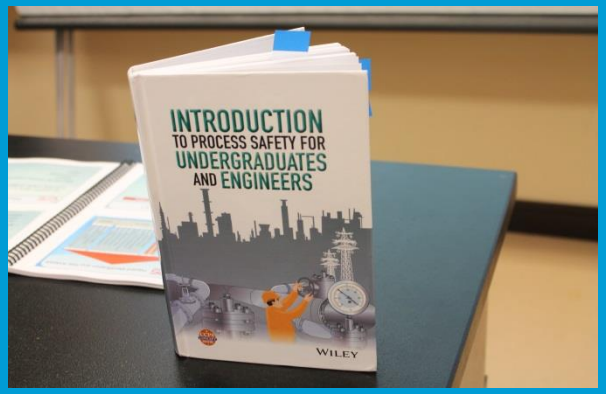
- LyondellBasell – Houston, TX
- Dow – Freeport, TX
- Chevron – Richmond, CA
- Chemours – Fayetteville, NC
- BASF – Wyandotte, MI
- Covestro – Pittsburgh, PA

2019 Planning Underway

- LyondellBasell - Jan 6 - 9
- The Dow Chemical Company - June 10 - 13
- BASF - July 22 - 25
- Bayer U.S Crop Science - July 29th – August 1st
- ExxonMobil - August 12-15
- Chemours TBD

Student Bootcamps





2016 Student Bootcamps

UC Berkeley – April 2-3
Georgia Institute of Technology – Sept. 10-11
University of Illinois-Urbana (mini regional) – Sept. 10-11

Impact of Student Bootcamps

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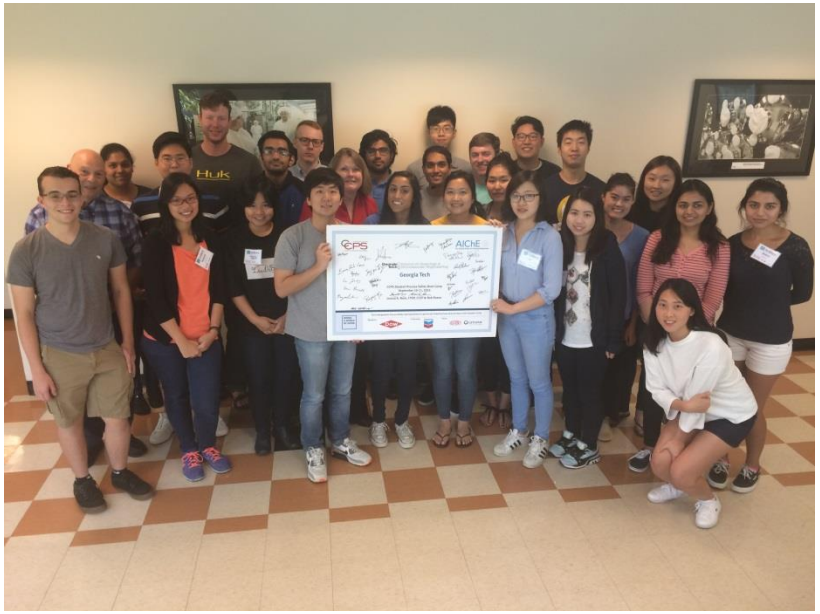
DOING A WORLD OF GOOD

2016
- UC Berkeley
- Georgia Institute of Technology
- University of Illinois-Urbana

2017
- Virginia Tech
- University of Delaware
- Louisiana State University
- University of Texas, Austin

2018
- University of Michigan
- Colorado School of Mines
- North Carolina State University
- Mississippi State University
- University of Tennessee-Knoxville
- Ohio State University



Average of 30 students/bootcamp

"The course helped emphasize the importance of process safety as lives are on the line. Keep up the work!"

– Undergraduate Student,
Colorado School of Mines

The Support

AIChE
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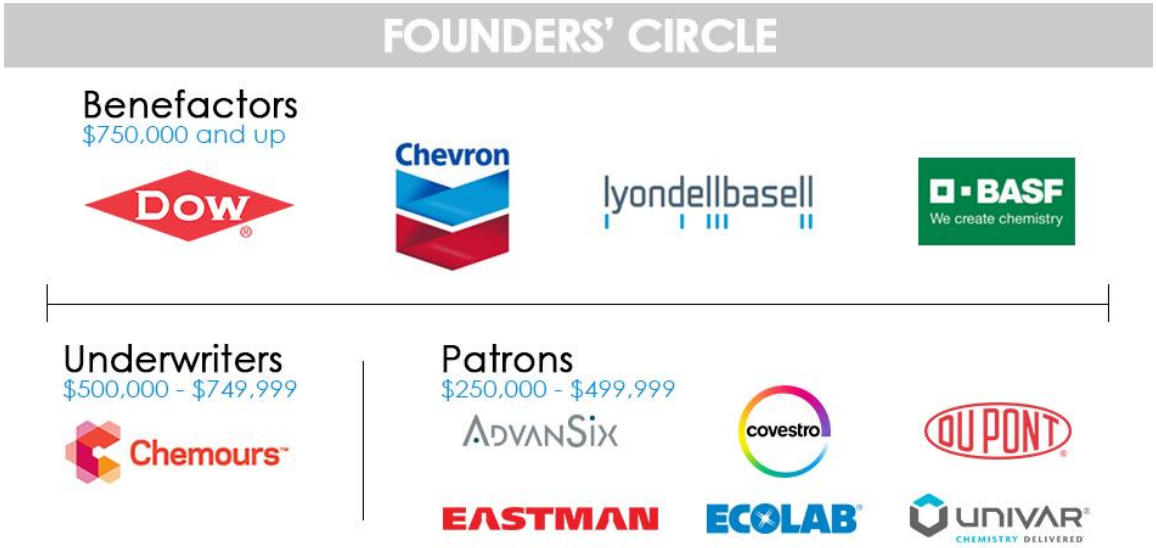
DOING A WORLD OF GOOD

The AIChE Foundation has raised $11MM towards the Doing a World of Good campaign.



MAJOR CONTRIBUTORS

Partners - $100,000-$249,999

Albemarle
Archer Daniels Midland Company
Bayer U.S. – Crop Science
Cabot Corporation
Evonik
ExxonMobil Corporation
ExxonMobil Corporation
FMC Corporation
Mitsui & Co. (U.S.A.), Inc.
Olin
PolyOne
Trinseo LLC
WACKER Chemical Corporation

Supporters - $50,000-$99,999

Air Liquide
Arkema Inc.
Bouchard Transportation
Cargill
Honeywell
Intercontinental Terminals Company LLC
LANXESS
Novus International, Inc.
Praxair

For a complete list of donors, visit www.DoingaWorldofGood.org

Process Safety — Start Them Young

Thank You!

Safety Equipment Philosophy in Oil & Gas Sector

Rehan Sajjad

BYCO Petroleum

INSPIRING
PEOPLE
PRESERVING
PLANET

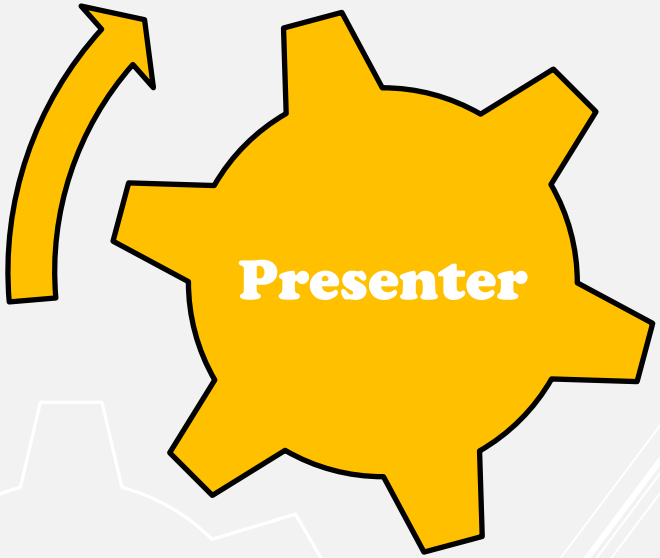
SAFETY CRITICAL EQUIPMENT

Rehan Sajjad Mughal

BYCO Petroleum Pakistan LTD.

Rehan Sajjad Mughal

- Chemical Engineering from.....



"**Safety** is the control of hazards in order to achieve an acceptable level of risk"

Process Safety

- Encircles Processes, Equipment & Instrumentation

Behavioral Safety

- Encircles Behaviors, Mindsets, Practices & Culture

KEY Challenges in Modern Process & Manufacturing Industries are

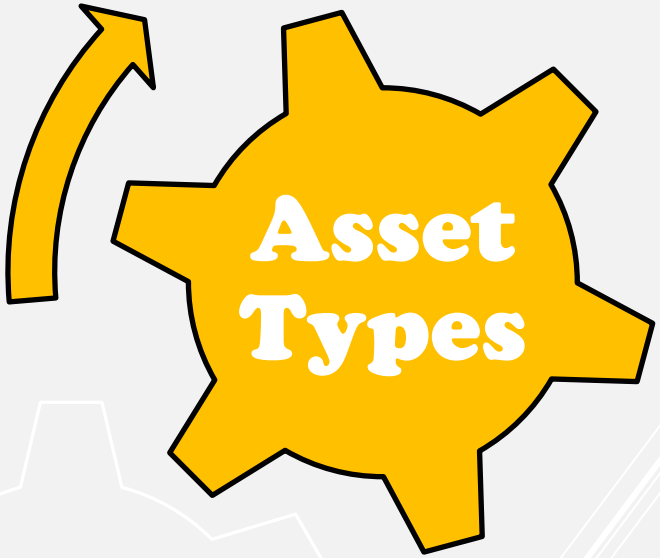
Limited Time

Limited Budget

Limited Skill Manpower

Sustainability

Best utilization of limited resources can be done by identifying and prioritizing critical assets



Normal Assets

Business Critical

Safety Critical

"Devices, equipment or systems whose failure could result in **catastrophic consequence**"

<u>For example:</u>

Major Loss of Containment

Explosion, Fire & Fatality

Environment Damage

HIGH HAZARD PROCESS

"Any activity using hazardous substances that, when they are released, ignited, or intentionally combined, have significant potential for **catastrophic consequence**"

LOW HAZARD OPERATION

"Any activity **without** potential for a catastrophic consequence"

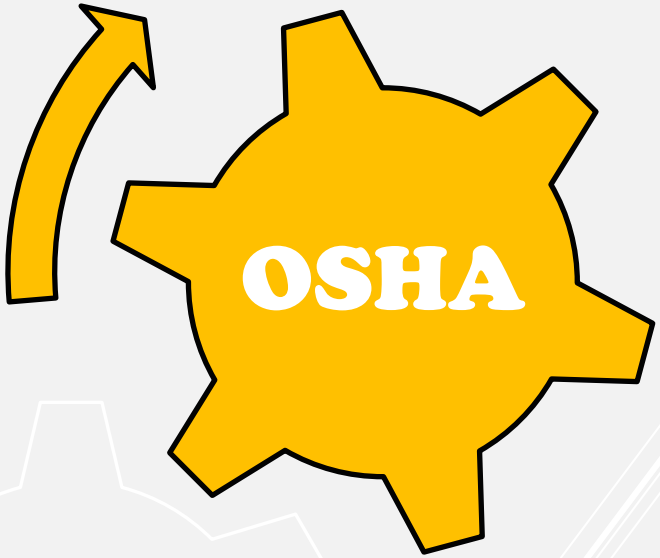
HHP, LHO hence SCD can be segregated based on following standard

NFPA 30

OSHA

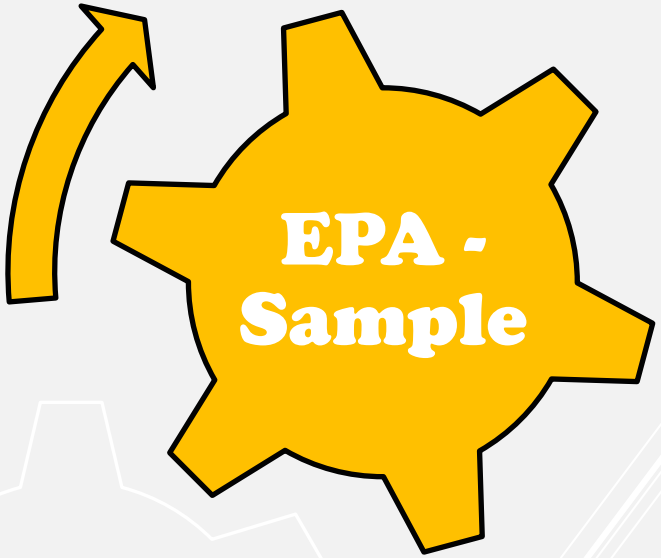
EPA

Refers to **NFPA & EPA** for detailed guidelines

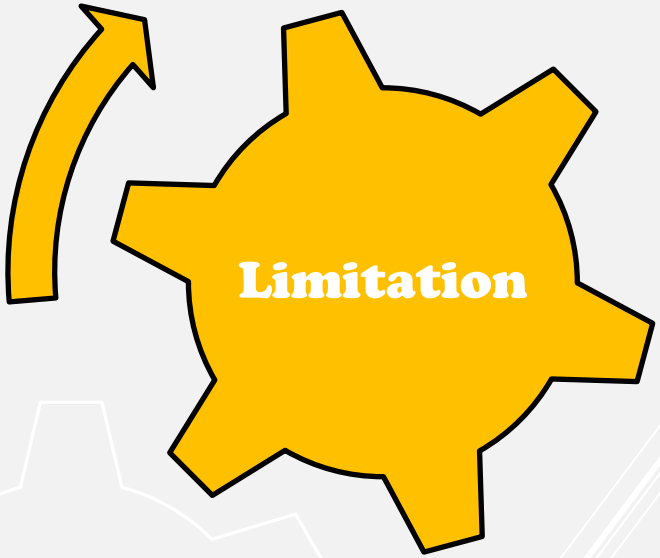


"**High HAZARD PROCESS** is all those Hazardous Chemicals with quantity greater than their threshold limit as identified by OSHA / EPA / regulated chemicals list

Chemical Name	EPA Quantity (lb) for HHP
H2S	10,000
HCL	5000
Caustic	10,000
Sulfuric Acid	10,000
Chlorine	2500
MEA	10,000



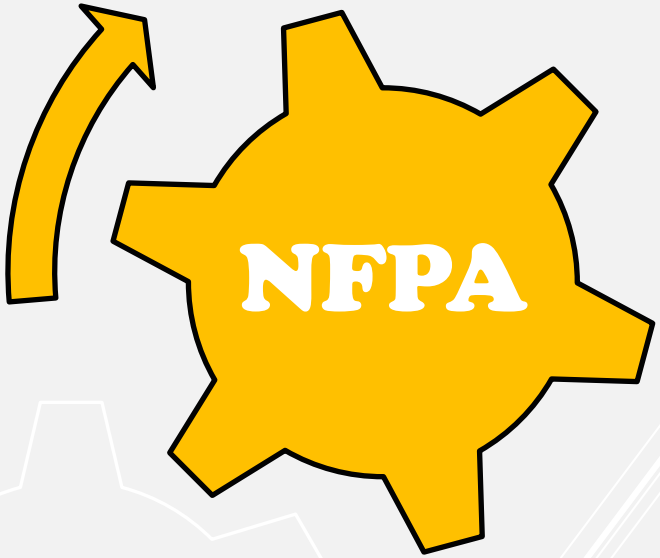
"**OSHA/ EPA** list of Hazardous Chemicals threshold limit does not cover all Hydrocarbons at an OIL & Gas Industry



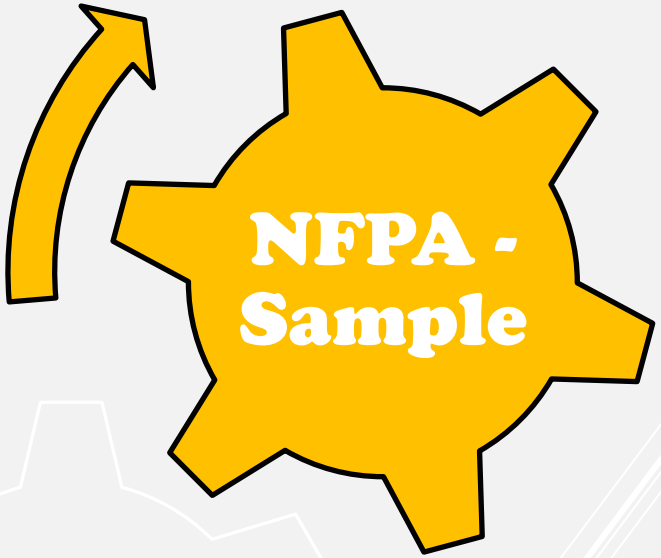
"**High HAZARD PROCESS** is one which involves a flammable gas or liquid with a flashpoint below 100 °F (37.8 °C) in one location, in a quantity of 10,000 pounds (4535.9 kg)or more"

