



Prevention Program Program Level 3 Processes

The heart of the Risk Management Program



Prevention Program

Program 2

- Safety information
- Hazard review
- Operating procedures
- Training
- Maintenance
- Compliance Audits
- Incident investigation

Program 3

- Process safety information
- Process hazard analysis
- Operating procedures
- Training
- Mechanical integrity
- Compliance audits
- Incident investigation
- Pre-startup review
- Management of change
- Employee participation
- Hot work permit
- Contractor accountability



Process Safety Information (PSI)

Process safety information is the foundation of a good prevention program



Guidelines and Best Management Practices

- One of the most important parts of the regulation relates to “recognized and generally accepted good engineering practices.”
- When it comes to the Risk Management Program and chemical safety in general (General Duty Clause), the strict interpretation of “grandfather clauses” ended on June 21, 1999



Purpose of PSI Requirement

- Ensure understanding of safety-related aspects of equipment, processes, and chemicals
- Know limits those aspects place on operations
- Adopt accepted standards and codes
- Most program elements depend on the accuracy and thoroughness of this information
 - Especially true for the process hazard analysis









Written PSI Requirements for Program 3 Processes

Chemical Hazards	Process Technology	Process Equipment
<ul style="list-style-type: none">✓ Toxicity✓ Permissible exposure limits (PEL)✓ Physical data✓ Reactivity✓ Corrosivity✓ Thermal & chemical stability✓ Hazardous effects of inadvertent mixing of materials	<ul style="list-style-type: none">✓ Block flow diagram or simplified process flow diagram✓ Process chemistry✓ Maximum intended inventory✓ Safe upper and lower limits for items such as temperature, pressure, flows or composition✓ Evaluation of the consequences of deviation	<ul style="list-style-type: none">✓ Materials of construction✓ Piping and instrument diagrams (P&IDs)✓ Electrical classification✓ Relief system design & design basis✓ Ventilation system design✓ Design codes & standards employed✓ Safety systems✓ Material and energy balances for processes built after June 21, 1999



Common Codes and Standards for Program 3 Processes

Organization	Codes Include
	<p>Piping, electrical, power wiring, instrumentation, lighting, product storage and handling, insulation and fireproofing, painting and coating, ventilation, noise and vibration, fire protection equipment, safety equipment, pumps, compressors, motors, refrigeration equipment, pneumatic conveying</p>
	<p>Power boilers, pressure vessels, piping, compressors, shell and tube heat exchangers, vessel components, general design and fabrication codes</p>
	<p>Welded tanks, rotating equipment, bulk liquid storage systems</p>
	<p>Fire pumps, flammable liquid code, liquid natural gas storage and handling, plant equipment and layout, electrical system design, shutdown systems, pressure relief equipment, venting requirements, gas turbines and engines, cooling towers, storage tanks</p>
	<p>Inspection and testing, noise and vibration, materials of construction, piping materials and systems, instrumentation</p>
	<p>Chlorine handling, inspections, testing, equipment integrity</p>



Common Deficiencies

- PSI incomplete, not current, or inaccurate
 - Maximum inventories
 - Safe operating control limits not specified in written documents
 - Piping and instrumentation diagrams (P&IDs)
 - Title block shows no date
 - No “checked” or “approved by” signature
 - Inaccuracies noted during walk-through



Common Deficiencies (cont.)

- Obsolete equipment or design with no plans to change and no documentation to show it is still safe
- Good engineering practices/industry standards not followed
 - Examples: propane bullets with rust, no traffic barriers around piping, tank testing not at proper interval

