

RISK-BASED PROCESS SAFETY

North Jersey Section AIChE
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 - BOC Gases – industrial gases
 - Schering-Plough - pharmaceuticals
 - ALZO International, Inc. – specialty chemicals

ATTRIBUTIONS

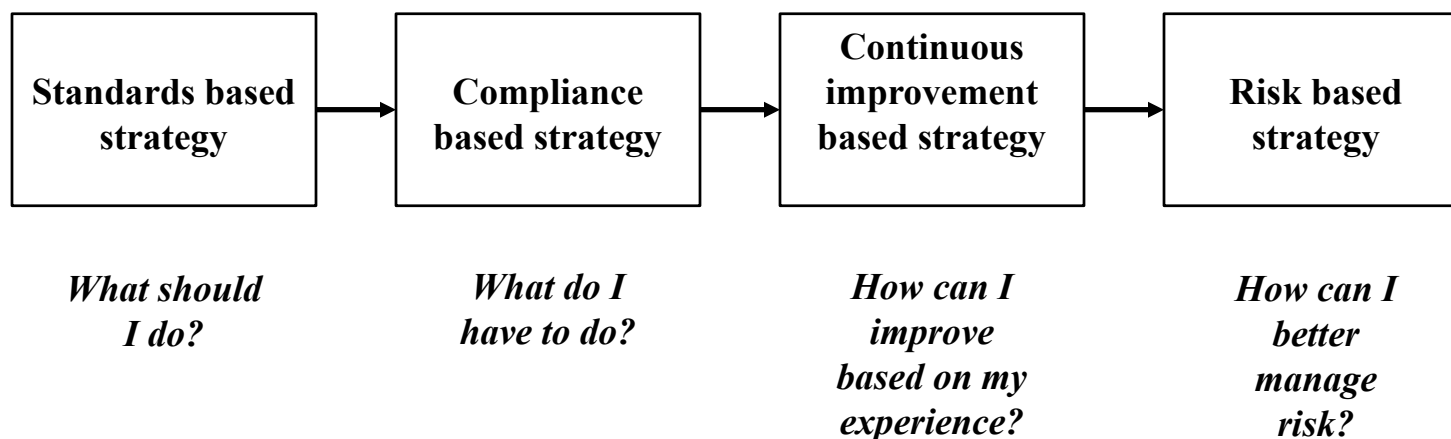


Some information presented on these slides was obtained (with permission) from:

- **Risk-Based Process Safety** – B. Karthikeyan, founding Director of Prism Consultants - Chemical Engineering Progress, March 2019
- **Guidelines for Risk-Based Process Safety** – CCPS, 2007
- *...as well as nearly 40 years of experience in the chemical process industry!*

Background of Risk-Based Process Safety (RBPS) Approach

- Several strategic approaches to chemical process safety have been developed over the years, for chemical accident and loss prevention
- This evolution of process safety and accident/loss prevention strategies can be illustrated as follows:



Background of Risk-Based Process Safety (RBPS) Approach



- Understanding the risk associated with an activity requires answering the following questions:
 1. What can go wrong?
 2. How bad can it be?
 3. How often might it happen?
- Based upon the level of understanding of the answers, a company can decide what actions, if any, are required to eliminate, reduce or control existing risk
- *...which brings us to the main objective of the Risk-based Process Safety (RBPS) approach...*



