

Process Safety Fundamentals

Cleveland AIChE

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B.S. Chemical Engineering

- **Case Institute of Technology (CWRU)**
- **Global Director – Retired**
 - **Process Safety & Chemical Security – The Sherwin-Williams Company**
- ***Certified Process Safety Auditor***
- Operations / Plant Management
- Process Engineering
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- Process Safety Management

**Commodity & Specialty Chemicals; Agricultural Chemicals;
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Introduction

Year	Location	Description
1984	Bhopal, India	Addition of water to a tank containing isocyanate vapors. 3,000 deaths in local community – eventually 15-22,000
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1990	Channelview, TX	Explosion of storage tank. 21 deaths
2000	Pasadena, TX	Explosion of a dry butadiene tank. 1 death
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What is Process Safety Management?

- 29 CFR 1910.119 – 14 paragraphs (OSHA Standard)
- ... involves adopting a comprehensive program to prevent or minimize the consequences of catastrophic releases of toxic, flammable or explosive chemicals. These releases may result in toxic, fire or explosion hazards

What is Process Safety Management?

- Process Safety involves all *managers, employees and contract workers*, with the purpose of ***minimizing uncontrolled change from design and/or operating intent at their facility***
- Process Safety is a disciplined framework for managing the integrity of hazardous processes, materials and operating systems by applying good design principles, engineering, operating and maintenance practices

Process Safety...today

- ...has moved from preventing catastrophic accidents to complying with government regulations
- Actions are frequently influenced by attorneys rather than engineering, operations and safety
- *“Imagine the unimaginable.” – Tom Hopkins*

***Good people do not need laws to
tell them to act responsibly.***

- Plato

Process Safety...future

- Focus on accident prevention rather than just reactive compliance
- Due diligence – Process safety Culture
 - Texas City Incident (23 Mar 2005) – See Baker Panel Report (374 pages)
 - Flixborough Disaster (1 Jun 1974)

Process Safety

- Make Process Safety a core value through leadership
- Enhance Process Safety *culture*
 - A culture reflects values
 - Values influence actions
- Become Best-in-Class in Process Safety
- Strive to have practices worth repeating

3 Keys to Process Safety ***– Not 14 paragraphs***

- Understand your processes, their hazards and their safe operating limits
- Consistently operate and maintain systems per documented procedures and standards
- Effectively manage all deviations and changes

Understand your processes, their hazards and their safe operating limits...

- Meaning...a solid understanding of all systems and hazards
 - *Program Assessments / Gap Analyses (Audits)*
 - *Process Safety Information (PSI)*
 - *Process Hazard Analyses (PHAs)*
 - *Incident Analyses*
 - *Emergency Planning & Response*

Consistently operate and maintain systems following documented procedures and standards

- Meaning a Zero Defect approach...if it can't be done right...don't do it
- Requires strong leadership
 - *Standard Operating Procedures (SOPs)*
 - *Training*
 - *Mechanical Integrity*
 - *Contractors*
 - *Hot Work*

Effectively manage all deviations and changes

- Meaning...addressing **any** change in:
 - Equipment
 - Maintenance
 - Processes and Procedures
 - Training
 - Raw Materials
 - Products
 - Personnel
- *Management of Change (MOCs)*
- *Pre-startup Safety Reviews (PSSRs)*

How do you get there?

... a comprehensive Process Safety Program should be *developed* in close consultation with *qualified employees*

About the Plan

- The Plan must be *written!*
- Must contain details of how employees are involved
- Must be practiced daily
- *It should be lived !!!*

Part 1

Gap Analyses / Program Assessments

Intent: ... self-evaluate the effectiveness of the Process Safety program by identifying deficiencies and assuring corrective actions ...

- *Establish a system to promptly address findings and recommendations.*
- ***Document actions taken***

Process Safety Information (PSI)

Intent: ... provide complete and accurate information concerning the processes and equipment ...

- Information must be *written!*
- Must be compiled before conducting any PHA.
 - Hazard information on **materials**
 - Information concerning the **process**
 - Information pertaining to the **equipment**

Process Hazard Analysis (PHA) aka Safety Review

Intent: ... develop a thorough, orderly, systematic approach for identifying, evaluating, and controlling processes ...