AND

"All processes handling, storing or processing combustible liquids at temperature higher than their flash point, in a quantity of 10,000 pounds (4535.9 kg)or more"



Chemical Name	Flash Point °F	Category
C1-C4	**-156**	**HHP**
Naphtha	**-8**	**HHP**
Gasoline	**-45**	**HHP**
Kerosene	107	Depends on Process Temperature
Jet fuel (A/A-1)	100 - 150	Depends on Process Temperature
Light Gas Oil	176	Depends on Process Temperature
HSD	>130	Depends on Process Temperature
Crude Oil	-	Depends on Process Temperature



Any equipment/ instrument & device falling under NFPA/ OSHA/ EPA threshold quantity

Containment Controls i.e. Relieve devices etc

Shutdown controls i.e. ESD system, alarms etc

Controlled Release Equipment/Systems i.e. Flare header

Safety Monitoring Systems i.e. Detectors

Active Mitigation Systems i.e. Fire protection systems, deluge and sprinklers

Passive Prevention and Mitigation Systems i.e. Dykes, Fire walls

Service/ Utility Systems that help maintain safe operation i.e. UPS, Diesel generators

AREA	MAJOR PROCESSES	HHP	LHO	JUSTIFICATION
Crude Storage Tank (Capacity	Tank	√		**HHP - General Set Rule**
	Tank inlet and outlet lines	√		**Wetted Part of HHP**
	Feed to Plant	√		**HHP based on Threshold Quantity**
All process equipment associated to Crude Tank i.e. Relief devices, Level Indicators, ESD system and secondary containment will be considered Safety critical equipment				

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CCPS

Center for Chemical Process Safety

Coffee Break

engro polymer & chemicals

An AIChE Technology Alliance

CCPS

Center for Chemical Process Safety

Chemical Plant Safety in Japan

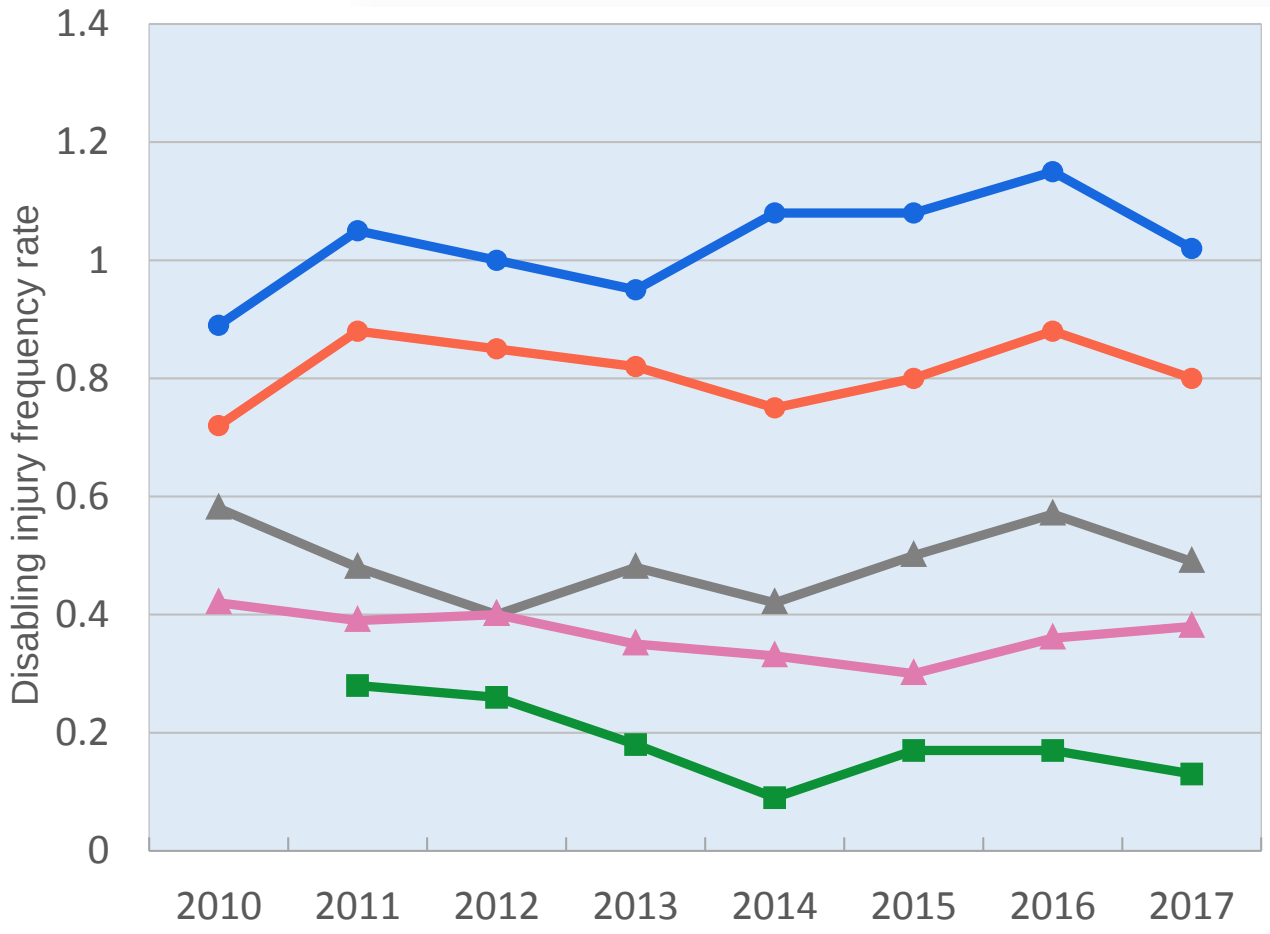
Yoshio Shiga

Mitsubishi Corporation

INSPIRING
PEOPLE
PRESERVING
PLANET

engro polymer & chemicals

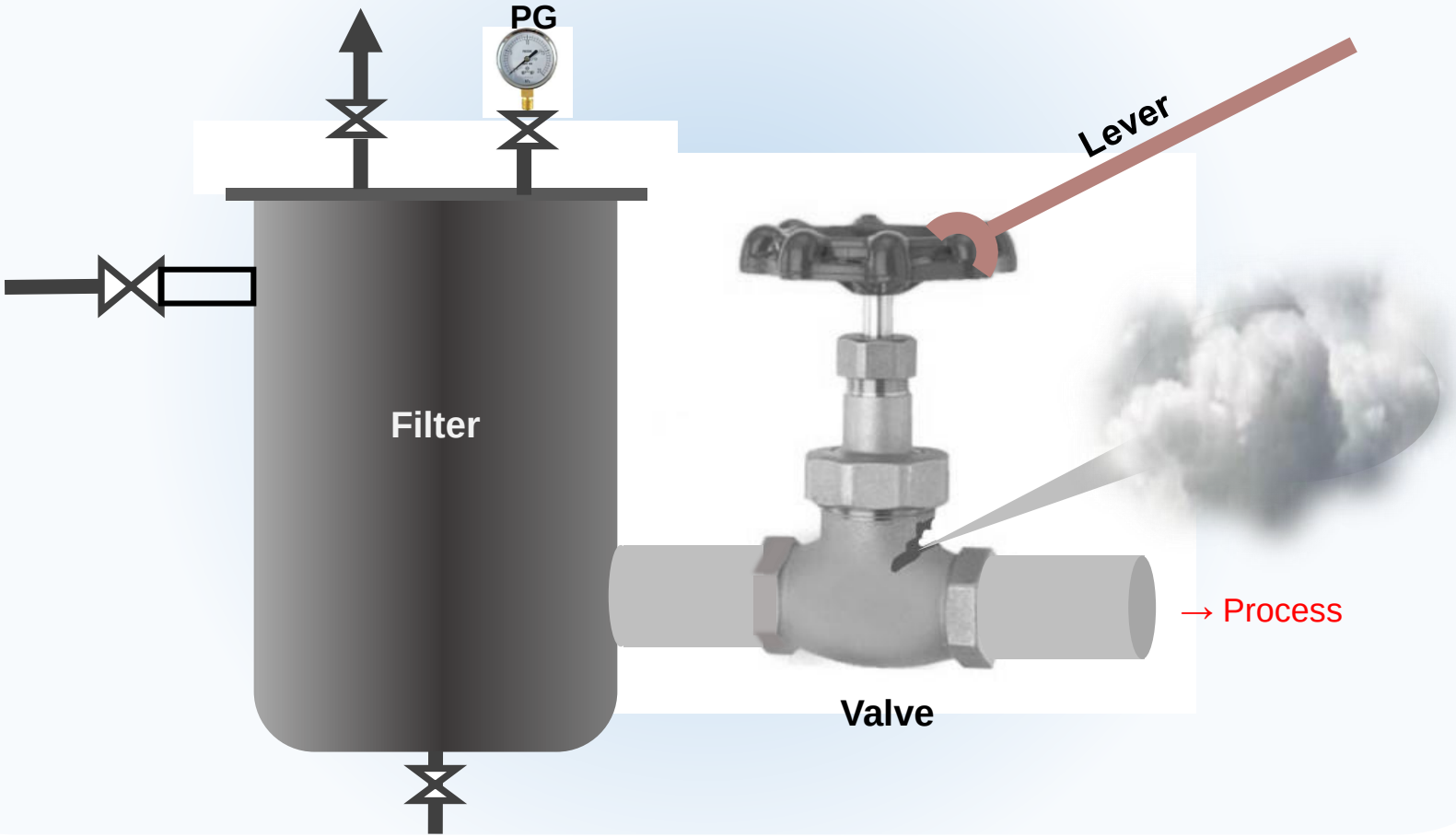
Disabling injury frequency rate in Japan



Disabling injury frequency rate = **Number of Lost work Injury** / **Working hours (a million)**

- manufacturing company
- chemical company
- JCIA contractor
- JCIA member company

