“Not all refining hazards are caused by the same factors or involve the same degree of potential damage. Personal or occupational safety hazards give rise to incidents – such as slips, falls, and vehicle accidents – that primarily affect one individual worker for each occurrence. Process safety hazards can give rise to major accidents involving release of potentially dangerous materials, the release of energy (such as fires and explosions), or both.. Process safety incidents can have catastrophic effects and can result in multiple injuries and fatalities, as well as substantial economic, property, and environmental damage...The Texas City tragedy in March 2005 was a process safety incident”

PSM - Definition

“Process safety in a refinery involves the prevention of leaks, spills, equipment malfunctions, over pressures, excessive temperatures, corrosion, metal fatigue, and other similar conditions”  
## Accidents That Affected The PSM Regulation Development

<table>
<thead>
<tr>
<th>Year</th>
<th>Company</th>
<th>Location</th>
<th>Deaths</th>
<th>Injuries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1984</td>
<td>Union Carbide</td>
<td>Bhopal</td>
<td>2000+</td>
<td>?</td>
</tr>
<tr>
<td>1989</td>
<td>Phillips 66</td>
<td>Pasadena, TX</td>
<td>24</td>
<td>132</td>
</tr>
<tr>
<td>1990</td>
<td>Arco</td>
<td>Channelview, TX</td>
<td>17</td>
<td>--</td>
</tr>
<tr>
<td>1990</td>
<td>BSAF</td>
<td>Cincinnati, OH</td>
<td>2</td>
<td>41</td>
</tr>
<tr>
<td>1991</td>
<td>IMC</td>
<td>Sterling, LA</td>
<td>8</td>
<td>128</td>
</tr>
</tbody>
</table>
Objective of OSHA PSM

Prevent *catastrophic* releases of hazardous chemicals in areas where employees could be exposed to serious harm
Catastrophic Release

- A major uncontrolled *emission, fire, or explosion*, involving highly hazardous chemicals
Highly Hazardous Chemical

- A Substance possessing:
  - toxic reactive
  - flammable
  - explosive properties

- Specific list of chemicals specified by OSHA:
  - Hydrogen Sulfide
  - Ammonia
  - Chlorine
Flammable Liquid

- Any liquid having a flash point below 100 F
  - LPG (Propane, Butane, Ethane, etc)
  - Naphtha
  - Cyclohexane
  - Aromatic Compounds (Benzene, Toluene, etc)
Who Must Comply?

OSHA List of Highly Hazardous Chemicals, Toxics and Reactive

Any flammable liquid or gas on site in one location, in quantities of 10,000 lbs or more
PSM Elements -- Building Blocks for Reducing Risk

- Employee Participation
- Operating Procedures
- Process Safety Information
- Process Hazard Analysis
- Training
- Mechanical Integrity
- Management of Change
- Pre-startup Safety Review
- Contractor Program
- Safe Work Practices
- Incident Investigation
- Emergency Planning
- Compliance Audits
- Trade Secrets
Element 1

Employee Participation

- Pre-Startup Safety Review
- Mechanical Integrity
- Management Of Change
- Employee Participation
- Compliance Audits
- Procedures
- Training
- Incident Investigation
- Hot Work Permits
- Contractor Plan
- Process Hazard Analyses
- Emergency Planning
- Trade Secrets
- Process Safety Information
Element 2

Process Safety Information

Process Technology

Chemical Hazards Information

Process Equipment

P&ID
Process Chemistry
Operating Limits
Design Codes
MSDS
Safety Systems
Chemical Hazards Information

- Information typically found on MSDS
  - Hazcom Information
  - Exposure Guidelines
  - Physical Data
  - Chemical Stability

- Corrosivity Data
- Chemical Incompatibility
- Hazardous Effects of Inadverent Mixing
- Thermal and Chemical Stability
Process Technology Information

- Block Flow Or Process Flow Diagrams
- Process Chemistry
- Maximum Intended Inventory
- Safe Upper and Lower Limits for Process Parameters
- Consequences of Deviation
Process Equipment Information

- Materials of Construction
- Piping and Instrumentation Diagrams (P&ID)
- Electrical Classification
- Relief System Design
- Ventilation system design
- Design Codes and Standards
- Material and Energy Balances (Processes built after 1992)
- Safety Systems
- Design Codes
Element 3

Process Hazard Analysis (PHA)

Identify And Control Process Hazards
PHA Prioritization

- Extent of the Process Hazards
- Number of Potential Affected Employees
- Age of the Process
- Operating History of the Process
PHA Requirements

- Hazards of the process
- Identify previous incidents
- Engineering and administrative controls (Safeguards)
- Failure of safeguards
- Facility Siting
- Human Factors
- Evaluation of safety and health impacts
PHA Team

- One person knowledgeable in the process -- Operator
- Other members as necessary
  - Engineering
  - Maintenance
  - Supervisors
  - Operations
- One person knowledgeable in the analysis method
PHA Report

- Document recommendations to reduce hazards
- PHA results must be reviewed with employees
- Must be filed for life of the process
- Reviewed every 5 years
Element 4