- Address
 - Hazards
 - Incidents & near misses
 - Controls & effects of failure of controls
 - Facility siting & human factors

Process Hazard Analysis (PHA)

- *Establish a system to promptly address findings and recommendations*
- ***Document actions taken***

Process Hazard Analysis (PHA)

- Identify hazards
 - Employee exposure and/or injury
 - Environmental impact
 - Business impact
- Understand design intent
 - What is *supposed* to be happening
- Understand deviation from intent
 - Usually leads to consequences

Incident Investigation

Intent: ... investigate each incident that resulted in, or could have resulted in a catastrophic release ...

- Initiate investigation no later than 48 hours after event
- Investigation team should include contractors, if a contractor is involved in the incident
- Investigation team should include several individuals familiar with the process where incident occurred

Incident Investigation

- *Establish a system to promptly address the incident findings and recommendations*
- **Document** all resolutions and corrective actions

Emergency Planning and Response

Intent: ... address what actions employees are to take when there is an unwanted release ...

- Establish and implement an emergency action plan
- Ensure plan is communicated
- Include procedures for handling small releases

Part 2

Operating Procedures

Intent: ... provide clear instruction for conducting activities involved in covered processes ...

- Must be *written*
- Must be consistent with PSI
- Address steps for each operating phase
- Must contain
 - Safe operating limits
 - Safety and health considerations
 - Safety systems and their functions

Operating Procedures

Don't Forget ...

- Lock out / Tag out
- Confined Space Entry
- Red Tag
- Opening Equipment or piping (aka Line Break)

Training

Intent: ... help employees understand the risks, nature and causes of problems arising from process operations ...

- Initial training
- Refresher training
- Documentation that training was understood
- *Written* documentation of training

Mechanical Integrity

A condition or state of a process or equipment which indicates that it is in full operating order and within manufacturers' operating tolerances

Mechanical Integrity

Intent: ... assure that equipment is ... designed, constructed, installed, and maintained to minimize the risk of releases ...

- Assure continued integrity of the equipment
- Preventive & predictive maintenance (PM)
- *Written* maintenance guidelines and training
- Inspection and testing
- Correct equipment deficiencies

Hot Work Permit

Intent: ... control, in a consistent manner, non-routine work conducted in process areas ...

- Control
 - Welding and cutting in process areas
 - All hot work except in designated maintenance work areas
- Train employees and contractors to follow hot work permit procedures
- Enforce hot work procedures rigorously

Contractors

Intent: ... establish an evaluation process for contractors who perform work in and around processes ...

- Hire only those contractors who accomplish work without compromising safety
- Contracting firm must assure contract employees are trained on performing the job safely, of the hazards related to the job, and applicable provisions of the emergency action plan
- Require *written* records from contracting firm on training and safety statistics

Part 3

Employee Participation

Intent: ... involve employees at a fundamental level ...

- Employee consultation (2-way communication)
- *Written* plan of action for implementation
- Consult on *all* aspects of Process Safety
- Allow ready access to all information relating to hazards and processes
- Corporate wisdom

Management of Change (MOC)

Intent: ... require management of all modifications to equipment, guidelines, personnel, raw materials and processing conditions by reviewing them prior to implementation ...

- Establish *written* guidelines to manage change
- Evaluate technical basis
- Evaluate impacts
- Train affected employees

Management of Change (MOC)

Why Manage Change?

To maintain:

“...evidence of business-related activities, events, and transactions with ongoing business, legal, compliance, operational, or historical value.”

To ensure:

- No safeguards have been compromised or removed
- No new hazards have been introduced
- The change does not result in deviations that lead to operations outside established safe operating limits

Management of Change (MOC)

What is it?