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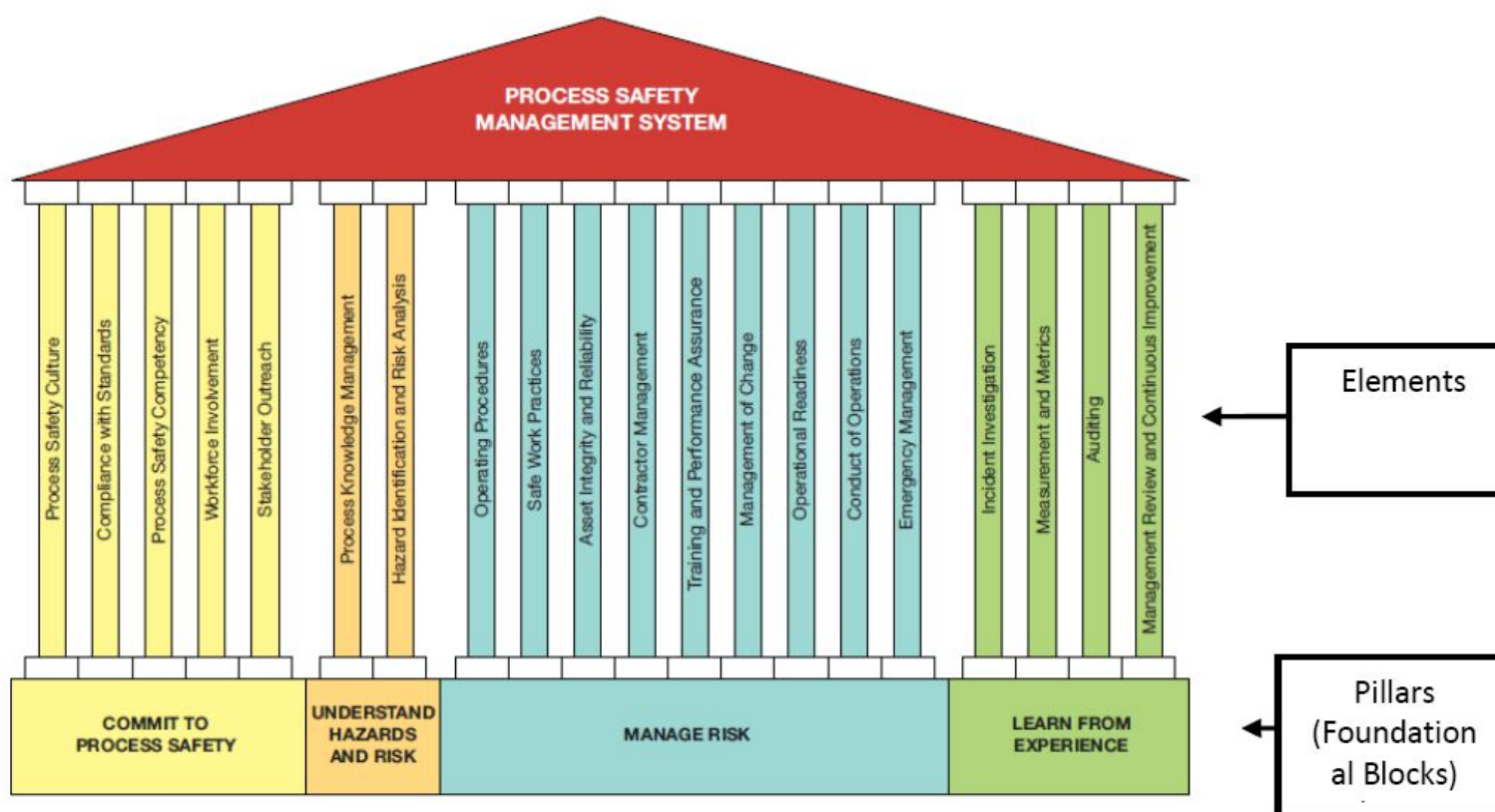
RBPS Design and Improvement Criteria

- The main objective of the RBPS approach is to help an organization build and operate a more effective process safety management system
 - These *Guidelines* describe how to design or improve each process safety activity so that the energy put into that activity is appropriate to meet the anticipated needs for that activity
 - The RBPS strategic approach is founded on the principle that appropriate levels of detail and rigor in process safety practices are predicated on three factors:
 1. A sufficient understanding of the risk(s) associated with the processes
 2. The level of demand for process safety work activity compared to available resources
 3. The existing process safety culture
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RBPS Management System Pillars

- An RBPS management system incorporates four main accident prevention pillars (or *foundational blocks*):



The 20 Elements of RBPS

- I. Commit to process safety**
 - 1. Process safety culture
 - 2. Compliance with standards
 - 3. Process safety competency
 - 4. Workforce involvement
 - 5. Stakeholder outreach

- II. Understanding Hazards and Risks**
 - 6. Process knowledge management
 - 7. Hazard identification and risk management