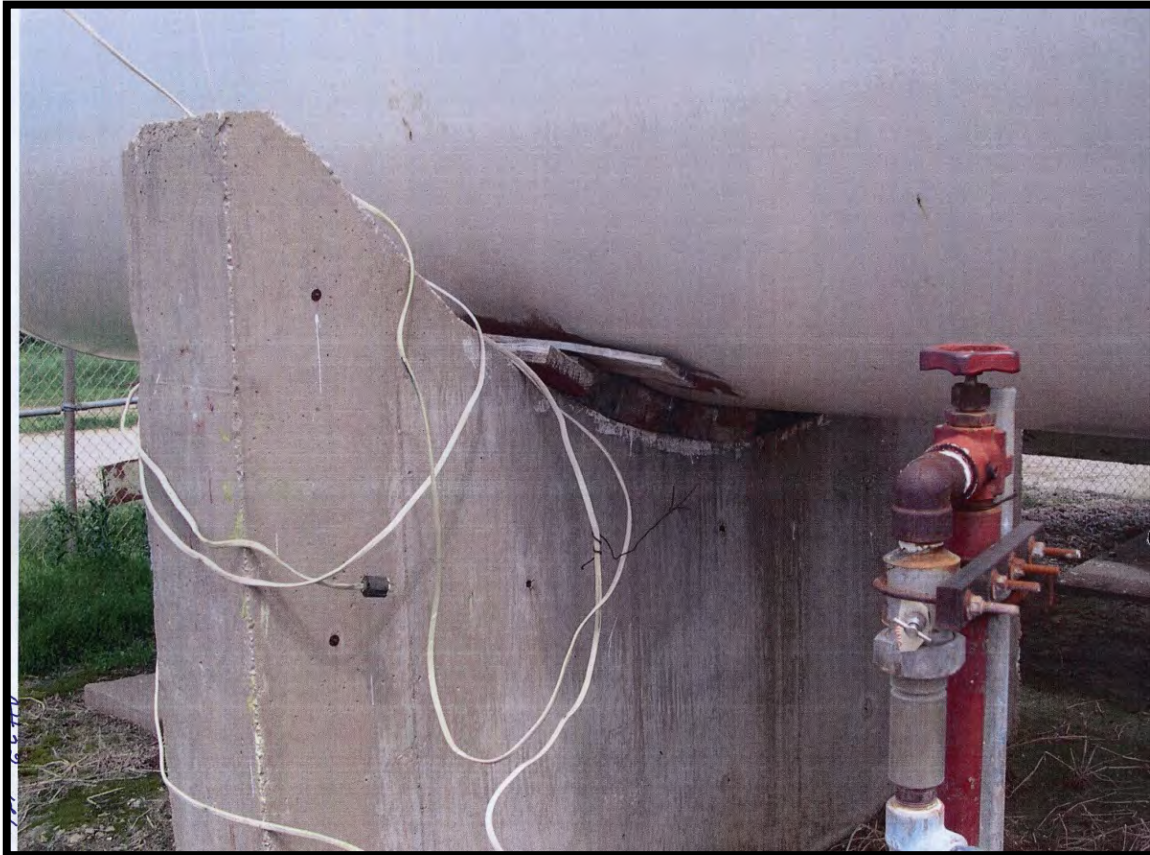


Rust – the cancer of steel





Saddles Fit Poorly





Saddles Not Designed to Prevent Movement





Vehicular Barriers Absent or Inadequate





Tanks On/Near Ground





Inadequate Bulkheads





Common Deficiencies (cont.)

- Other examples of good engineering practices/industry standards not followed include
 - Anhydrous ammonia pipes not marked throughout the entire facility
 - Markings not readily readable from any vantage point
 - No emergency water near the ammonia loading area



New Standard Released

- Make sure to consider new standards once they are released
- There is no “grandfathering” of old standards
- ANSI/CGA K61.1 (1999) superseded by CGA G-2.1(2014) “Requirements for the Storage and Handling of Anhydrous Ammonia” 6th Ed.



Process Hazard Analysis (PHA)

Determining what could lead to problems



PHAs

- Used to identify the potential hazards of the process and potential for chemical releases
- Things to consider
 - Operating pressures or runaway reactions
 - Human error
 - Typical causes of accidents
 - Need for hazard mitigation
- Incorporate PSI
- Findings used to develop operating procedures, training, mechanical integrity program, and emergency response plan/program



PHA Terms

- **Hazards:**

- Unsafe acts or conditions that create potential for accident(s) with undesirable consequences
- Loss of containment of flammable, combustible, highly reactive, or toxic materials
- Uncontrolled electrical hazards or mechanical overpressure

- **Accident:** unplanned sequence of events that has undesirable consequences

- **Consequence:** impact of accident (i.e., effects on people, property, or environment)



PHA Terms (cont.)