Leak from broken value

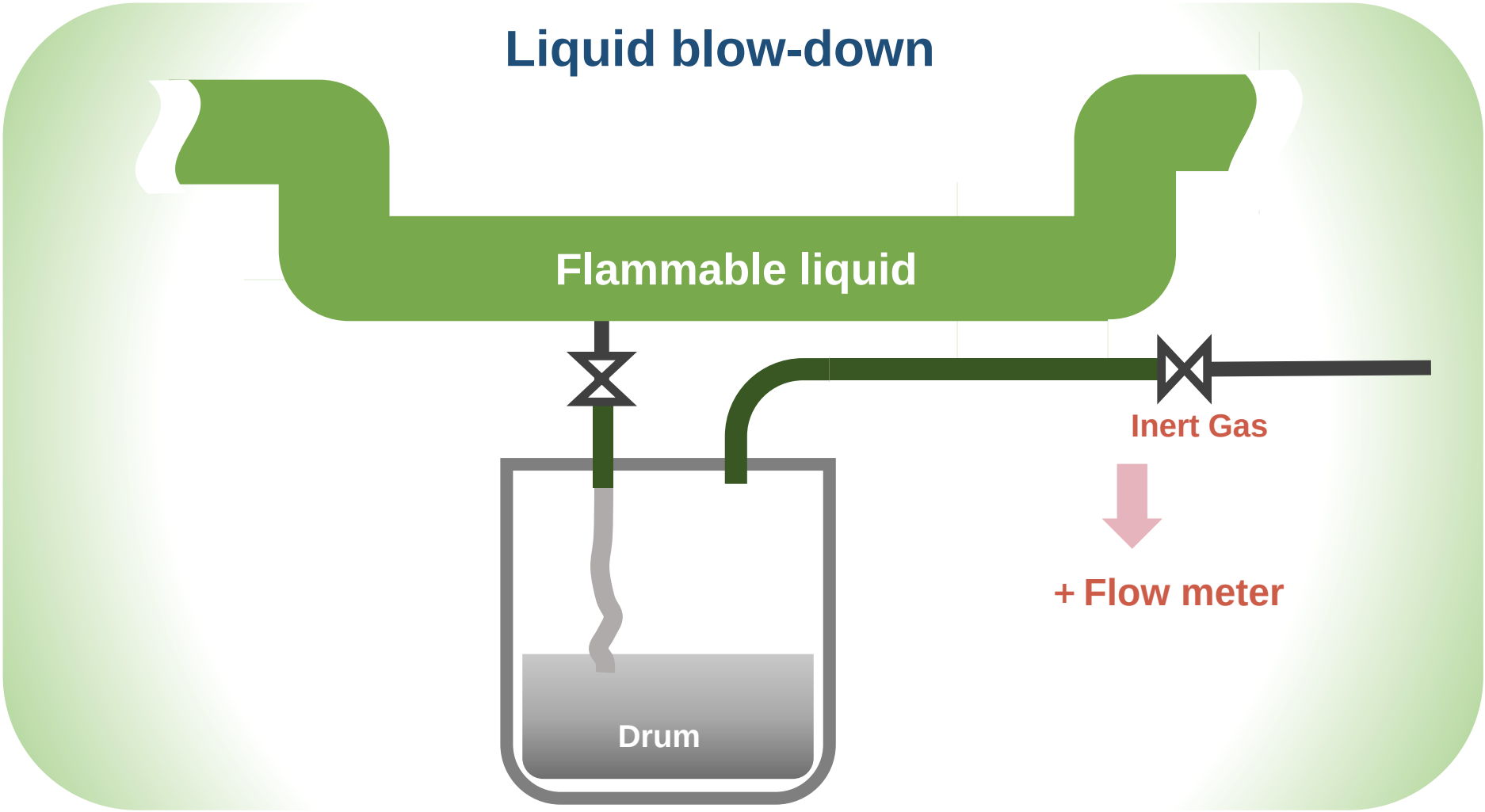


W/O Learning → Dangerous

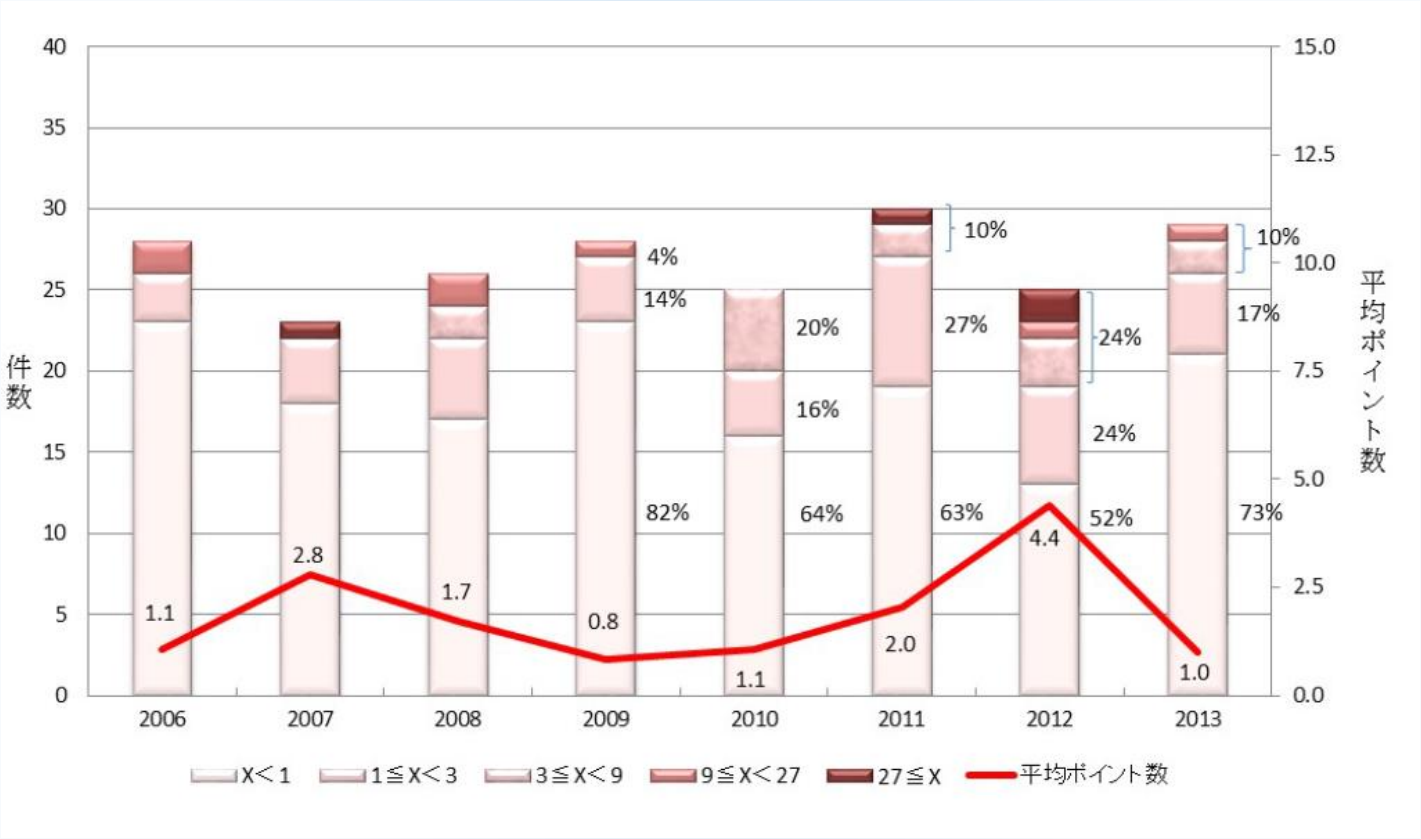
W/O Thinking → Waste

Sharing Experience/Notice/Thinking

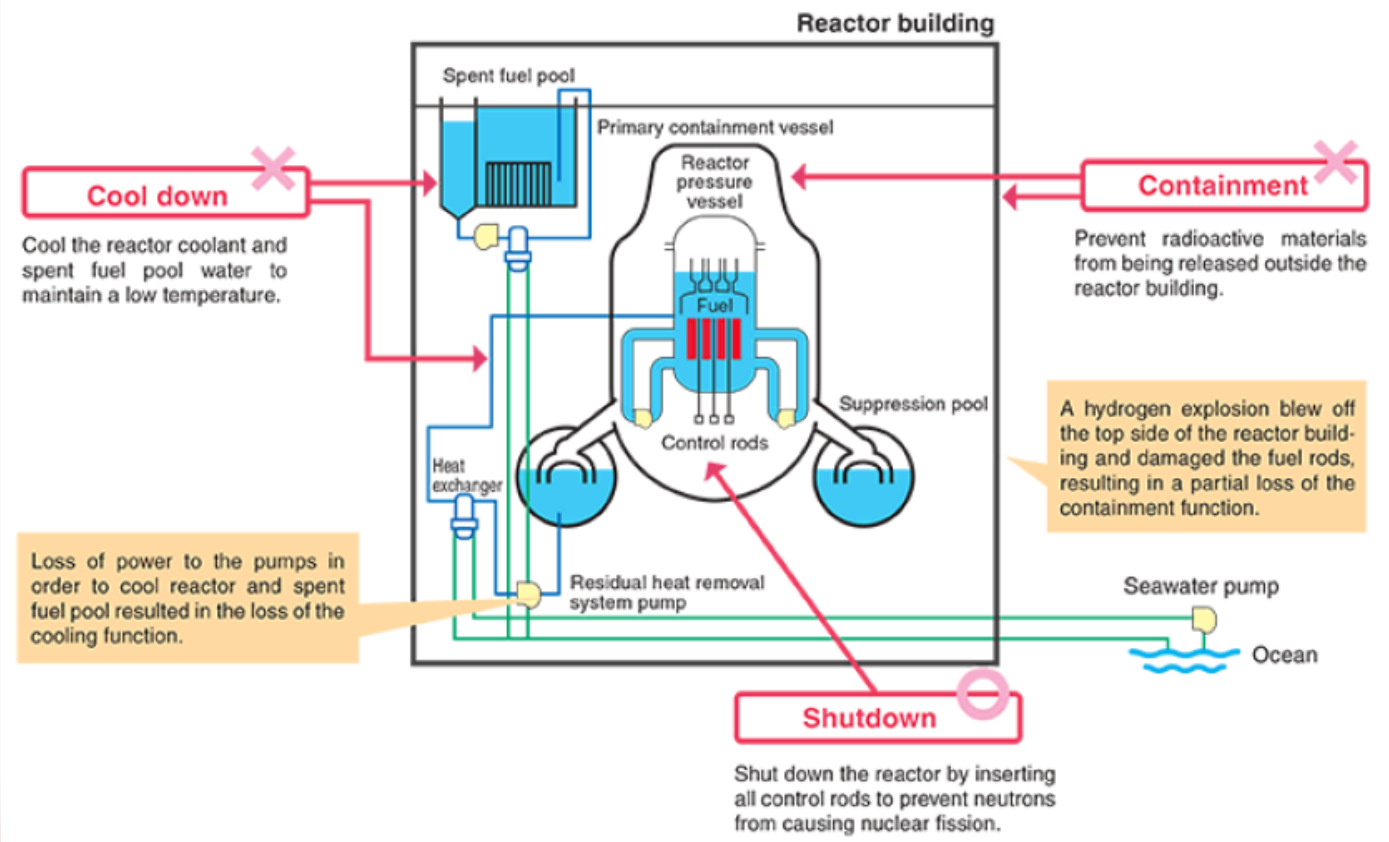
Liquid blow-down



Number of cases by accident scale



Outline of the Accident at the Fukushima Daiichi Nuclear Power Station



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CCPS
Center for Chemical Process Safety

First Time in Pakistan

REGIONAL

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CCPS
Center for Chemical Process Safety

MEETING

engro polymer & chemicals

OSHA Process Safety Management (PSM) Model implementation - Success Story

by

Ahsan Sarfraz

Fatima Group

INSPIRING
PEOPLE
PRESERVING
PLANET

Achieving Excellence in Process Safety Management (PSM)

At Fatima Fertilizer Complex--- "A Success Story"

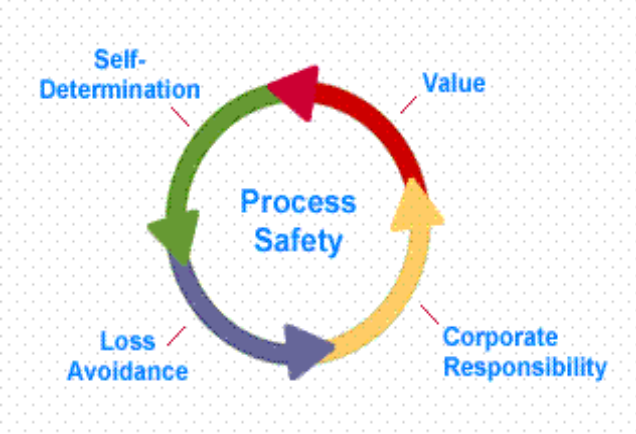
Muhammd Ahsan Sarfraz – HSE Manager

Fatima Fertilizer Company Limited, Pakistan

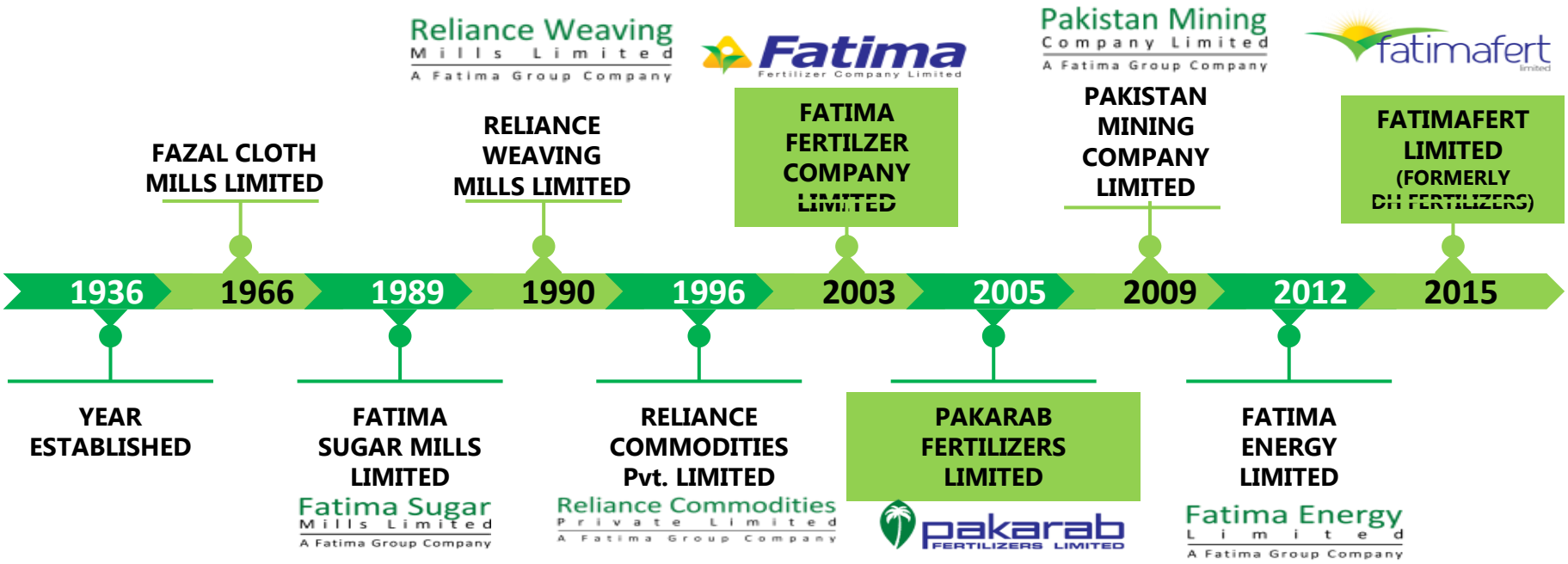
Fatima
Fertilizer Company Limited

Outline

- Fatima Group and Fatima Fertilizer Overview
- Factors Driving PSM In FFCL
- PSM Elements and Rating Scale
- Gap Analysis and Implementation Strategy
- Outcomes and Performance Measures
- Challenges Ahead
- Questions



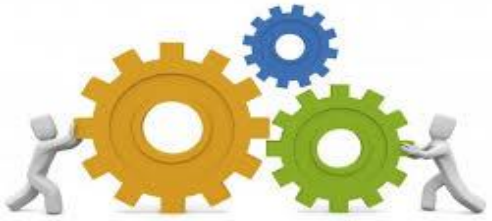
Fatima Group (FG) - A Journey of Success Since 1936



- Annual Turnover : 764 Million USD
- More than 6,300 Permanent Employees

Factors Driving PSM in FFCL

- Fatima Group **HSE Vision** and **Committed Leadership**.
- Recognized **Industry Trend**
- Human, Economic, Environmental **Loss Prevention**
  - **Series of LTI and Operational Upsets in 2012.**
- Company **Reputation and Recognition**
- Purely **Self Initiative** without any Legal Obligation



Benchmark Rating Scale and PSM Model

- **22 elements** PSM Model was implemented **(in house)**
- **DuPont** was selected as an external consultant and facilitator in the process.

1	Fundamental systems in place
2	Awareness of role, systems and expectations
3	Skills & systems fully in place and practiced
4	Excellence in all results
5	World Class Performance

PSM 22 Element Classification- FFL Philosophy

Leadership

1. Management Commitment
2. Policies & Principles
3. Procedures and Perf. Standards
4. Goals, Objectives and Plans

Personnel

13. MoC - Personnel
14. Contractor Safety Management

Organization

5. Integrated Organizat. Structure
6. Line Management Responsib. & Accountability
7. Safety Personnel
8. Motivation & Awareness

Facilities

15. Quality Assurance
16. Pre-start-up Safety Reviews
17. Mechanical Integrity
18. MoC - Facilities

Processes

9. Training & Development
10. Effective Communication
11. Audits & Observations
12. Incident Investigation & Reporting

Technology

19. Process Safety Information
20. MoC – Technology
21. Risk Assessment and PHA
22. Emergency Preparedness

Initial Gap Analysis

- Absence Of **HSE Goals & Objectives** And **Reward / Reprimand** System.
- High Number Of **Injuries, High TRIR** And **Process Fires**.
- High Rate Of **Loss Of Containments And Process Releases**.
- Less Significance And **Importance Of Safe Practices**.
- Inadequate **Contractors Safety Management System**.
- **Weak Emergency Response** And Lack Of Trust Between Site And **Local Community.**
- **Low Employees Morale**.
- HSE Department In **Policing Role**.

Implementation Strategy

In order to transform site safety culture, following strategy was devised.

Deployment of Highly experienced HSE leadership with execution team.

Gap Analysis to assess the Process Safety Culture & Organizational Reliability.

Bench Marking with OSHA PSM standard and Roadmap development.

Adapting **Change Management strategy**; Identifying and involving Change activators (Mngt & Staff) and neutralizing resistors by What is in it for me.

Implementation Strategy

Conversion of PSM literature into crisp/presentable format in local languages.

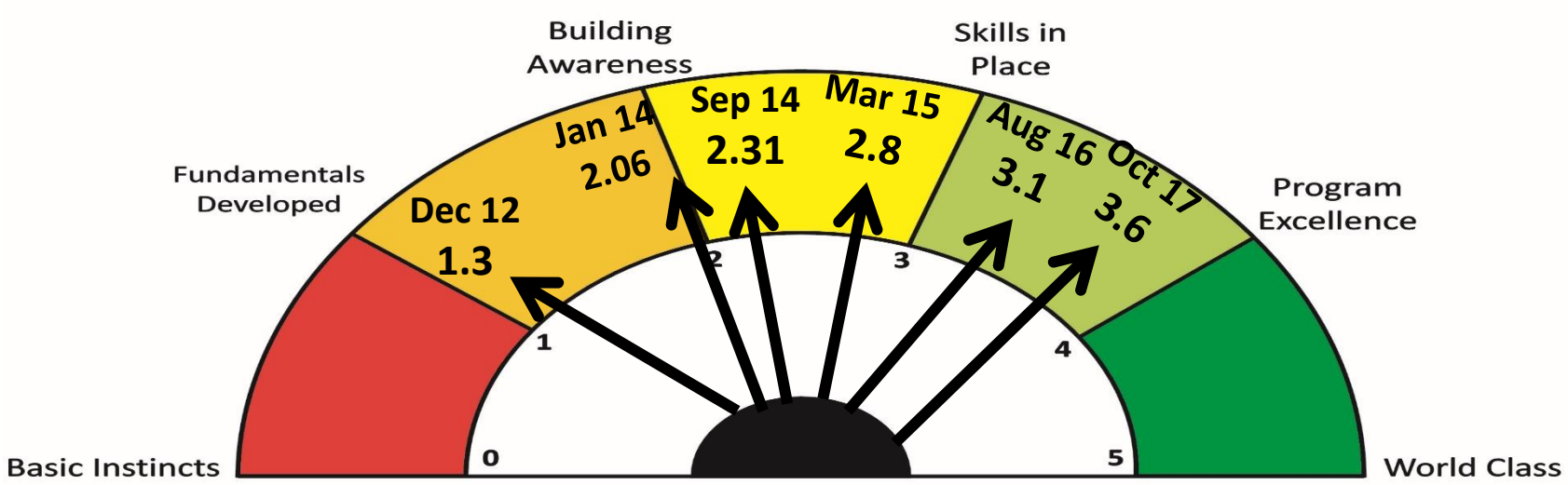
Periodic Campaigns, Quizzes and Competitions to reinvigorate PSM drive.

PSM Validation of all employees and contactors engagement programs.

Inception of extensive in-house PSM Audit Program for progress review

Internal Audits Rating

- 06 extensive internal audits were performed by team to raise the bar during 05 years time.
- Detailed action plan was developed and stewarded as the result of each audit in true spirits.