- It is the ***process*** by which changes are managed – it is **not** an event
- It is a ***procedure*** that triggers a *series* of actions necessary to assure that modifications are reviewed and implemented by knowledgeable personnel who
 - are qualified to assess the risk
 - take necessary actions to minimize the risk
 - establish a follow-up system

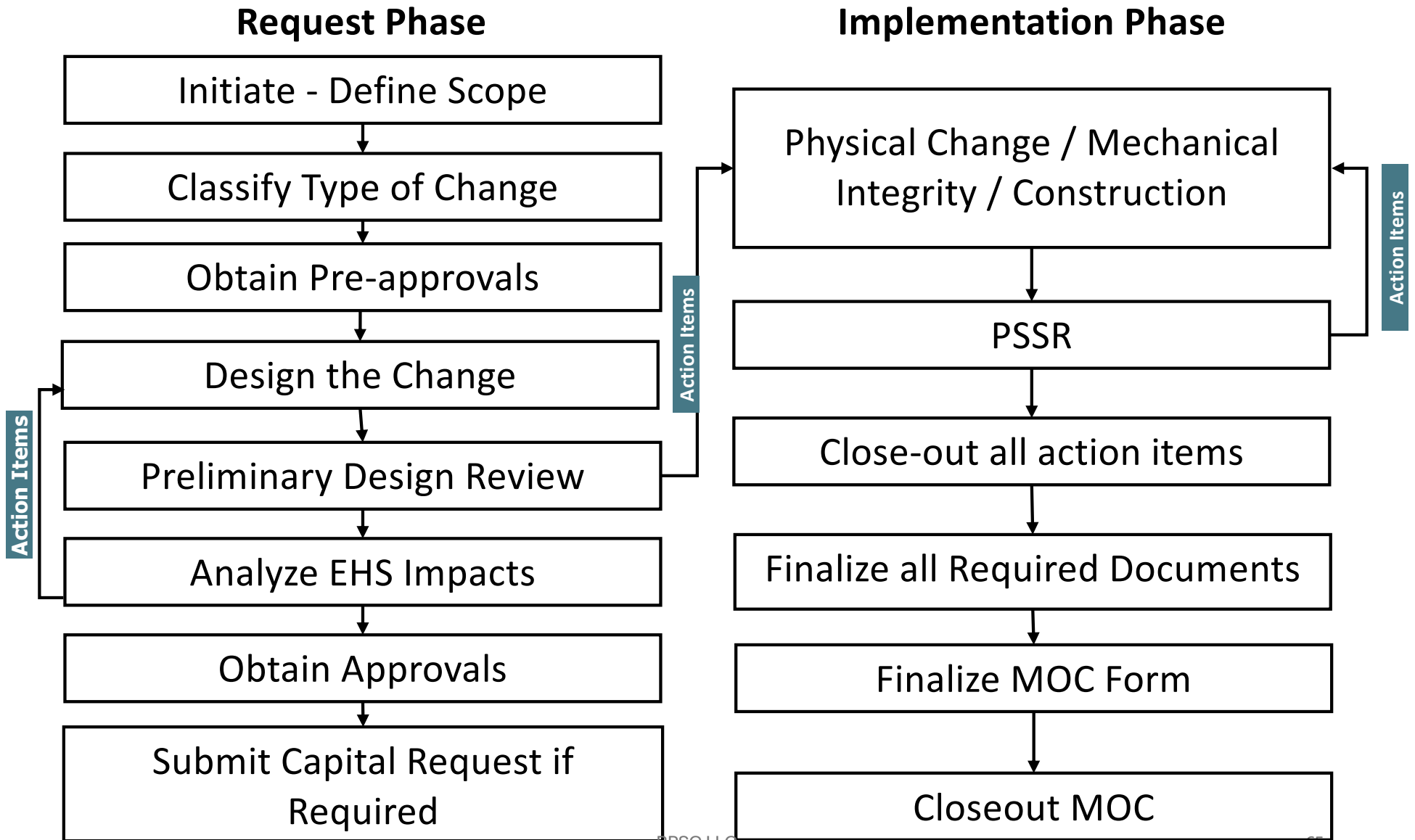
Management of Change (MOC)

When does a Change require an MOC?