- **Risk:** measure of potential human injury, economic loss, or environmental impact in terms of severity or likelihood





Risk Matrix Example

Severity

		Probability				
		1 Frequent (once per year or more)	2 Reasonably Probable (once per decade)	3 Occasional (sometime during facility lifetime)	4 Possible (unlikely but possible)	5 Improbable (unlikely to occur)
Severity	A Catastrophic (death or severe damage)	1A	2A	3A	4A	5A
	B Severe (severe injury or major damage)	1B	2B	3B	4B	5B
	C Marginal (lost time injury or moderate damage)	1C	2C	3C	4C	5C
	D Negligible (first aid injury or minor damage)	1D	2D	3D	4D	5D
	E Not a Hazard	1E	2E	3E	4E	5E
		Unacceptable				
		Undesirable				
		Acceptable with Controls				
		Acceptable / Improbable				



PHA Factors Affecting Risk

- Process materials
- Process conditions
- Physical design
- Equipment
- Control system
- Standard operating procedures
- Operator training

- Test, inspection, maintenance practices
- Plant layout
- Emergency plans
- Protective measures
- Staff attitude
- Management attention
- Source siting



PHAs Must Cover

- Process hazards
- Previous incidents with potential for catastrophic results (including near misses)
- Engineering and administrative controls
- Consequences of failure of controls
- Stationary source siting
- Human factors
- Qualitative evaluation of health and safety impacts of control failure



PHA Requirements

- Performed by appropriate team
 - Experienced with process (not just contractors)
 - Knowledgeable about PHA technique
- System must be developed to
 - Address recommendations
 - **Document** resolutions
 - Take **timely** corrective actions





PHA Requirements (cont.)

- Update and revalidate at least ***every five years***
- PHAs and documentation of actions must be kept for life of process
- Communicate actions resulting from resolution to all appropriate personnel





Common Deficiencies

- Industry standard(s) have not been reviewed since the facility was designed/built (i.e., “grandfathered”)
- PHAs only conducted for PSM-covered processes
- Analysis has not been reviewed/updated at least every five years
 - PSI not up to date, so PHA not started on time
- PHA findings
 - Not resolved
 - Not documented
 - Not tracked – will show up on next PHA



Common Deficiencies (cont.)

- Facilities rely on generic analyses performed by the design and build companies for their reviews
 - Needs to be specific to facility
 - Needs to account for process changes
 - Ensure that accidents and near misses that have occurred at the facility are considered



Common Deficiencies (cont.)

- Facilities do not modify checklists provided by industry for facility specific issues
- Stationary source siting inadequately addressed
 - Facility located in floodplain
 - Vessel proximity to
 - Railroad or highway, or
 - Other vessels with incompatible materials (i.e. chlorine and anhydrous ammonia)
- Ensure PHA considers hazards associated with piping
 - Underground piping
 - Anhydrous ammonia travels in pipes throughout facility, but only the storage vessel is mentioned



PHA – Red Flag

Documentation only mentions PSM

Can use one analysis for both PSM and Risk Management Program, but ensure that the analysis is all-encompassing



Standard Operating Procedures (SOP)

More than just a piece of paper



SOPs Must Be

- Appropriate for equipment and operations
- Complete
- Easily understood by facility's operators
- Readily accessible to workers who operate or maintain process
- Reviewed/modified as often as necessary to reflect current practices and process changes



Required SOPs

- Initial startup
- Normal operations
- Temporary operations
- Emergency shutdown
- Emergency operations
- Normal shutdown
- Start-up following a normal or emergency shutdown or major change
- Lockout/tagout
- Confined space entry
- Opening process equipment or piping
- Entrance into the facility



Overlooked Procedures

- Temporary operations
 - Steps to ensure operations function safely
 - Documentation prepared and training conducted prior to starting temporary operations
- Start-up following emergency shutdown
 - After emergency shutdown, there may be additional steps (e.g., evaluating equipment status due to potential damage)
- Lock-out/tag out and confined space entry requirements
 - Similar to OSHA's requirements



Overlooked Practices

- Control of facility entrance by non-operations personnel
 - Need to control “outsiders” in unit
 - Inform them of hazards to avoid (e.g., area unsafe due to minor leak)
 - Inform operations of hazards outside personnel might introduce (e.g., work involving ignition sources)
 - Applies to maintenance, engineering, management, visitors (anyone not part of operations)
 - Who needs to be evacuated if emergency occurs
 - OSHA requires facilities to be able to perform evacuation head count (29 CFR 1910.38)



Requirements Consequences of Deviation

- What deviations need to be addressed?