- III. Manage Risk**
 - 8. Operating procedures
 - 9. Safe work practices
 - 10. Asset integrity and reliability



The 20 Elements of RBPS continued

III. Manage Risk (continued)

- 11. Contractor management
- 12. Training and performance assurance
- 13. Management of change
- 14. Operational readiness
- 15. Conduct of operations
- 16. Emergency management

IV. Learn from Experience

- 17. Incident investigation
- 18. Measurement and metrics
- 19. Auditing
- 20. Management review and continuous improvement



Pillars (Foundational Blocks)

- **Commit to Process Safety**
 1. The cornerstone of process safety excellence, management commitment has no substitute
 2. Organizations generally do not improve without strong leadership and solid commitment
 3. The entire organization must make the same commitment and it must become embedded in the corporate culture
- **Understanding Hazards and Risks**
 1. Organizations that understand hazards and risks are better able to allocate limited resources in the most effective manner
- **Manage Risks** (*focuses on three issues*):
 1. Prudently operating & maintaining the processes that pose the risk
 2. Managing changes to those processes to ensure that the risk remains tolerable
 3. Preparing for and responding to, incidents that do occur

Pillars (Foundational Blocks)

- **Learn from Experience**
 - 1. This involves monitoring and acting on, internal and external sources of information**
 - 2. The most cost-effective ways to learn from experience are to:**
 - a. Apply best-practices to make the most effective use of available resources*
 - b. Correct deficiencies exposed by incidents and near-misses*
 - c. Apply lessons learned from other organizations*
 - d. In addition, companies must also develop a culture and infrastructure that helps them remember the lessons, and apply them in the future*
 - 3. The development of metrics can provide timely feedback on how the RBPS systems are performing**
 - 4. Periodic management reviews help sustain existing performance and drive improvement**

Pillars (Foundational Blocks)

- **Focus on these foundational blocks enables organizations to**
 - improve process safety effectiveness,
 - reduce the frequency and severity of incidents
 - improve long-term safety, environmental and business performance
- **A risk-based approach also helps avoid gaps, inconsistencies and excess work, insufficient work and rework that can lead to system failure**
- **To work most effectively, RBPS practices should be integrated with other management systems, such as those for product quality, human and equipment reliability, personal health and safety, environmental protection and security**
- **Now, let's take a closer look at the “*Elements*”....**



Elements of Risk-based Process Safety

- **Commit to Process Safety (Pillar 1):**

- 1. Process Safety Culture**

- » *How do we do things around here? What do we expect here? What do we do when no one is looking?*

- 2. Compliance with Standards**

- » *Identify and address relevant process safety standards, codes, regulations and laws*

- 3. Process Safety Competency**

- » *(1) Continuously improve knowledge and competency, (2) Ensure that appropriate information is available, (3) Consistently apply what has been learned*

- 4. Work-force Involvement**

- » *Workers at all levels and in all positions should have roles and responsibilities for enhancing and ensuring safety*

- 5. Stakeholders Outreach**

- » *(1) Seek out individuals / organizations that can be affected by operations and engage them in dialogue, (2) establish relationships w/ community organizations, other companies / professional groups, local, state and federal authorities, (3) provide accurate information about company activities, hazards and risks*



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Elements of Risk-based Process Safety

- **Understand Hazards and Risks (Pillar 2):**

- 1. Process Knowledge Management**

- » *Focuses on elements that are easily recorded:*

- 1. written technical documents and specifications,
 - 2. engineering drawings and calculations
 - 3. specifications for design, fabrication, and installation of process equipment
 - 4. other written documents, (e.g., SDSs)

- 2. Hazard Identification and Risk Analysis**

- » *HIRA is a collective term addressing:*

- **Hazards** – What can go wrong?
 - **Consequences** – How bad could it be?
 - **Likelihood** – How often might it happen?