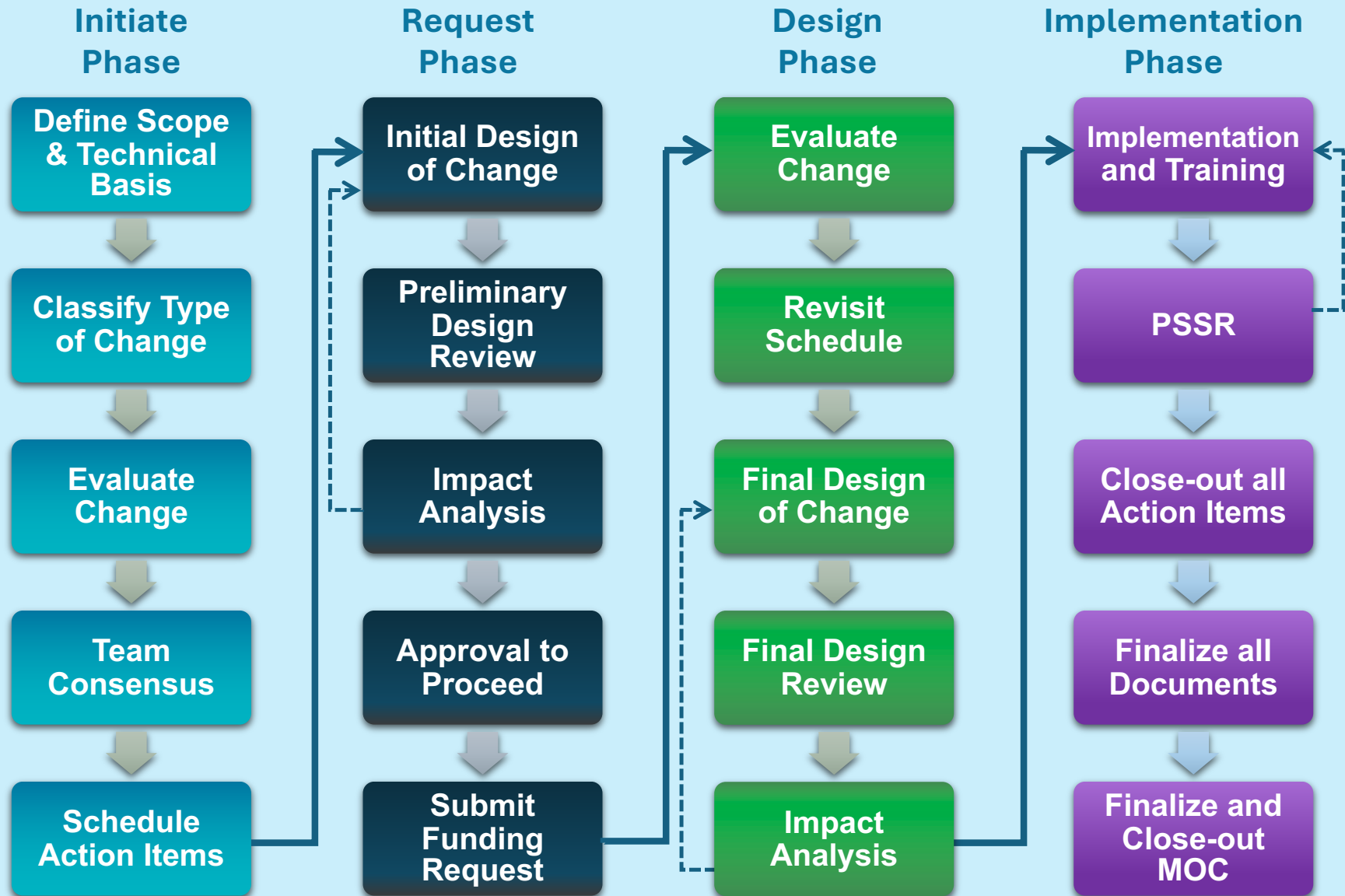
- If you have to tell someone about it, it should be subjected to the MOC process
- Always...when in doubt