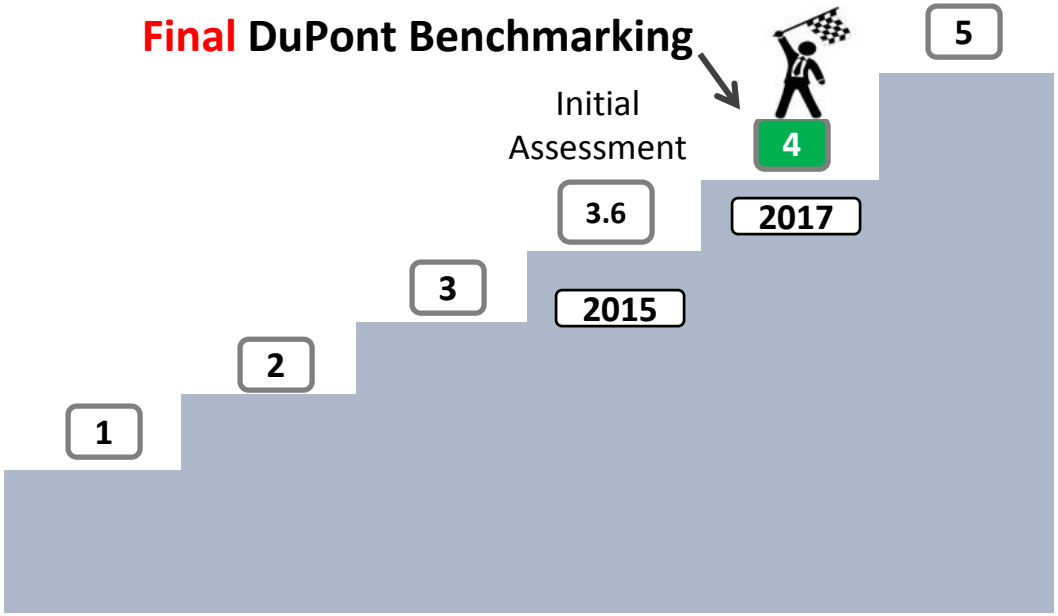


External Audits Rating

- 02 external audits were performed by DuPont.
- FFL Site declared at Excellence level in this **Shortest Time Span of 05 Years.**

5	World Class
4	Excellence
3	Skill
2	Awareness
1	Fundamentals

Five-level scale of PSM Elements by DuPont

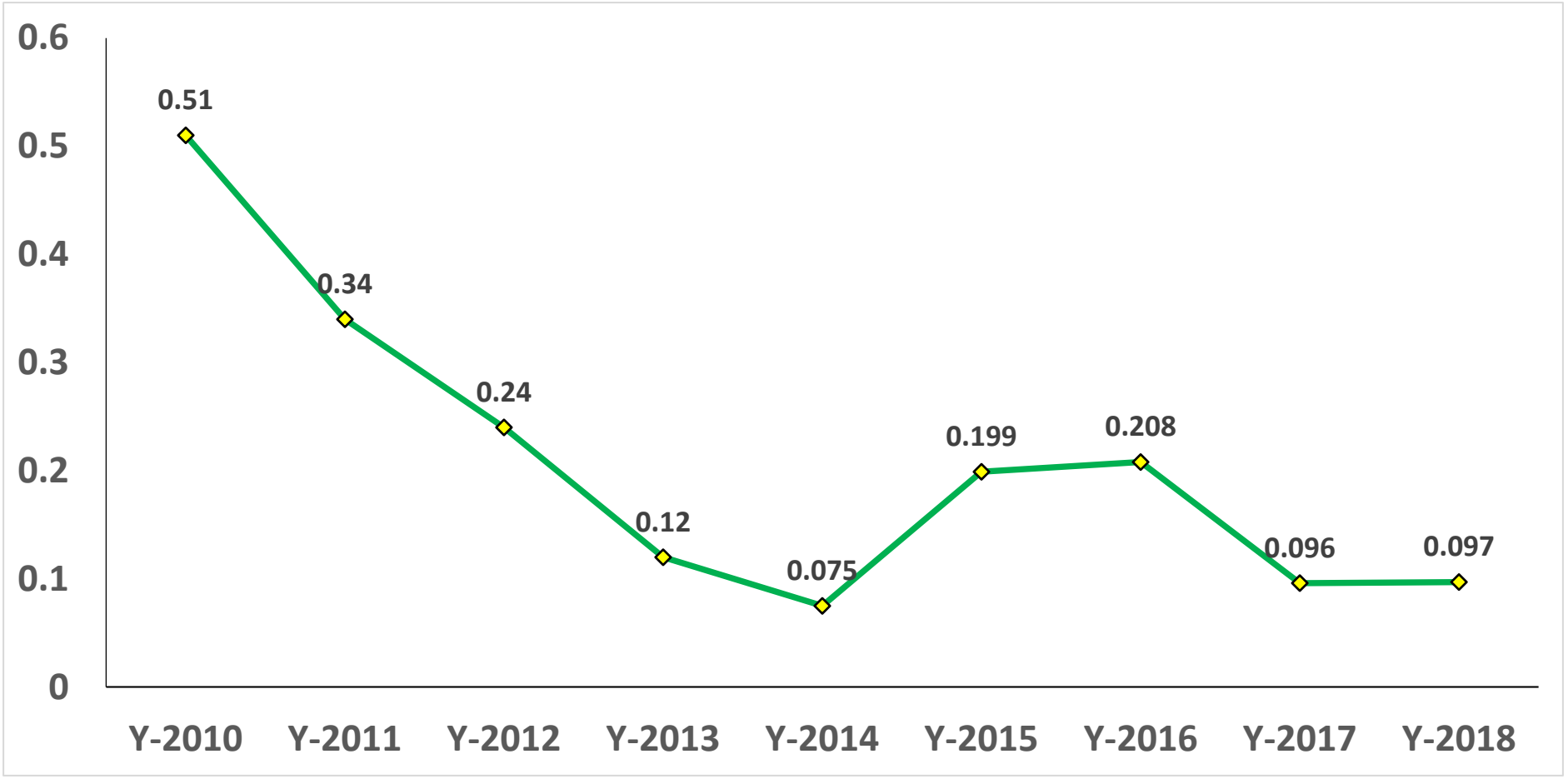


Outcomes / Achievements

FFCL believes that robust PSM implementation equates to enhanced safety, reliability & productivity and same is evident as:

- No Fatality / LTI after implementation.
- Lowest TRIR, above **46.3**million Safe Man-Hours.
- Decreased number of Fires, Process Releases and Injuries
- Improved service and capacity factors of plants.
- High Morale of Employees.
- Improved Emergency Response.
- Reduced risk to nearby communities and Increased reputation & community engagement.

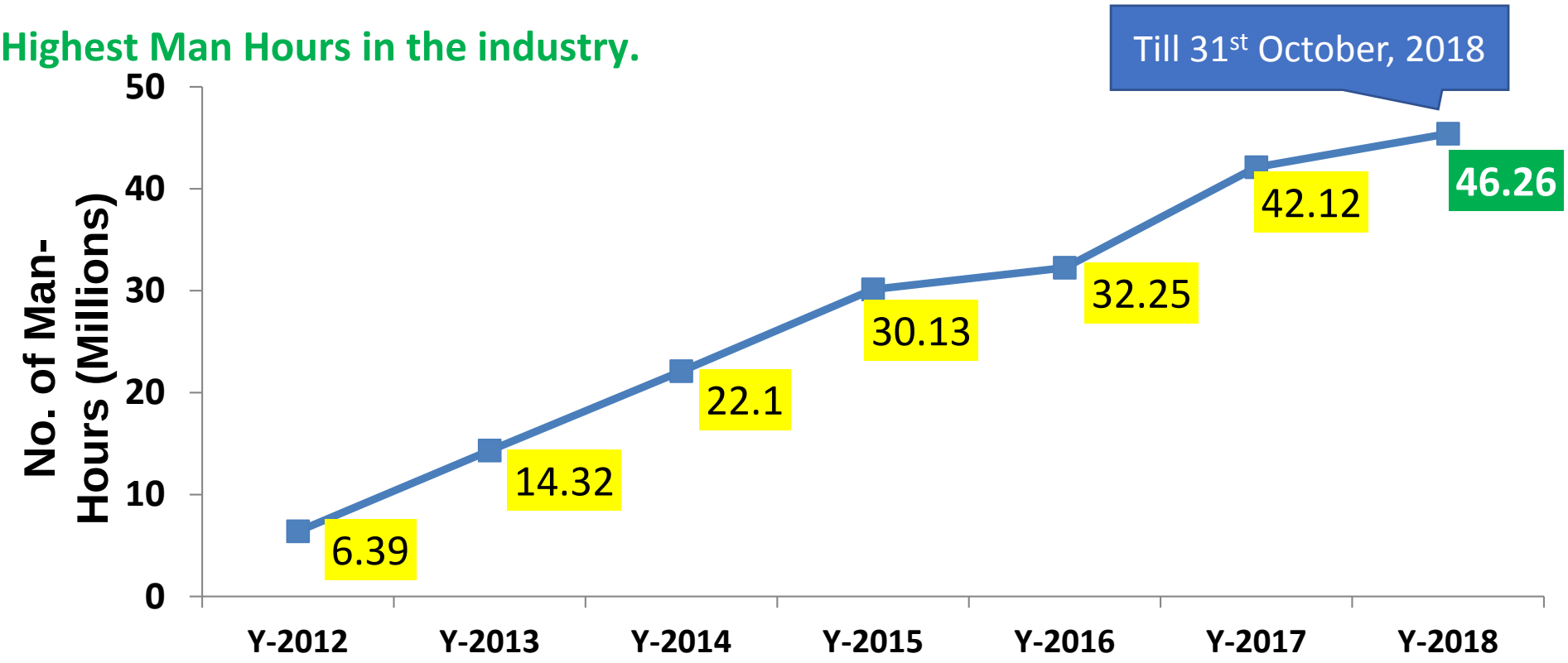
TRIR Trend


0.6
0.5
0.4
0.3
0.2
0.1
0
0.51
0.34
0.24
0.12
0.075
0.199
0.208
0.096
0.097
Y-2010
Y-2011
Y-2012
Y-2013
Y-2014
Y-2015
Y-2016
Y-2017
Y-2018

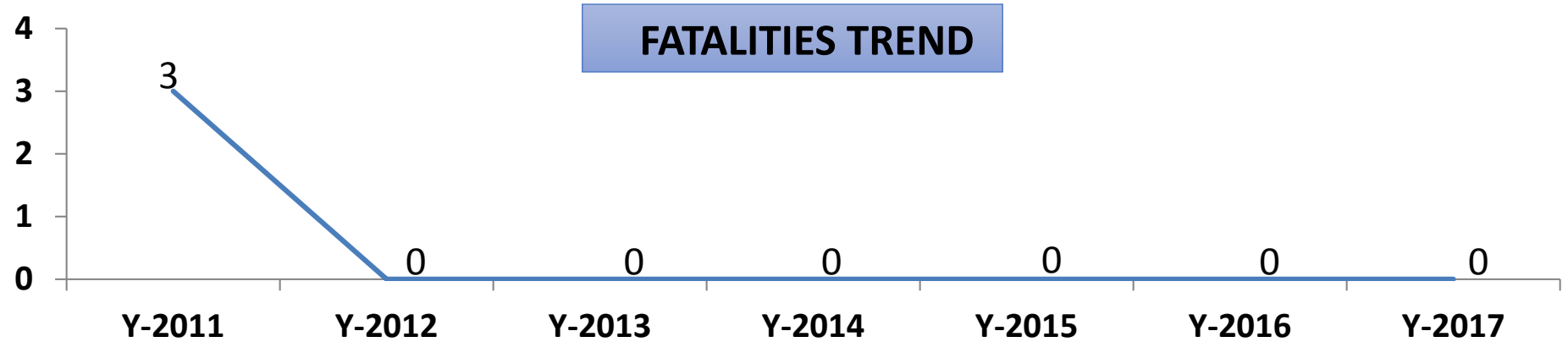
SAFE MILLION MAN-HOURS

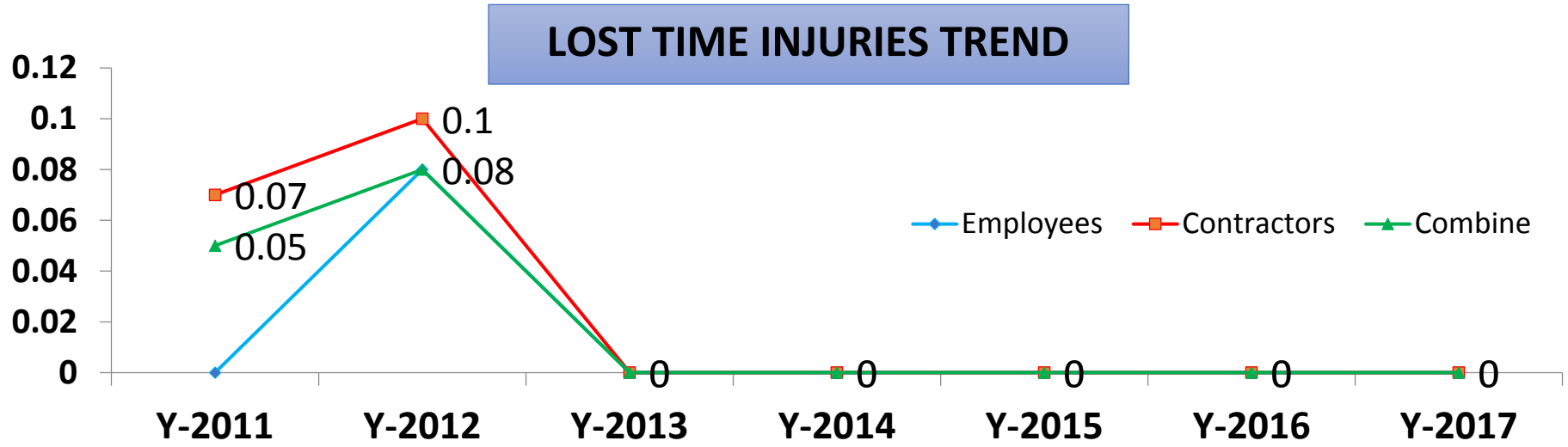
Indication of successful HSE performance. No Recordable injury since June- 2012.

Highest Man Hours in the industry.

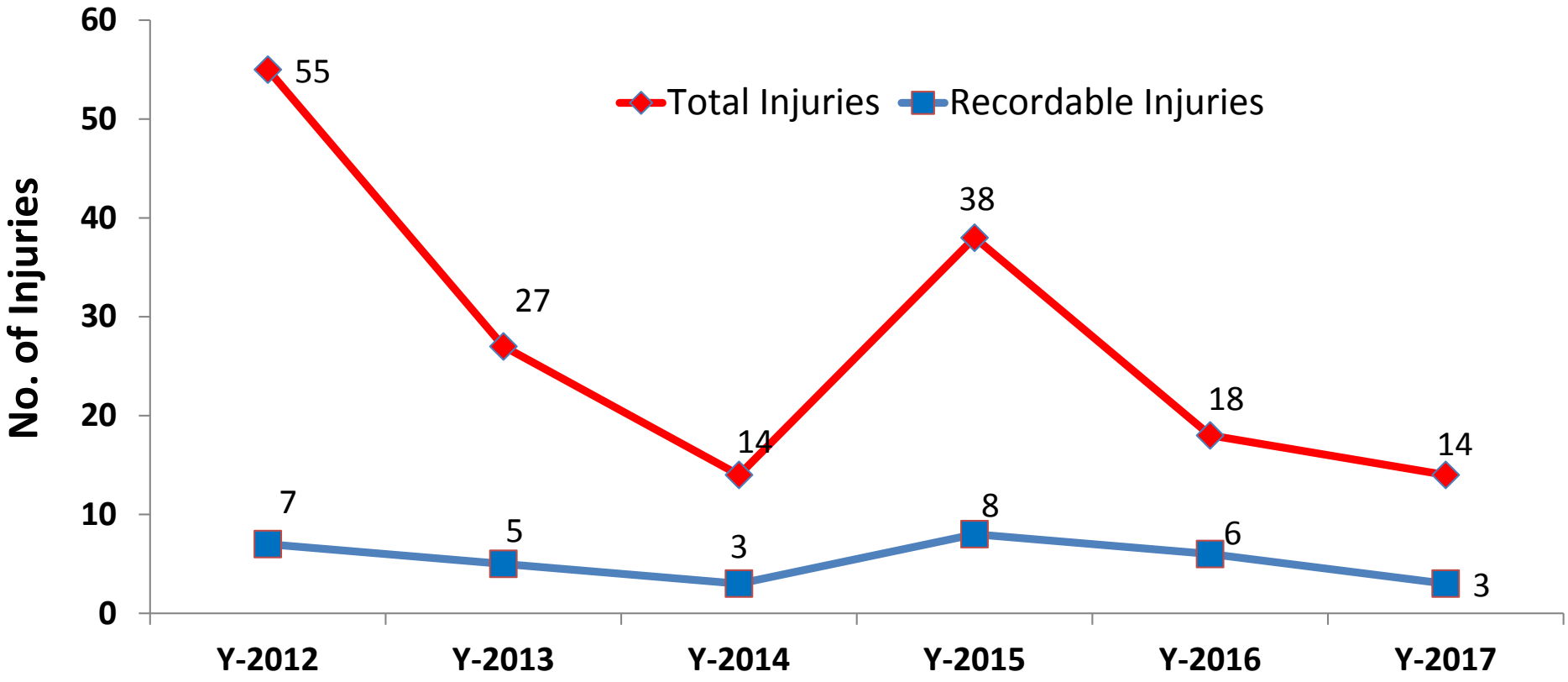


Fatalities & Lost Time Injures





Decreasing Injuries Trend (Company & Contractor Employees)



Challenges Ahead

- Sustainability and Strive for Excellence.
- Inter-dependent Culture.
- Increasing Safe Million Man-Hours and Complacency.
- Contractor Safety Excellence.
- Off The Job Safety Improvement.
- Occupational Health & Industrial Hygiene Program Compliance.
- Environmental Management System Benchmarking.