Examples include

- High pressure
 - High or low temperatures
 - Exceeding capacities
 - Operating without adequate level
 - Feeding too fast
- Consequences could be leak, rupture, overflow, explosion, equipment damage, etc.



SOP Requirements

- Steps to avoid or correct deviations
 - Operating instructions to maintain appropriate conditions
 - Specific steps to take to correct problems if they occur
- Ensure procedures include safety systems and their functions
- Annually document certification that procedures are current and accurate



SOP Requirements (cont.)

- Ensure procedures address the following safety and health considerations
 - Chemical properties and hazards
 - Precautions for preventing chemical exposure
 - Control measures for exposure
 - Quality control for raw materials and chemical inventory
 - Special or unique hazards



Common Deficiencies

- Failure to have all of the required procedures
 - Document if an operating scenario is not applicable to the process (most common – no temporary operations)
- Failure to annually certify
- Failure to include operating limits and consequences of deviation in operating procedures



Do SOPs Reflect Actual Operations?

- Do NOT treat the annual certification as a mere signature on the page
- How inspectors spot issues
 - Revision date
 - What operators say differs from what is written
 - Management of Change (MOC) documents



Training

A trained workforce poses less risk



40 CFR Part 68 Training Requirements

Training Requirement	Section
Operating Procedures, Safe Work Practices & Refresher	68.71
Mechanical Integrity	68.73(c)
Management of Change & Pre-Startup	68.75(c) 68.77(b)(4)
Contractors	68.75(c) 68.87(c)
Emergency Response	68.95(a)(3) 68.87(c)



Operating Procedure Training

- Employees trained in operating procedures pertinent to their duties
- Training required for updated/new procedures prior to startup of process after major change
- Refresher training required at least every 3 years
- On-site documentation required for employees & contractors
 - Employee identity
 - Date of training
 - Means used to verify employee understood training



Mechanical Integrity Training

- Training required for employees responsible for process maintenance activities
- Training must cover
 - Overview of process
 - Hazards of process
 - Procedures applicable to do job tasks
- Maintenance contractor responsible for training employees in facility's maintenance procedures



Training Prior to Startup After Major Change

- Ensure personnel know how to do their job before equipment is restarted
 - Changes can include new process equipment and/or introduction of regulated substance(s)
- Training in updated procedures for
 - Operator, employees, and contractors
 - Those involved in maintaining process equipment



Contractor Training

- Prior to start-up after change
 - Inform and train contract employees whose job tasks were affected
- Ensure each contract employee is instructed in
 - Known potential fire, explosion, or toxic release hazards of the process
 - Process hazards related to his/her job
 - Applicable provisions of emergency action plan



Emergency Response Training

Applies only to facilities that will respond to a release of the regulated substance(s) (68.95(a)(3))

- Train employees in relevant emergency response program procedures



Common Deficiencies

- Some employees do not get refresher training
 - Process maintenance and contractor personnel
 - Multiple shifts (particularly overnight and weekend shifts)
- Lacking documentation of each individual's training
- Training does not address facility-specific operating procedures
- Documentation does not include how it was verified that employees understood training



Mechanical Integrity (MI)

Well-maintained equipment is less likely to fail



Mechanical Integrity Requirements

- Critical to safe operations
 - Preventive maintenance
 - Inspections and tests required
 - Running equipment to failure unacceptable
- Mechanical integrity program
 - Prevent incidents/accidents/releases
 - Save facility money





Mechanical Integrity (MI) Program Includes

- Written program
- Criteria or rationale used to establish testing and inspection frequency
- Test and inspection schedule established for all equipment
- Adherence to calibration testing and inspection schedules
- Established process for use, removal, or replacement of equipment out of specifications
- Written test procedures for all tests performed



Mechanical Integrity Requirements

- Each inspection and test ***must be documented***
 - Date
 - Inspector's name
 - Equipment identifier
 - Test or inspection performed
 - Results





Mechanical Integrity Requirements (cont.)

- Document inspection results and corrective actions
 - Equipment deficiencies are results outside acceptable limits (as defined by PSI)
 - Correct equipment deficiencies
 - Prior to further use or
 - In safe and timely manner when necessary means are taken to assure safe operation





Quality Assurance

- Assure that new equipment as installed or fabricated is suitable for process application
- Perform appropriate checks and inspections to assure that equipment is installed properly and is consistent with design specifications and manufacturer's instructions
- Assure that maintenance materials, spare parts, and equipment are suitable for process application



Common Deficiencies

- No written mechanical integrity procedures
- Equipment not inspected or tested
- Testing/inspection interval doesn't meet industry standards
- Failure to follow recognized and generally accepted good engineering practices
 - Proactive relief valve replacement
 - Proactive hose replacement
 - Painting



Common Deficiencies (cont.)