Elements of Risk-based Process Safety

- **Manage Risk (Pillar 3):**

- 1. Operating Procedures**

- » *Instructions that, (1) list the steps for a given tasks and (2) describe the manner in which the steps are to be performed*

- 2. Safe Work Practices**

- » *Generally divided into three categories*
 - 1. Operating Procedures** – activities generally involving production
 - 2. Maintenance Procedures** – involve inspecting, testing, calibrating, maintaining or repairing equipment
 - 3. Safe-work Procedures** – fills in the gaps between Categories 1 and 2

- 3. Asset Integrity and Reliability**

- » *Work activities related to this element focus on (1) Preventing a catastrophic release of a hazardous material or sudden release of energy, and (2) Ensuring high availability (or dependability) of critical safety or utility systems that prevent or mitigate the effects of these types of events*

- 4. Contractor Management**

- » *A system of controls that ensures that contracted services support both safe facility operations and the company's process safety and personal safety performance goals*



Elements of Risk-based Process Safety

- **Manage Risk (Pillar 3) continued:**

- 5. Training and Performance Assurance**

- » *Training is practical instruction in job and task requirements and methods, while Performance Assurance is the means by which workers demonstrate that they have understood the training and can apply it in practical situations*

- 6. Management of Change (MOC)**

- » *This element helps ensure that changes to a process does not inadvertently introduce new hazards or unknowingly increase risk of existing hazards*

- 7. Operational Readiness**

- » *The Readiness element ensures that shut down processes are verified to be in a safe condition for re-start – it addresses start-ups from all types of shut down conditions and the length of time the process was in the shut down condition*

- 8. Conduct of Operations**

- » *The execution of management and operational tasks in a deliberate and structured manner*



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Elements of Risk-based Process Safety

- **Manage Risk (Pillar 3) continued:**

- 9. Emergency Management**

- » *The **Emergency Management** element includes the following:*

- 1. Planning for possible emergencies
 - 2. Providing the resources to execute the plan
 - 3. Practicing and continuously improving the plan
 - 4. Training or informing employees, contractors, neighbors and local authorities on what to do, how they will be notified, and how to report an emergency
 - 5. Effectively communicating with stakeholders in the event an incident does occur





Elements of Risk-based Process Safety

- **Learn from Experience (Pillar 4):**

- 1. Incident Investigation**

- » *This is a process for reporting, tracking and investigating incidents that includes:*
 1. A formal process for investigating incidents, including staffing, performing, documenting and tracking investigations of process safety incidents, and
 2. The trending of incident and incident investigation data to identify recurring incidents

- 2. Measurement and Metrics**

- » *This element establishes performance and efficiency indicators to monitor the near-real-time effectiveness of the RBPS management system and its constituent elements and work activities*

- 3. Auditing**

- » *This element is intended to evaluate whether management systems are performing as intended*

- 4. Management Review and Continuous Improvement**

- » *The routine evaluation of whether management systems are performing as intended and producing the desired results as efficiently as possible*



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Elements of Risk-based Process Safety

- *Now let's take a look at how these elements were, or could have been applied in real-life circumstances.....*

Epilogue:

Ototoxicants and Hearing Impairment



- Noise has traditionally been considered the primary risk factor for hearing loss
- 1996 NIOSH publication “Preventing Occupational Hearing Loss—A Practical Guide” estimated that a worker may be exposed to up to three hazardous agents simultaneously in the workplace
- Recent evidence suggests that exposures to chemicals commonly found in industrial environments may affect hearing alone or in combination with noise exposure
- A 2010 report from The Nordic Expert Group for Criteria Documentation of Health Risks from Chemicals defines the term “ototoxicant” as *any substance, including drugs or industrial chemicals, that is toxic to the auditory system*

Epilogue:

Ototoxicants and Hearing Impairment



- OSHA and NIOSH released a joint safety and health bulletin in 2018 to raise awareness of ototoxicants
- While there are no compulsory regulations targeted toward ototoxicants, OSHA has recognized the risk associated with combined exposures to noise and ototoxic substances
- Guidance from the Department of the United States Army identifies 21 chemicals classified as ototoxicants, including metals such as arsenic, lead, mercury, and manganese, and solvents such as carbon disulfide, ethylbenzene, toluene, and xylene, among others
 - Any exposure to these ototoxicants, either in combination with noise or alone, that is greater than 50% of each chemical's respective occupational exposure limit would trigger enrollment in a hearing conservation program

"There is no expedient to which a man will not resort to avoid the real labor of thinking."

Sir Joshua Reynolds



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