‘Still A Long Way To Go…’

Thank You !
Questions

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Distributionn of Souvenirs

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Hats off to the EPCL team for putting it together

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Process Safety Metrics – API-754 Implementation

By

Shakeel H. Kadri

Executive Director,

CCPS, AIChE

INSPIRING

PEOPLE

PRESERVING

PLANET

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Center for Chemical Process Safety

Leadership message on Process Safety Metrics

Shakeel Kadri

Executive Director, CCPS

22 November 2018

Presentation at the 1st Pakistan CCPS Regional Meeting

The Global Community Committed to Process Safety

CCPS Workshop

"Process Safety Metrics: API-RP-754 Implementation"

Workshop facilitator:

Shakeel Kadri

October 10th 2018 (0800 Hrs. to 1500 Hrs)

Le Méridien Al Khobar, Saudi Arabia

The Host and sponsor for this CCPS workshop is Saudi Aramco, with support from other CCPS member companies

The Global Community Committed to Process Safety

Agenda

7:30 – 7:45	**Introduction / Workshop opening thoughts**
7:45 to 10:00	**Overview – Process Safety Metrics**
	Process Safety Metrics Journey [CCPS]
	Why API RP-754? **API RP-754 Key Concepts**
	API RP 754 – Lagging and Leading Indicators • **Tier 1 Process Safety Events**
10:00-10:15	Tea/Coffee break
10:15 to 11:30	**API RP 754 – Lagging and Leading Indicators** • **Tier 2 Severity System**
	Tier 1 and Tier 2 Data Capture and Data Analysis
	CCPS Incident Evaluation App
	API RP-754 Tier 3 Indicators, data capture / analysis **API RP-754 Tier 4 Indicators, data capture / analysis**
11:30-12:30	Lunch break
12:30 to 15:00	**Metrics sharing from Regional companies** • **Saudi Aramco** • **SABIC** • **Saudi Chevron Phillips** • **Air Products**
	Process Safety Leading Indicators Benchmarking Project [CCPS]
	Metrics driven improvement initiatives
	Communicating Process Safety Metrics

Workshop Objectives

Attendees who complete this workshop will be able to:

- Understand their status relative to the history of Process Safety performance measurement
- Alignment of CCPS and API-754 Metrics
- Competently use API RP 754: Process Safety Performance Indicators for the Refining and Petrochemical Industries – 2nd edition
- Use the CCPS Process Safety Event Evaluation App
- Establish Tier 1 – 3 event data collection requirements
- Select effective leading indicators (Tiers 3 & 4)

THIS IS A WORKSHOP – IT SHOULD BE A DIALOG

Workshop Objectives [cont'd]

- Perform basic data analyses for Tier 1 – 4 indicators
- Test individual Tiers 3 & 4 indicators for their "leading value"
- Identify promising areas for improvement initiatives
- View examples of improvement initiatives developed by industry leaders
- Effectively communicate Process Safety indicator results
- Understand and overcome barriers to indicator program implementation
- Provide ample opportunities to address particpants questions and perform benchmarking

THIS IS A WORKSHOP – IT SHOULD BE A DIALOG

Safety Metrics History

The key process safety objective is to identify failures, gaps or conditions and to correct them before they contribute to a major process safety incident.

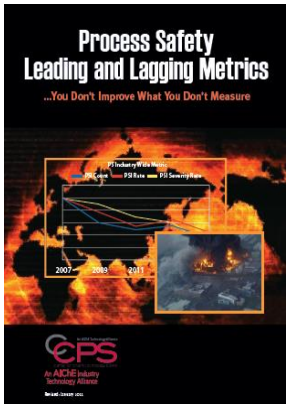
What Gets Measured Gets Done.

And What Gets Done, Gets **IMPROVED**!

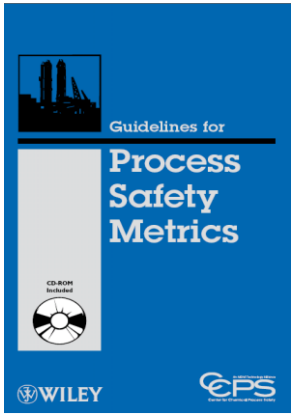
CCPS Process Safety Metrics Deliverables [2007-2008]

"You Don't Improve What You Don't Measure"

- Common Industry-Wide Lagging Metric
- Near-Miss or Other Lagging Metrics
- Leading Metrics
- Pamphlet with Recommendations in these three areas COMPLETED December 2007!



Process Safety Metrics Guideline Book Completed

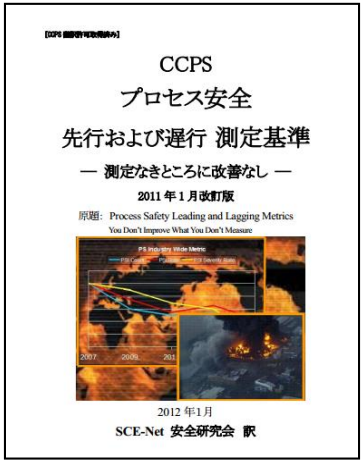


If you are not managing process safety well, you are probably not managing other things well.

Available in Multiple Languages

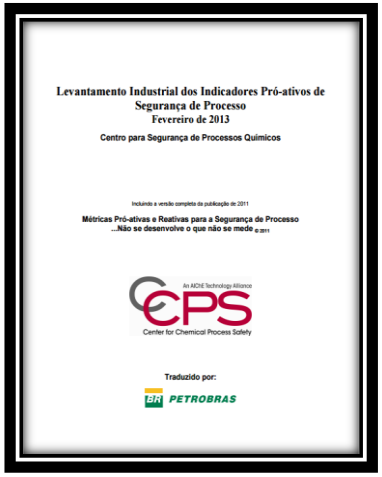
Spanish

http://www.aiche.org/sites/default/files/docs/pages/metrics%20spanish%20updated.pdf



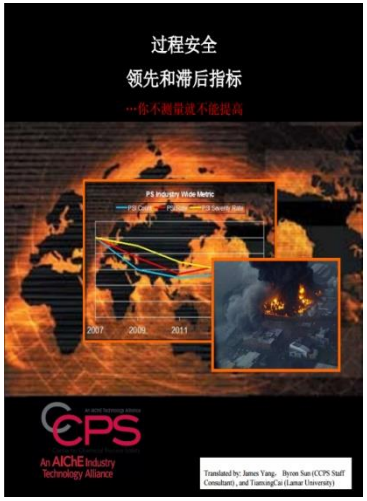
Japanese

http://www.aiche.org/sites/default/files/docs/pages/CCPS_ProcessSafety_Lagging_Japanese_2011_2-24.pdf



Portuguese

http://www.aiche.org/sites/default/files/docs/pages/project_233_leading_indicator_white_paper-_edited_-_2-21-13_r1_portugues.pdf



Chinese

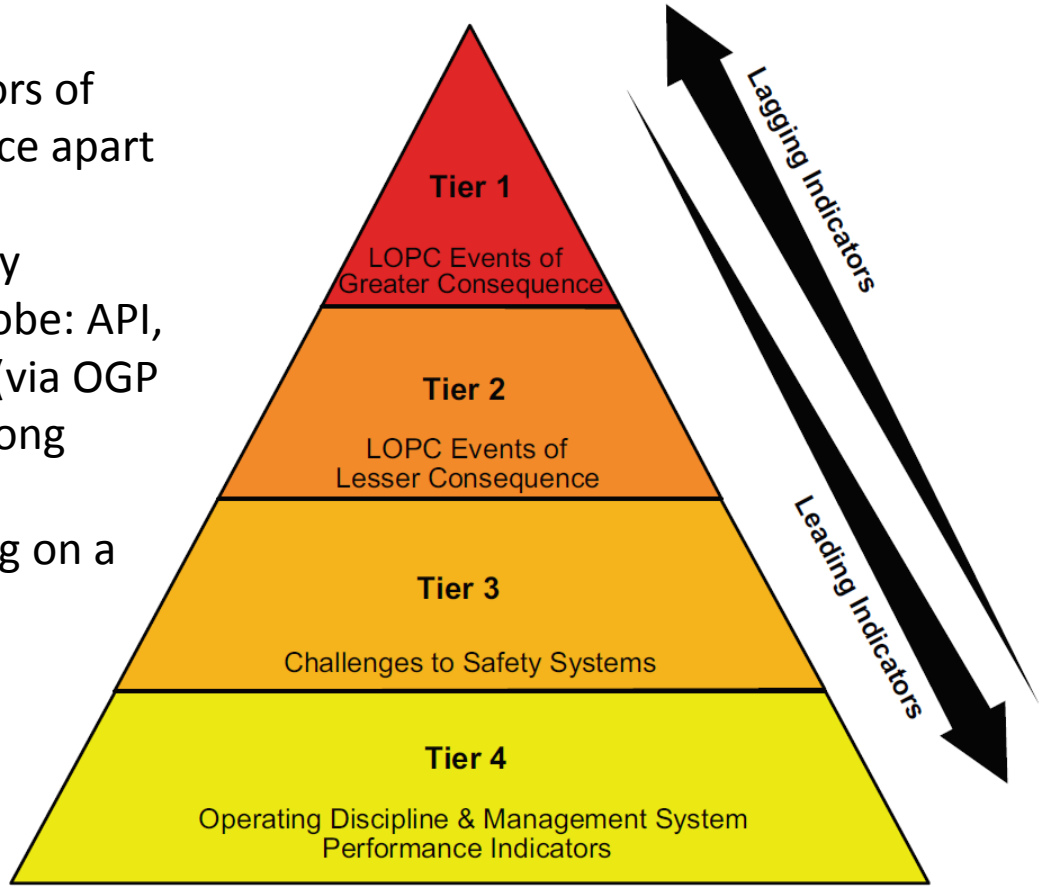
http://www.aiche.org/sites/default/files/docs/pages/PSMetricsSimplifiedChinesev5.pdf

Industry Call to Action

- Baker Panel Report : **RECOMMENDATION #7 – LEADING AND LAGGING PERFORMANCE INDICATORS FOR PROCESS SAFETY**
  - BP should develop, implement, maintain, and periodically update an integrated set of leading and lagging performance indicators for more effectively monitoring the process safety performance of the U.S. refineries by BP's refining line management, executive management (including the Group Chief Executive), and Board of Directors. In addition, BP should work with the U.S. Chemical Safety and Hazard Investigation Board and with industry, labor organizations, other governmental agencies, and other organizations to develop a consensus set of leading and lagging indicators for process safety performance for use in the refining and chemical processing industries.
- CSB Report: **13.0 RECOMMENDATIONS -** {American Petroleum Institute (API) and United Steelworkers International Union (USW).}
  - a. …create performance indicators for process safety in the refinery and petrochemical industries. Ensure that the standard identifies leading and lagging indicators for nationwide public reporting as well as indicators for use at individual facilities. Include methods for the development and use of the performance indicators.
  - b …..In the development of each standard, ensure that the committees include representation of diverse sectors such as industry, labor, government, public interest and environmental organizations and experts from relevant scientific organizations and disciplines.

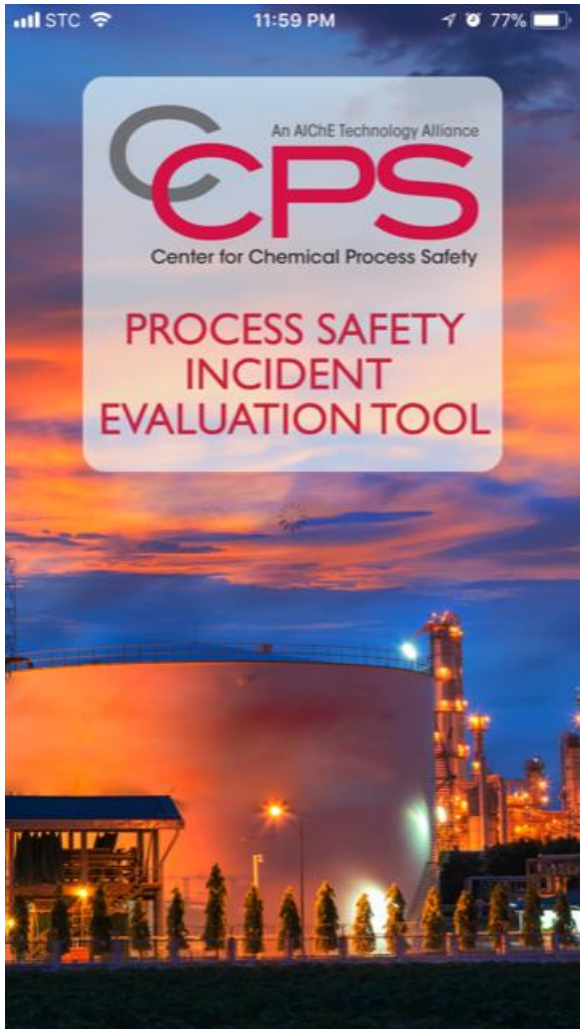
API RP 754 – *Process Safety Indicators for the Refining and Petrochemical Industries*

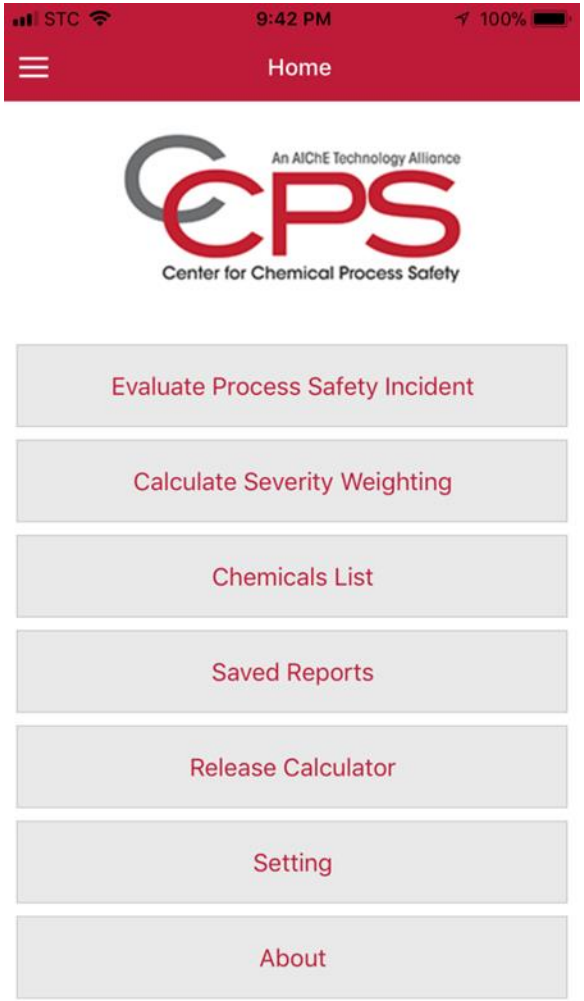
- Proven successful indicators of Process Safety performance apart from Personnel Safety
- Adopted by major industry associations across the globe: API, AFPM, ACC, UKPIA, IOGP (via OGP 456), IPIECA and ICCA among others
- Provides for benchmarking on a consistent basis

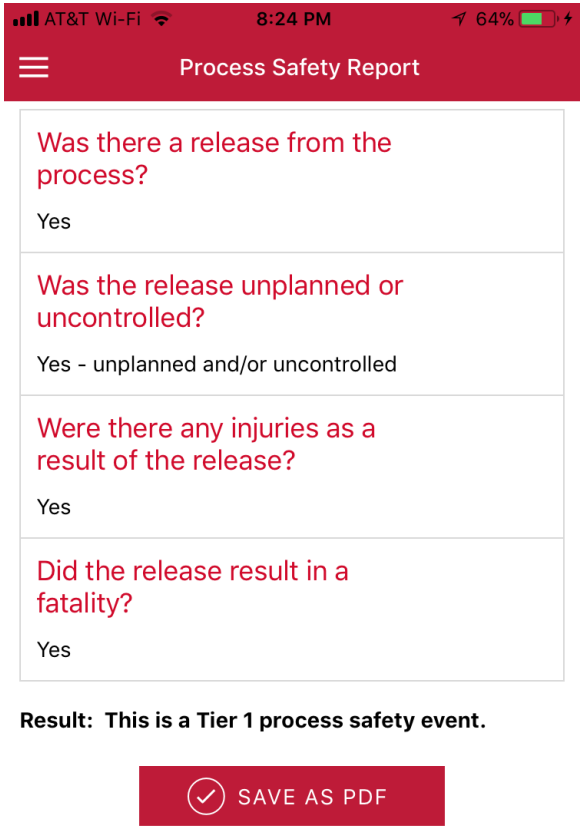


Workshop attendees develop competence in application of RP 754

CCPS Incident Evaluation Tool / APP







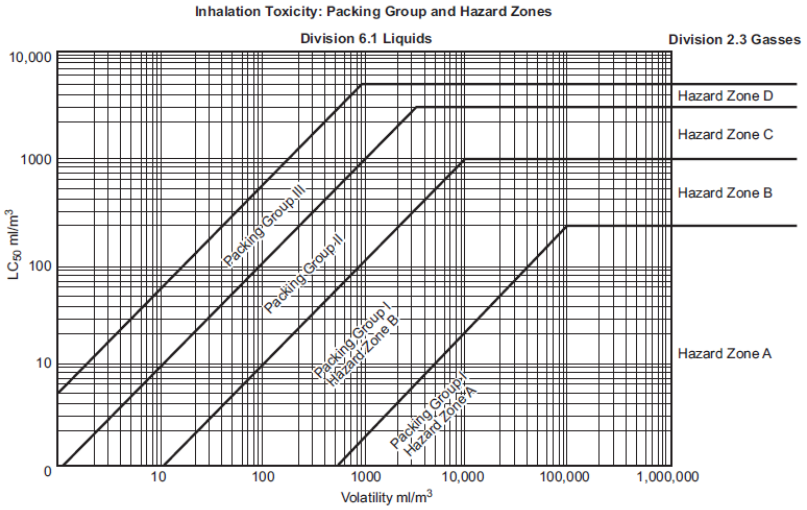
"The Global Community Committed to Process Safety"

Tier 1 Process Safety Events

Tier 1 Threshold quantities, toxics

Threshold Release Category	Material Hazard Classification	Typical Materials	Outdoor Threshold	Indoor Threshold
T1-1	TIH Zone A	MIC, Phosgene, Florine, HCN	≥ 5 kg (11 lb)	≥ 0.5 kg (1.1 lb)
T1-2	TIH Zone B	H_2S, Cl_2, SO_3, BF_3	≥ 25 kg (55 lb)	≥ 2.5 kg (5.5 lb)
T1-3	TIH Zone C	HF, HCl, SO_2	≥ 100 kg (220 lb)	≥ 10 kg (22 lb)
T1-4	TIH Zone D	NH_3, CO, Ethylene Oxide	≥ 200 kg (440 lb)	≥ 20 kg (44 lb)

Hazard Zone	Inhalation Toxicity
A	LC_{50} less than or equal to 200 ppm
B	LC_{50} greater than 200 ppm and less than or equal to 1000 ppm
C	LC_{50} greater than 1000 ppm and less than or equal to 3000 ppm
D	LC_{50} greater than 3000 ppm or less than or equal to 5000 ppm



The table above and graph to the right (Appendix F) define toxicity zones for gases and liquids.