- No plan for replacing equipment when it fails
- No program for monitoring integrity of tanks
 - Especially worst-case vessel
- Failure to consider piping, particularly underground piping



Compliance Audits

Self-inspect and fix problems



Compliance Audits

- Think of this as an opportunity
- Play inspector for the day
 - Use EPA's inspector's checklist found at the bottom of the following website*
<https://www.epa.gov/rmp/guidance-facilities-risk-management-programs-rmp>
- Safety audits \neq compliance audits

*Website active as of November 2016



Compliance Audit Requirements

- Conduct and certify compliance audits every *three* years
- Self-audit compliance with **CAA 112(r) Prevention Program** requirements
- Identify problem areas, recommend corrective actions, and follow through



Compliance Audit Requirements (cont.)

- Must be performed by at least one person knowledgeable in the process
 - If performed by outside consultant, someone from facility must also participate
 - In documents, specify the name and title of person from the facility participating in the audit
- Documentation
 - Develop report of audit's findings
 - Respond to each of the audit's findings
 - Should be developed promptly, and any corrective actions listed explicitly
 - Retain the two most recent compliance audit reports



Addressing Findings

- Assign responsibility for each recommendation to an individual
- Assign start date and completion date
- **Document** action taken, label “closed” with date of completion



Common Deficiencies

- Failure to conduct compliance audit on every process every three years
- No certification by company official
- Failure to detect major prevention program errors
- Issues found not addressed/documentated
- Action items not documented or tracked to ensure resolution
- Only partially audited, or assumes that sections audited previously do not need to be evaluated



Compliance Audit – Red Flag

The same finding appears on subsequent audits

Are changes in program needed to improve compliance?



Incident Investigation

An incident occurred. Now what?

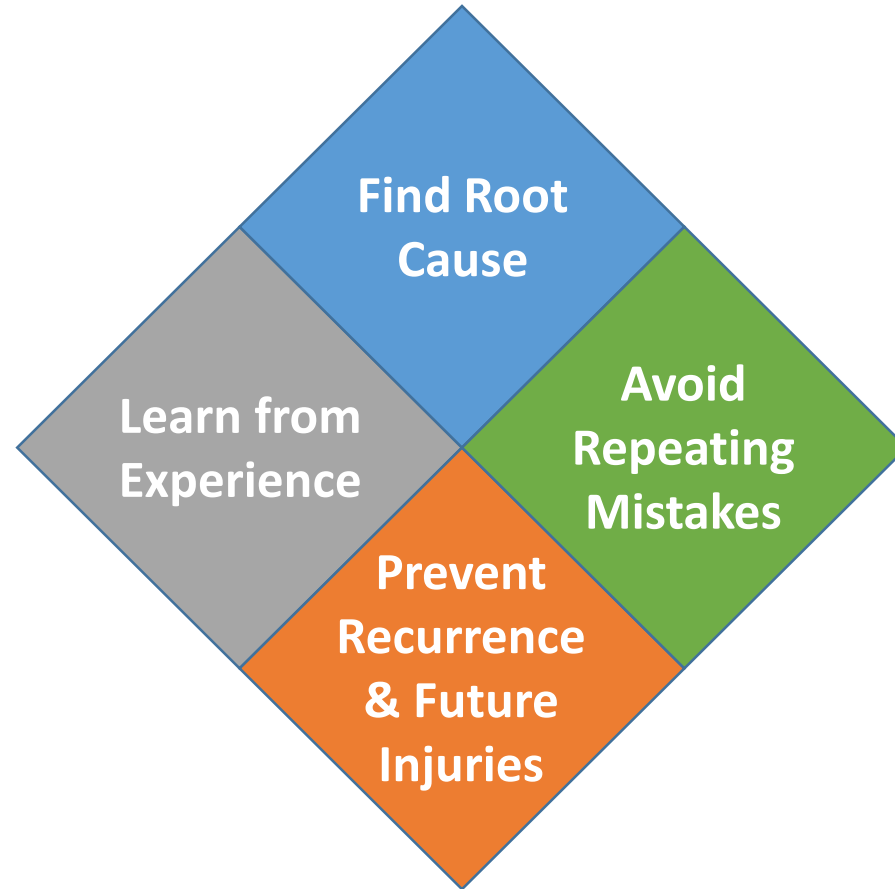


Definitions

- **Incident:** event that resulted in, *or could reasonably have resulted in*, catastrophic release
- **Catastrophic release:** one that presents imminent and substantial endangerment to public health and the environment