Management of Change

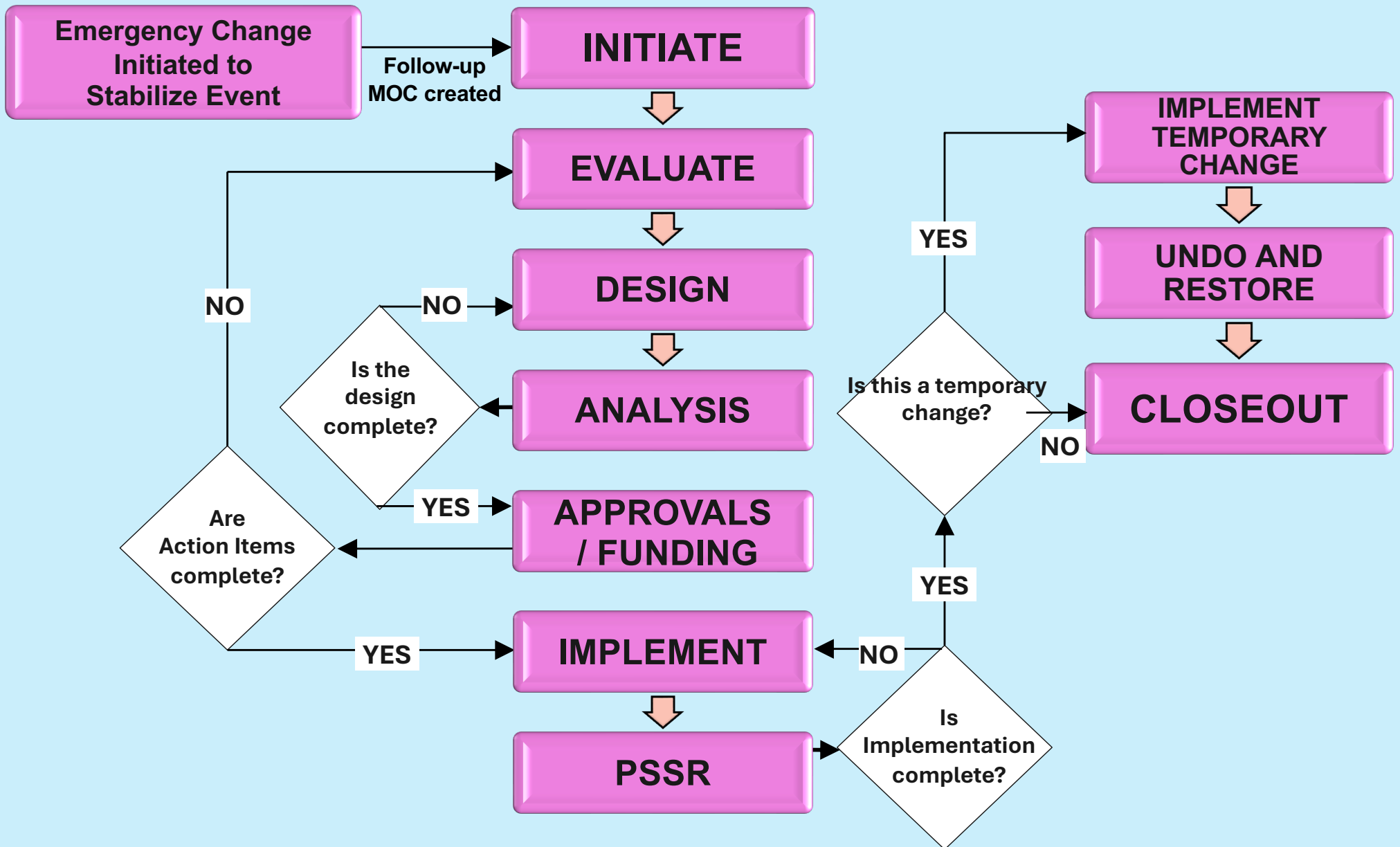
Lifecycle Flow Chart – The Process



MOC LIFECYCLE FLOW CHART



MOC Workflow



Pre-Startup Safety Review

Intent: ... assure that, when modification necessitates a change to PSI, important considerations are addressed before process is operated ...

- Ensure:
 - Construction and modifications are **per design specifications**
 - All procedures have been updated and are adequate
 - All action items have been satisfactorily completed before putting the change in effect
 - ***Employees are involved in the review***
- Document PSSR – list action items
- Track status of all action items

What can happen if I don't do MOC when I need to?