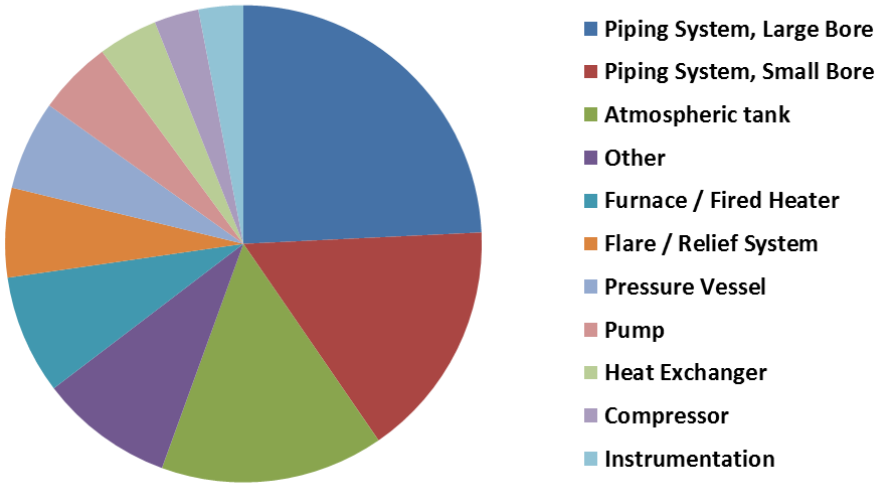
RP 754 – Tier 1 PSE Severity Weighting

Severity Points	Consequence Categories				
	Safety / Human Health[c]	Direct Cost from Fire or Explosion	Material Release within any 1-Hour Period[a]	Community Impact	Offsite Environmental Impact[b]
1	Injury requiring treatment beyond first aid to any worker. (Meets the definition of a US OSHA recordable injury)	Results in $100,000 to <$1,000,000 Direct Cost Damage	Release volume is 1x to < 3x Tier 1 TQ outside secondary containment	Officially declared shelter-in-place, evacuation, or other public protective measures (road closure) that last ≤ 3 hours	Results in $100,000 to < $1,000,000 Acute Environmental Cost
3	Days Away From Work injury to any worker or injury requiring treatment beyond first aid to a third party	Results in $1,000,000 to <$10,000,000 Direct Cost Damage	Release volume is 3x to < 9x Tier 1 TQ outside secondary containment	Officially declared shelter-in-place, evacuation, or other public protective measures (road closure) that last > 3 hours but ≤ 24 hours	Results in $1,000,000 to < $10,000,000 Acute Environmental Cost, or Small-scale injury or death of aquatic or land-based wildlife
9	A fatality to a worker or A hospital admission of a third party	Results in $10,000,000 to <$100,000,000 Direct Cost Damage	Release volume is 9x to < 27x Tier 1 TQ outside secondary containment	Officially declared evacuation > 24 hours but ≤ 48 hours	Results in $10,000,000 to < $100,000,000 Acute Environmental Cost, or Medium-scale injury or death of aquatic or land-based wildlife
27	Multiple worker fatalities or multiple hospital admissions of third parties or a fatality to a third party	Results in ≥ $100,000,000 Direct Cost Damage	Release volume exceeds 27x Tier 1 TQ outside secondary containment	Officially declared evacuation exceeding 48 hours	Acute Environmental Cost equals or exceeds $100,000,000, or Large-scale injury or death of aquatic or land-based wildlife

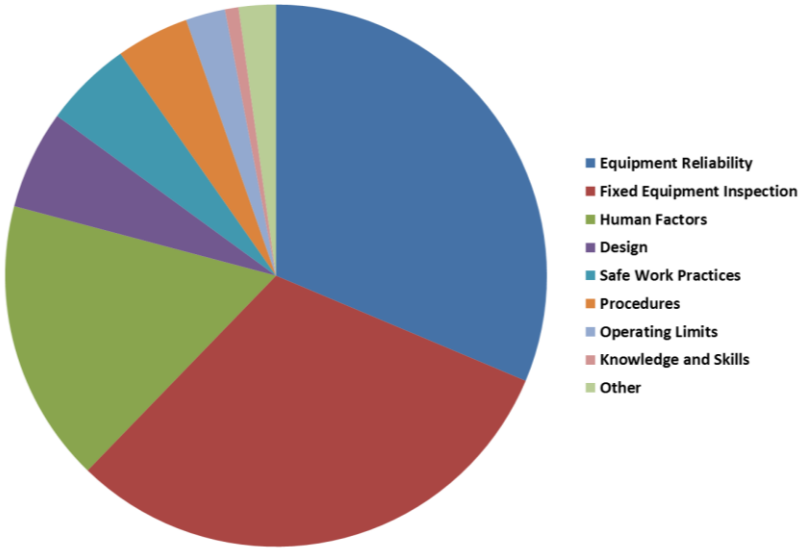
Increasing Severity

Tier 1&2 PSE Data Analysis

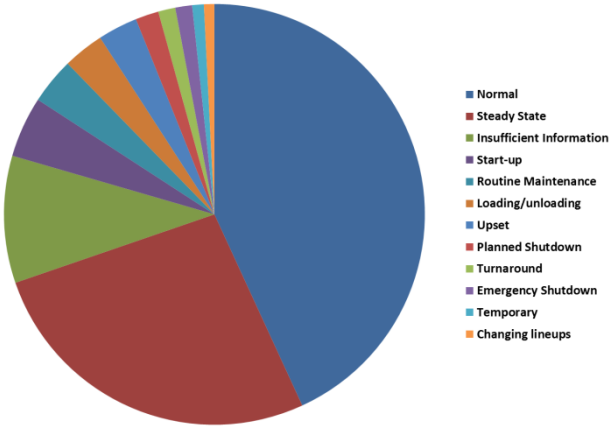
Company Point of Release for Tier 1 & 2 PSEs