Operating Procedures

Objective

*Develop, implement, and maintain* clearly written detailed procedures for safely operating and maintaining a process during all operating modes.
Operating Procedures
Modes of Operation

- Initial Startup
- Normal Operation
- Temporary Operations
- Emergency Shut-Down
- Normal Shut-Down
- Start-up following a turn around or after emergency shut-down
Operating Procedures -- Content

- Operating Limits
  - Consequences of deviation
  - Steps to correct or avoid deviations -- Trouble Shooting

- Safety and Health Measures
  - Precautions to prevent over exposure
  - Action to take if exposure occurs
  - Hazards

- Safety Systems
Operating Procedures

- **Safe Work Practices**
  - Lockout / tagout
  - Confined space entry
  - Opening process equipment
  - Control over entrance into facility

- **Annual Certification**
  - Current and accurate
Element 5

Training

- Initial Training

Conducted for each current employee and each new employee before working in a newly assigned process

- Process Overview
- Operating Procedures
- Specific Safety and Health Hazards
- Safe Work Practices
Training

- **Refresher Training**
  - Assures operators understand and follow current operating procedures
  - Every 3 years -- More often if necessary
Training Documentation

- Verify each employee has received training
- Verify each employee has understood training

Written Tests

Observations

Verbal Tests
Element 6

Contractor Plan

Purpose

Define responsibilities of facility employers and contract employers to ensure safe operation
Contractor Plan - FHR Responsibilities

- Evaluate safety performance and programs
- Inform contract employers of hazards
- Train contract employers on emergency action plan
- Control the entrance, presence and exit of contractors in covered process areas
- Periodically evaluate contract employers in meeting their obligations
- Maintain an injury and illness log
Contractor Plan - FHR Responsibilities

- Train employees on how to safely perform their job
- Instruct employees in the hazards
- Train employees in emergency action plan
- Document that each employee has received and understood the training
- Assure that employees follow FHR safety rules including safe work practices
- Advise FHR of unique hazards associated with their work
Element 7

*Pre-Startup Safety Review (PSSR)*

- Emergency Procedures
- Operating Procedures
- Process Hazard Analysis
- Design Specifications
- Training
- Safety Procedures

Don’t Start That Machine!
Element 8

Mechanical Integrity

A strong mechanical integrity program and proper operations form the first line of defense against accidental releases from process equipment.
Mechanical Integrity

Covered Equipment

- Piping Systems
- Emergency Shutdown Systems
- Pumps
- Tanks
- Relief vent systems
- Controls
- Furnaces / heaters
- Vessels
Mechanical Integrity

Quality Assurance

- Assure new or modified equipment is suitable
- Assure that equipment is correctly installed or modified
- Assure that maintenance materials, spare parts, and equipment are suitable
Mechanical Integrity

Written procedures to maintain the on-going integrity of process equipment:

- Preventive maintenance
- Equipment Repair
- Inspection and Testing
Mechanical Integrity

Maintenance Employee Training

- Process overview
- Hazards associated with the process
- Maintenance procedures
Element 9
Hot Work Permit

Establish hot work permit system that complies with 29 CFR 1910.252 (a)
Element 10
Management Of Change (MOC)

Objective

Prevent changes in the process from introducing unacceptable hazards to workers
Management of Change Program

Written Procedure for managing changes to:

- Process Chemicals
- Equipment
- Technology
- Process Safety Information
- Procedures
- Facilities
Management of Change

Specific Items To Be Addressed For Each Change

- Technical Basis -- Why?
- Time Period for Change
- Safety and Health Impacts
- Authorization Requirements
Element 11

*Incident Investigation*

Investigate each incident that resulted or could have resulted in a catastrophic release
Incident Investigation

- Incident investigation must be started as soon as possible, but no later than 48 hours after the incident

- Incident investigation team
  - At least one person knowledgeable in the process including contract employees where applicable
Incident Investigation Report

- Incident Investigation Report
  - Date of incident
  - A description of the incident
  - Factors contributing to the incident
  - Recommendations

- Report must be reviewed with all affected employees including contract employees if necessary

- System to resolve report recommendations
Element 12

Emergency Planning And Response

Institute an emergency response plan according to 29 CFR 1910.38(a)

Plan must be reviewed with each employee
Emergency Planning And Response / Emergency Plan

- Emergency escape procedures and routes
- Accounting for all employees after evacuation
- Procedures for employees who remain to perform critical plant operations
Emergency Planning And Response / Emergency Plan

- Rescue and medical duties

- Preferred means of reporting fires and emergencies

- Emergency drills are not required, but are recommended
Element 13

Compliance Audits

- Evaluate compliance with the PSM standard every 3 years
- Audit team must include at least one person knowledgeable in the process
- Audit report documents findings
Compliance Audits

- Document responses to each of the findings listed in the audit report
- Document that all findings have been corrected
- Keep the two most recent compliance audits
Element 14

*Trade Secrets*

- Employer must make available all necessary information available to employees
  - Process Safety Information
  - PHAs
  - Operating Procedures
  - Incident Investigations
  - Emergency Planning and Response
  - Compliance Audits