Comair Flight 191 (August 27, 2006)

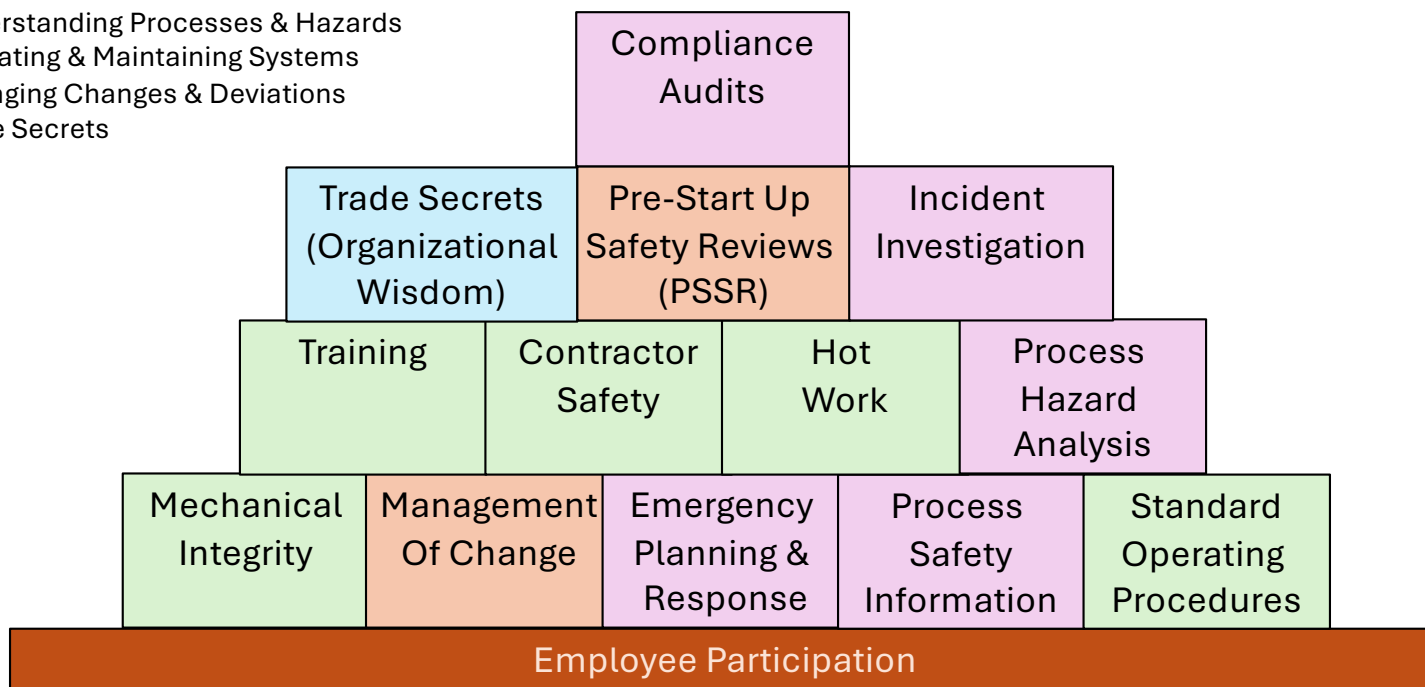
- Lexington Airport
- New striping on the runway, but runway maps were not updated
- When the crew took off using the old map, the plane crashed and 49 people were KILLED