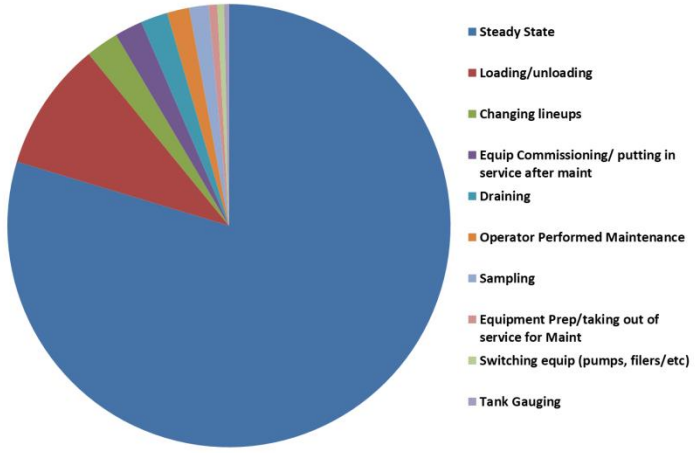
T 1 & 2 Causal Factors



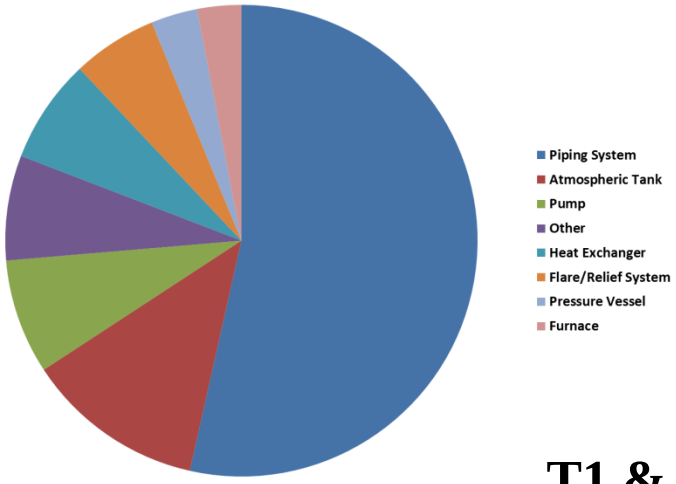
Company T1&2 by Mode of Operation

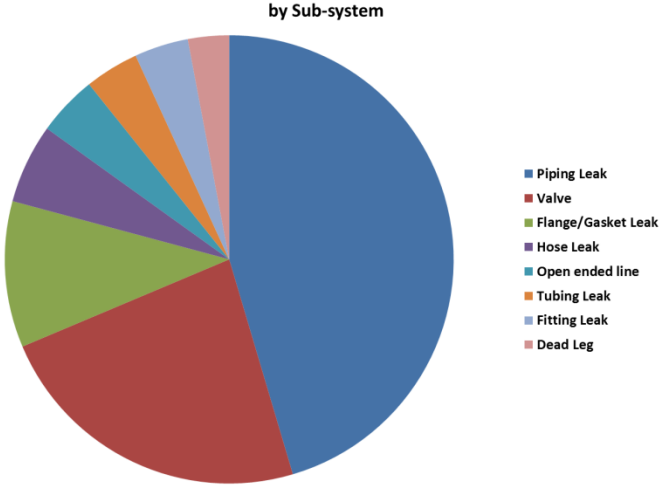


Mode of Operation in Steady State

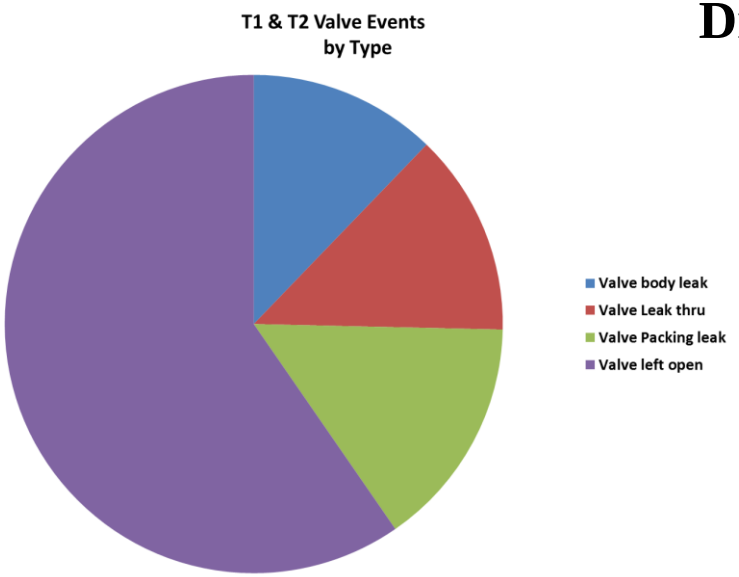


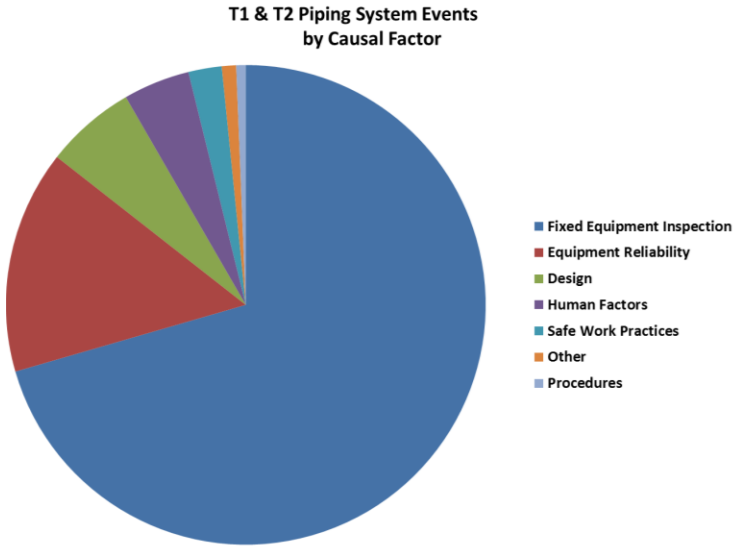
Tier 1&2 PSE Data Analysis





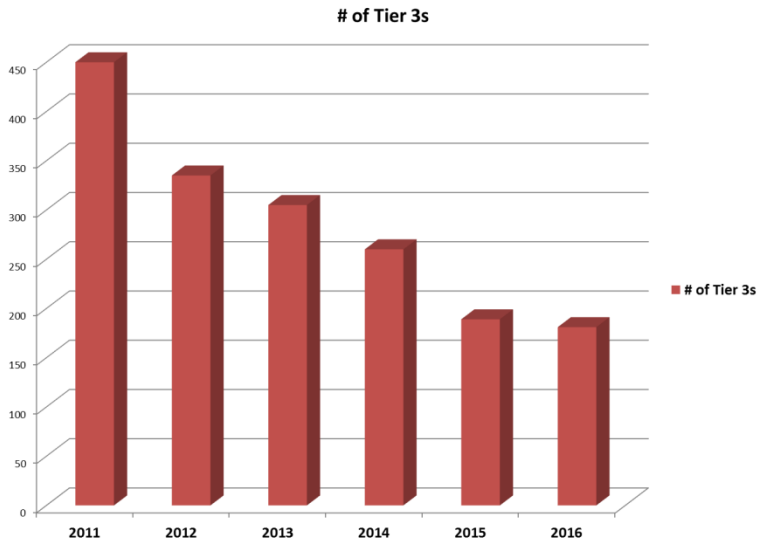
T1 & T2 Data Drilldown

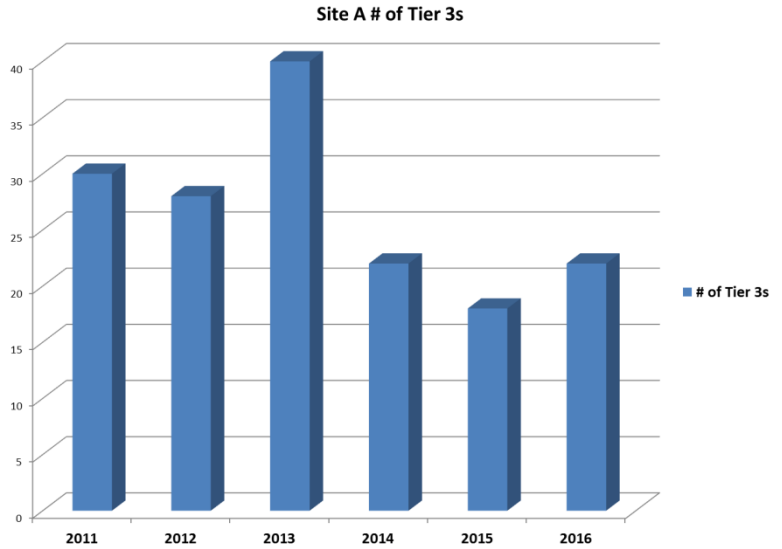


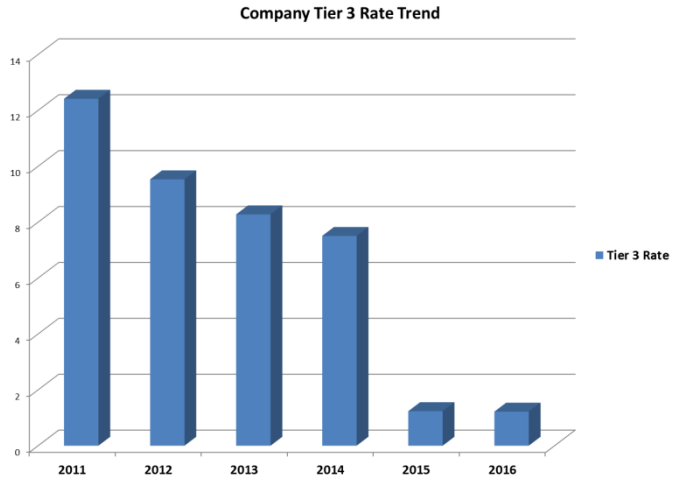


Tier 3 PSE Data Analysis

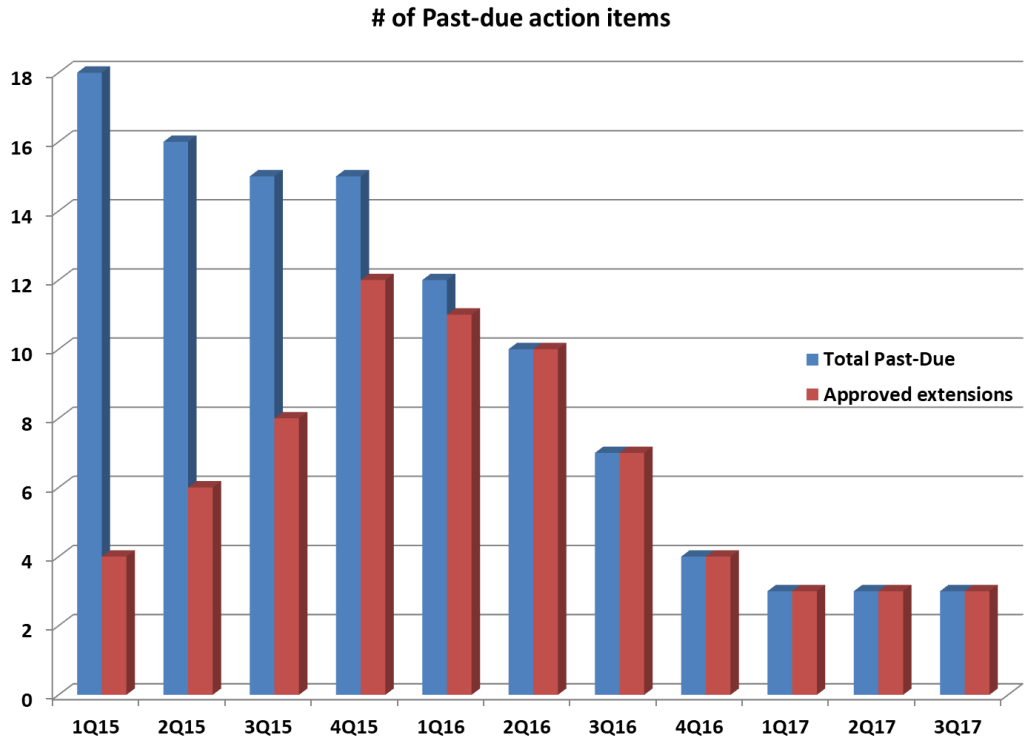
Tier 3 at the company and site levels







Tier 4 PSE Data Analysis



Risk Level	# Open Prior Quarter	# New This Quarter	# Closed This Quarter	# Open End of Quarter	# Open > 2 Yrs.	# Open > 3 Yrs.
Higher	3	0	0	3	3	3
Medium	0	0	0	0	0	0
Lower	0	0	0	0	0	0

Process Safety Leading Indicator Metrics

Industry Survey on Leading Metrics

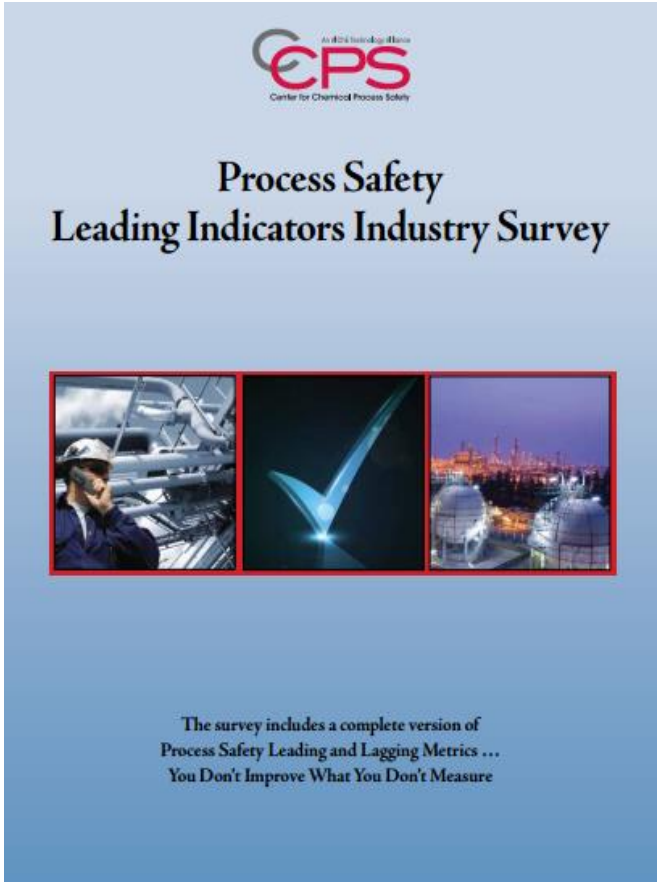
A CCPS Project

An AIChE Technology Alliance

CCPS

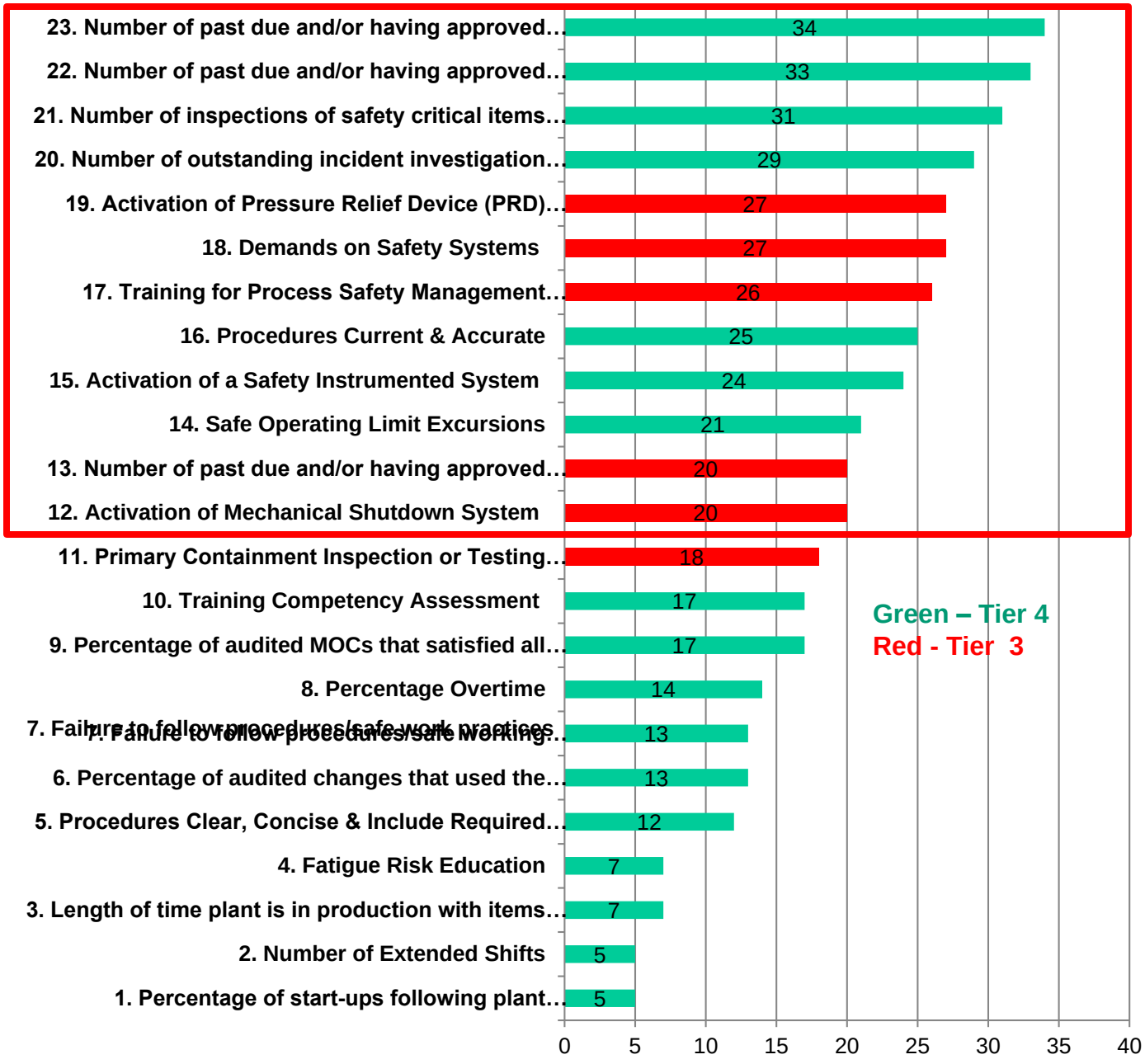
Center for Chemical Process Safety

Free Publication



Published in 2013 - Available for download at:
http://www.aiche.org/sites/default/files/docs/pages/leading-indicator-survey_0.pdf

of Companies using a Specific Indicator



All 25 leading indicators were used by one or more of the responding 43 companies.

12 or more leading indicators were used by 20 or more of the 43 companies, (45%)

The red box on the chart highlights the 12 leading indicators used by the 20 or more companies

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Barriers to Implementing Process Safety Indicator Programs

Management's visible responses to problems identified by the metrics are as important – if not more important– than the metrics themselves.

Barriers to Implementation

- Senior Management Commitment/support is essential for the implementation and sustainability of a successful metrics program.
- There can be differences in understanding metrics definitions across the company, e.g., different geographies, acquisitions
- Resources are needed in order to report metrics in a timely manner.
  - Maintaining trained resources who understood the definitions and how to extract the data from the computer tracking system presented a challenge due to transfers, turnovers and retirements.

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Communicating Process Safety Indicators

Best Practices in Reporting Process Safety Indicators

Communicating process safety results is a critical element for a process safety improvement strategy.

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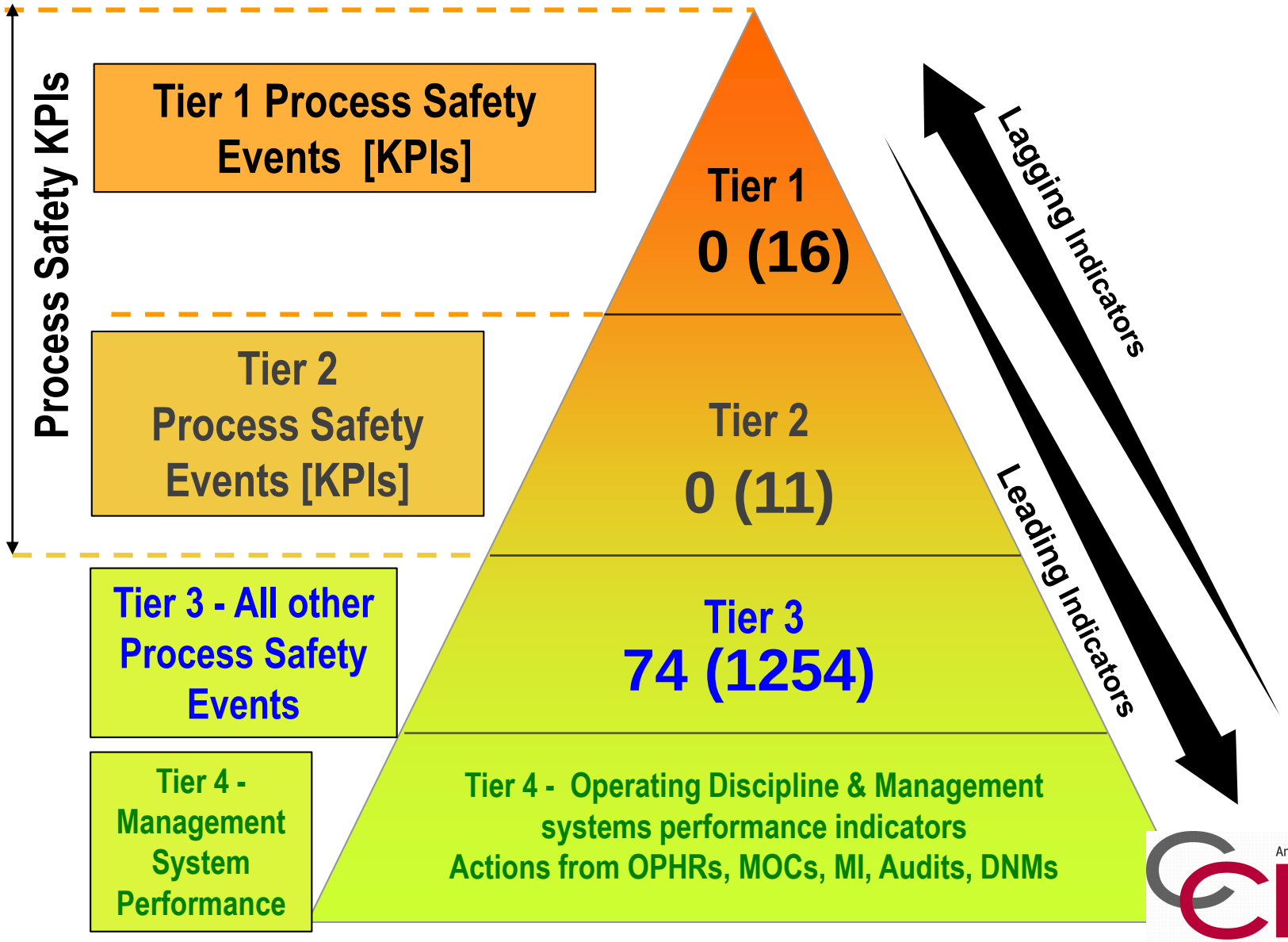
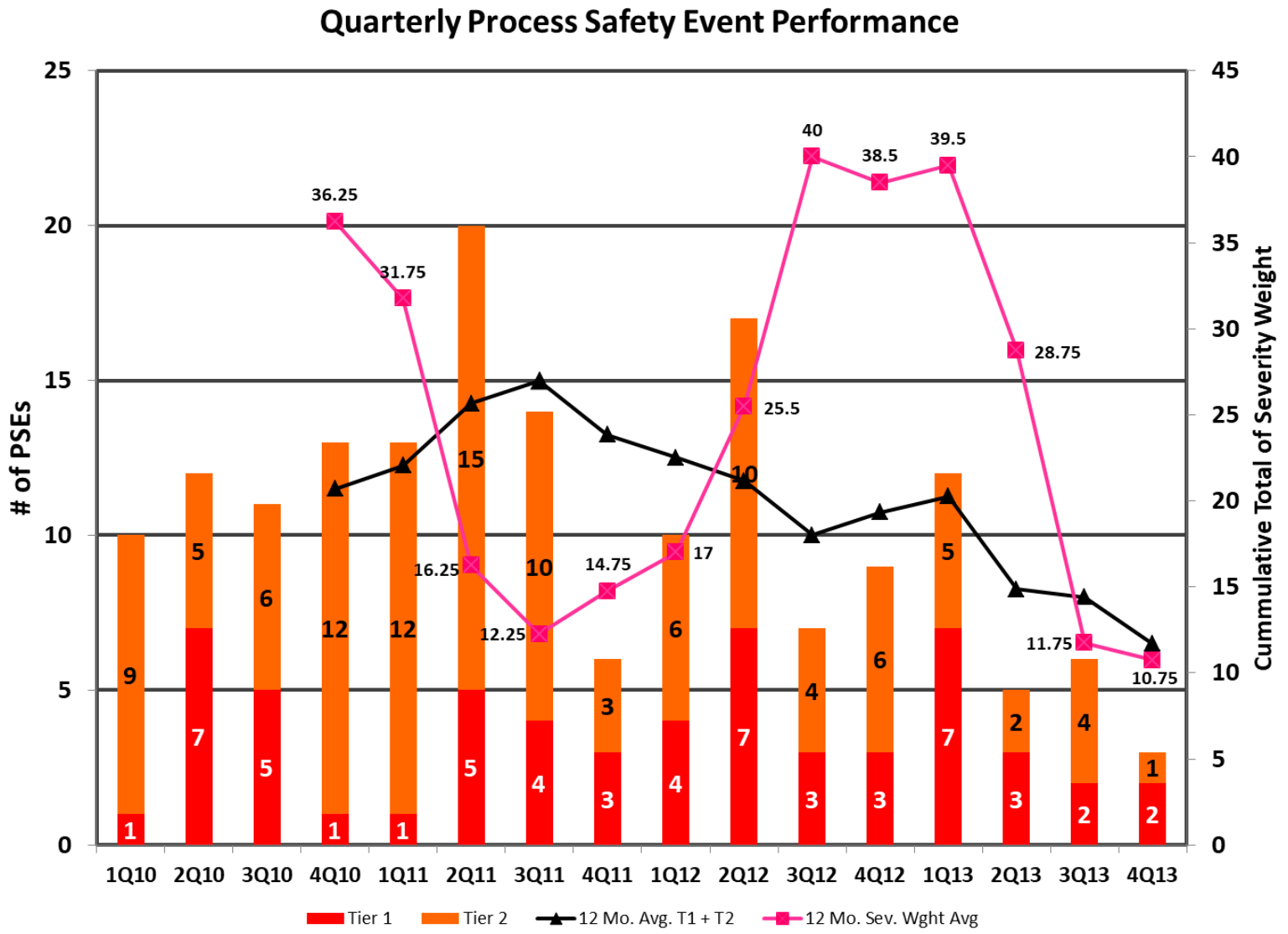
Global Process Safety Metrics