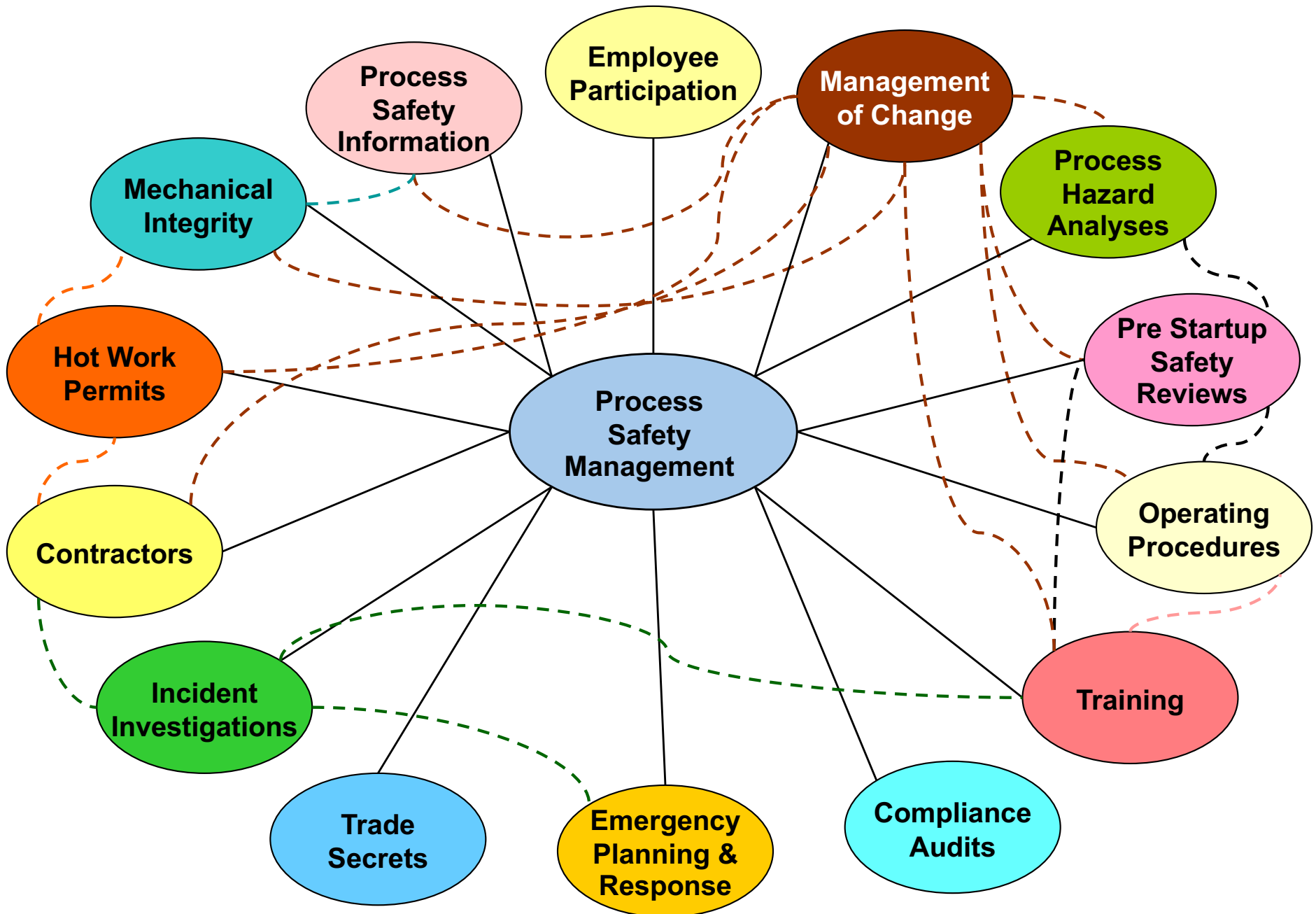
PSM Plan – Main Focus Areas

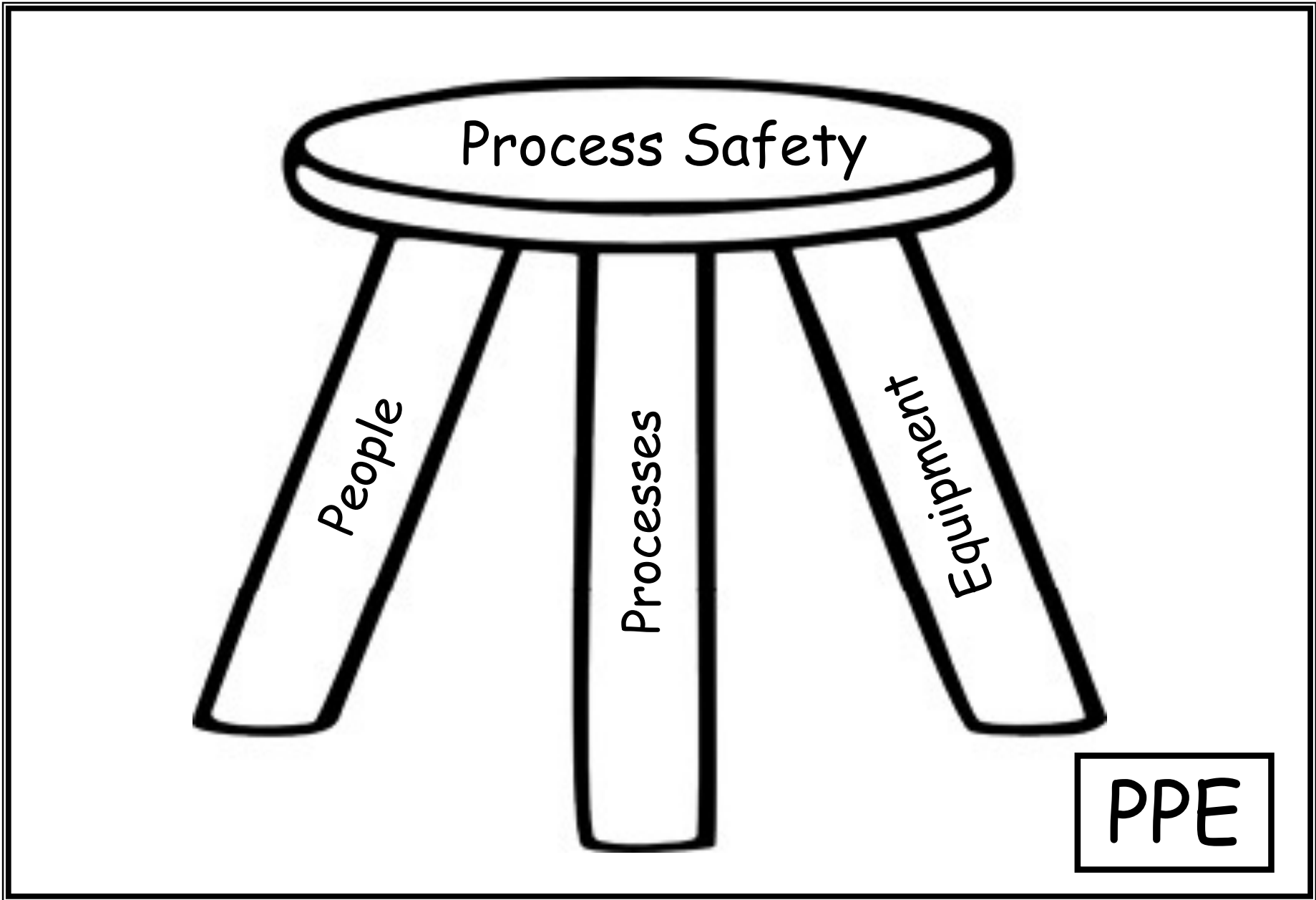
- Employee Involvement
- Understanding Processes & Hazards
- Operating & Maintaining Systems
- Managing Change & Deviations
- Trade Secrets aka Organizational Wisdom

Foundation of PSM - 14 Elements

- Employee Involvement
- Understanding Processes & Hazards
- Operating & Maintaining Systems
- Managing Changes & Deviations
- Trade Secrets







Process Safety...

Prevent

Protect

Mitigate

Year	Location	Description
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2000	Pasadena, TX	Explosion of a dry butadiene tank. 1 death Root Cause - ???
2005	Texas City, TX	Explosion during startup of Isomerization Unit. 15 deaths and 170 injuries Root Cause – Management of Change
2008	Port Wentworth, GA	Dust explosion involving sugar – total destruction of the building complex. 14 deaths and 36 injuries Root Cause – Management of Change

***(Process) Safety is something that happens
between your ears, not something you hold
in your hands.***

- Jeff Cooper

Thank You !