September 2014 (YTD)

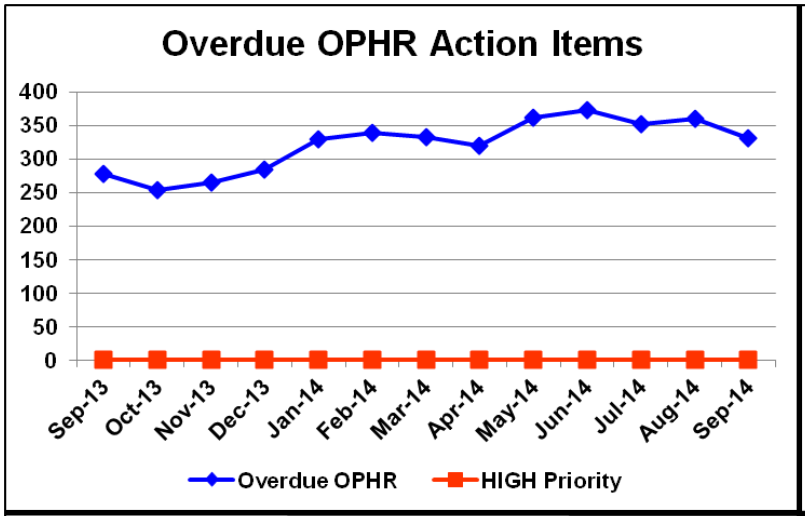


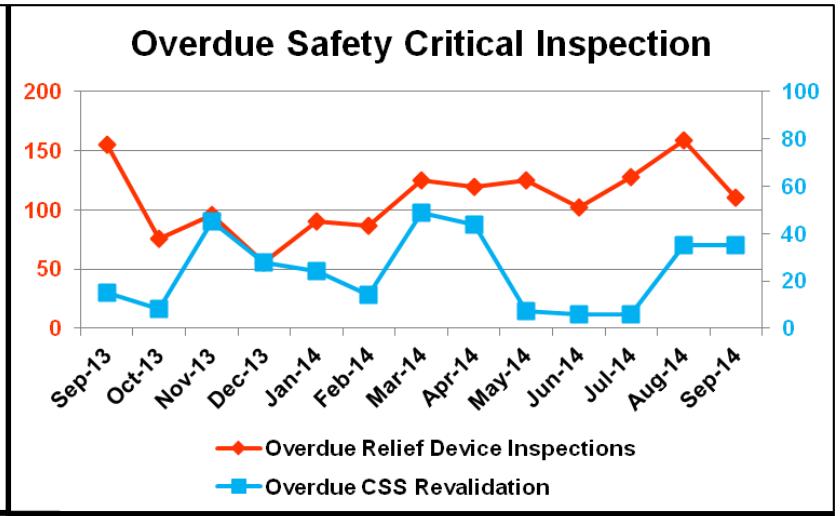
Multi-year Process Safety KPI Trend

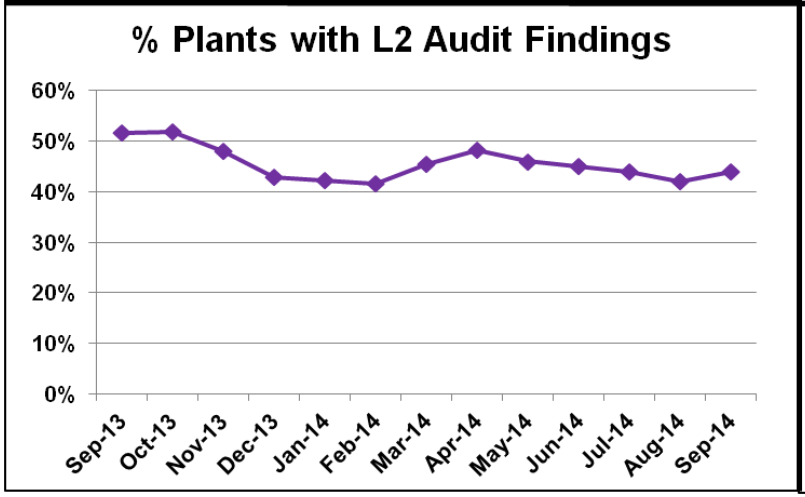


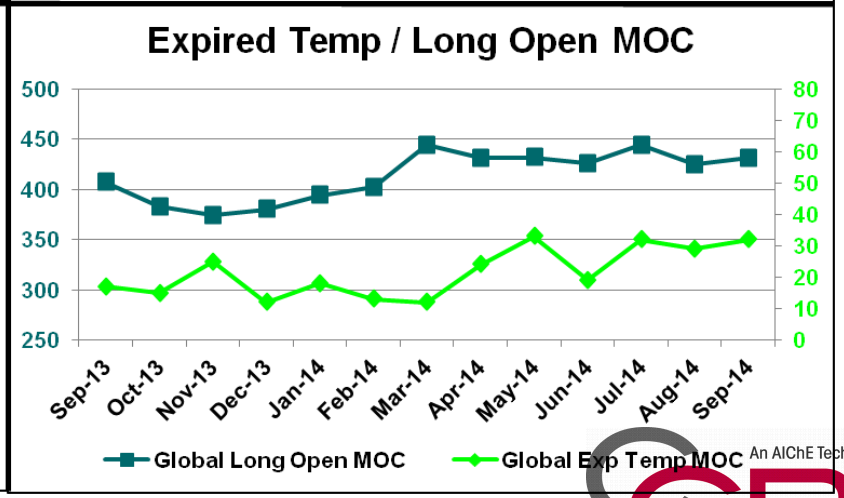
Global Process Safety Metrics

Leading Indicators 12 Months Trend









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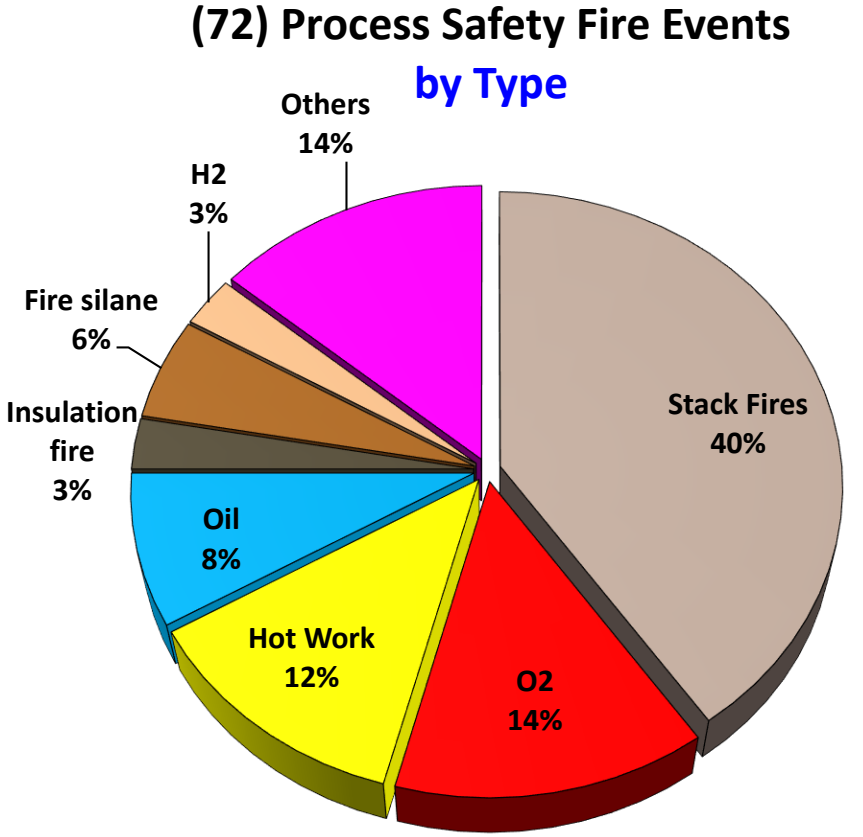
ZERO Fire Initiative

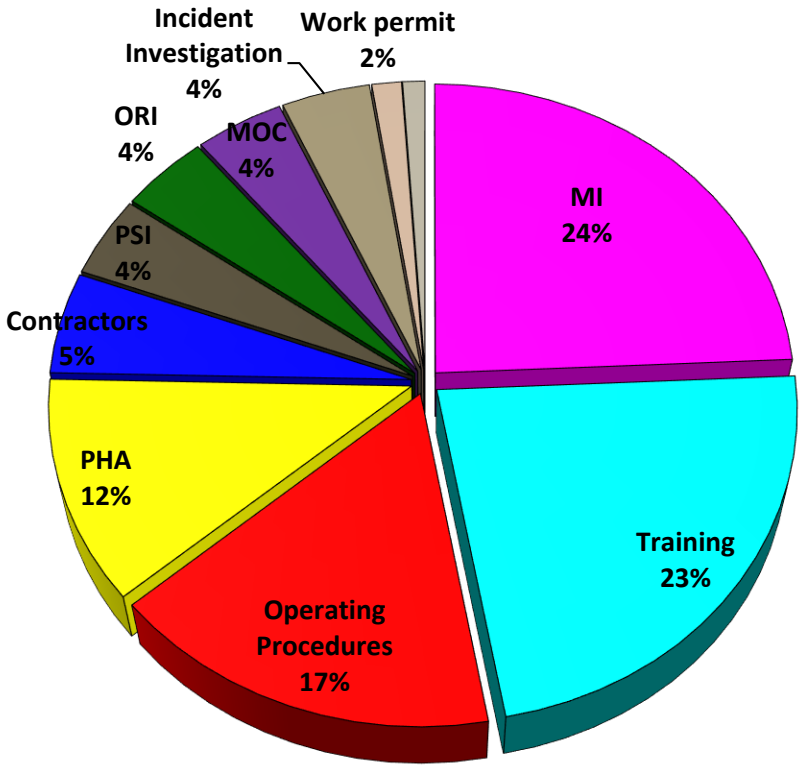
(72) Process Safety Related Fire Events

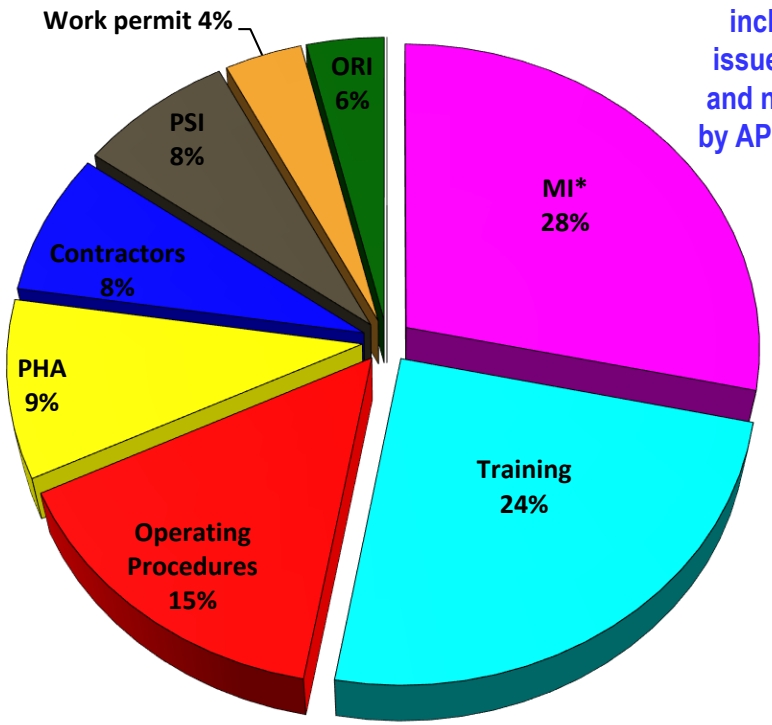
- **(5) Tier 1 Process Safety Fire Events**
  - Massiac contractor burn (LTI)
  - Gent Compressor Oil Fire
  - Tangshan Expander Oil Fire
  - Hsin Chu TW NF3 Bundle Fire (LTI)
  - Wison ASU Compressor Building Fire
- **(3) Tier 2 Process Safety Fire Events**
  - Insulation Fire CO2 Tank, Poland
  - Silane Fire, Shiwha, Korea
  - T2 VSA O2 blower fire, Merak, Indonesia
- **(64) Tier 3 Events**
  - (29) Stack Fires – venting to safe locations
  - (9) O2 Fires
  - (8) Hot Work related
  - (3) Oil Fires
  - (3) Silane Fires
  - (12) Others not classified



- **25% of fire related KPI events resulted in LTI**
- **Stack fires Corrective Action Team working to reduce occurrence (low risk)**
- **Oxygen fires and Machinery fires identified for improvement efforts**

Process Safety KPI Causes Attributed to PSM Elements





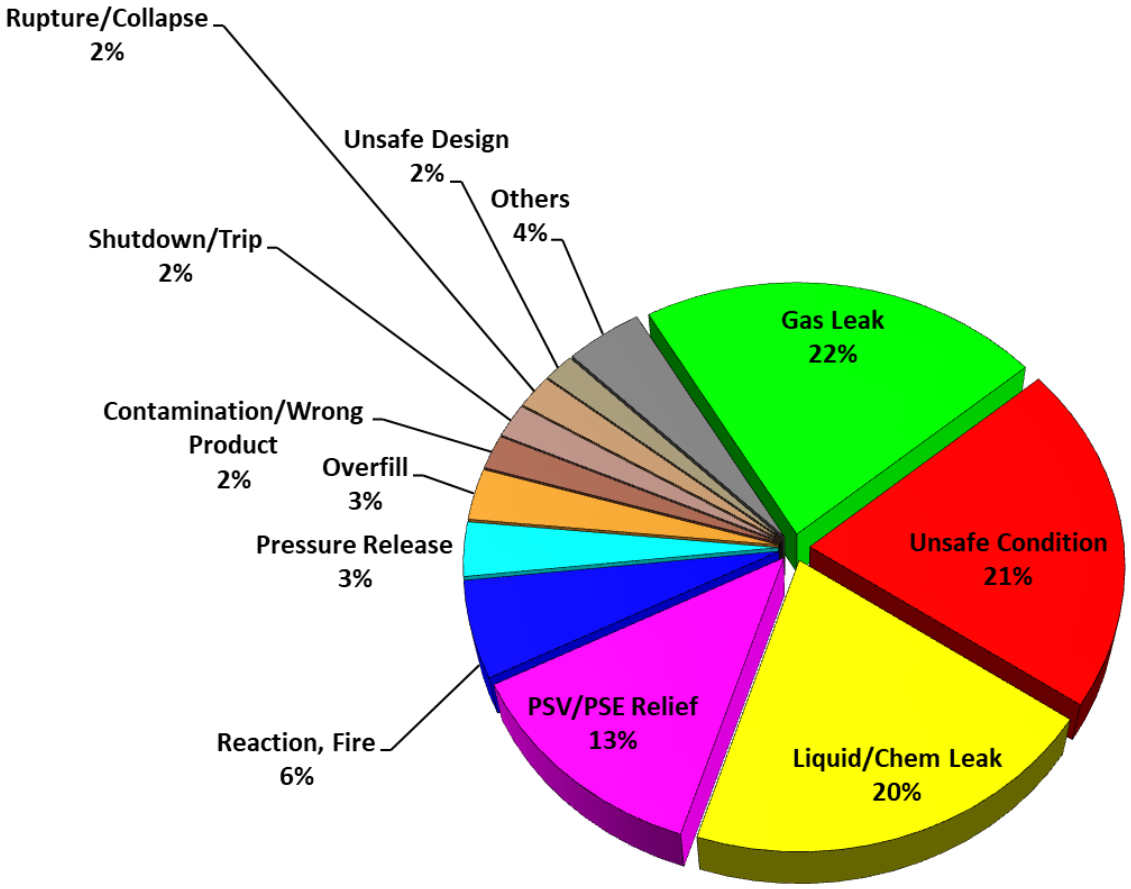
(*) Note: events classified as "MI" include both issues covered and not covered by AP's formal MI Pgms

FY10-13 Process Safety KPI PSM Elements

FY13 Process Safety KPI PSM Elements

PSM Element colors are the same for both pie charts

FY13 Process Safety Event
Hazard Conditions



- Loss of Primary Containment (LOPC) accounted for 60% of Process Safety Events in FY13 vs. 66% in FY12
- Unsafe condition / early hazard identification lowered to 21% in FY13 vs. 24% in FY12

WCCE10, Barcelona, 3.10.2017

Process Safety Incidents

From Tracking to active Reduction Initiatives

Hans V. Schwarz, BASF

BASF
We create chemistry

An AIChE Technology Alliance

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Center for Chemical Process Safety

Thanks!!

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Closing Remarks

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Thank You

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