Purpose





Potential Incidents to Investigate

- CERCLA/EPCRA reportable releases
- Risk Management Program reportable accidents
- Accidents reported on the OSHA 300 Log
- Incidents where management of change procedures were implemented



Potential “Near Miss” Investigations

- Many facilities do not value the knowledge that can be gained from “near miss” investigations
- Consider investigation if
 - “...and the safety systems were tripped”
 - “...it was fortunate that nobody was in the area”
 - “...this same maintenance issue/safety valve relieving keeps happening”



Near Miss Investigations as an Opportunity

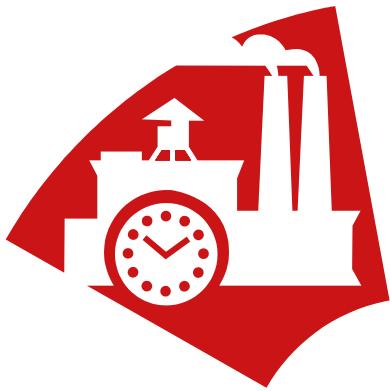
Learn from the past to prevent harm in the future

Don't wait for someone to get injured or for a release to occur before deciding to make changes



Requirements

- Initiate investigation within 48 hours of incident
 - Includes weekends and holidays
 - Investigation for Friday incident must begin no later than Sunday
- Establish knowledgeable investigation team





Requirements (cont.)

- Summarize investigation in written report
 - Date of incident
 - Date investigation began
 - Description of incident
 - Factors that contributed to incident
 - Address investigation team's findings and recommendations



Incident Investigation Resolution

- Owner/operator required to “promptly address and resolve” findings
- Regulation does NOT require adoption of all recommendations
- All resolutions and corrective actions must be documented
- Review findings with all affected personnel
- Retain investigation summary for 5 years



Common Deficiencies

- Not all incidents are investigated, possibly including
 - Near misses
 - 5-year accident history
 - EPCRA/CERCLA reportable releases
- Unresolved or undocumented findings/recommendations
- Reports never finalized
- Findings not discussed with affected employees/contractors
 - Make sure to document these discussions



Incident Investigation – Red Flag

Investigation's only finding was equipment failure and/or human error at fault

Did the investigation get to the true root causes?



Incident Investigation – Inspection Tip

- When no incidents have been investigated, inspectors look at
 - Various reports to see if incidents should have been investigated
 - OSHA 300 logs
 - Risk Management Program reportable accidents
 - EPCRA/CERCLA release reports
 - Procedures for incident investigation to see how near misses are discussed
 - Procedures to ensure that all required elements are addressed



Elements Unique to Program 3

Management of Change, Pre-Startup Review, Employee Participation, Hot Work, Contractors



Prevention Program

Program 2

- Safety information
- Hazard review
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Program 3

- Process safety information
- Process hazard analysis
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- Incident investigation
- **Pre-startup review**
- **Management of change**
- **Employee participation**
- **Hot work permit**
- **Contractor accountability**



Management of Change (MOC)

- Owner or operator required to establish and implement **written** procedures to manage changes to process chemicals, technology, equipment, and procedures that would affect CAA 112(r) covered process
 - Does not include replacements in kind



MOC Procedures Must Address

- Technical basis for change
 - Describe change
 - Provide drawings and specifications as necessary
- Impact on safety and health
 - Evaluate potential change in hazards, consequences, and risk
- Necessary time period for change
 - Permanent
 - Temporary with established end date



MOC Procedures Must Address (cont.)

- Modifications to operating procedures
- Authorization requirements for proposed change
 - Appropriate authorization levels
 - Authorized before installation



Additional MOC Requirements

- Prior to start-up of the process
 - Inform and train employees affected by the change
 - Includes all shifts, maintenance personnel , and contractors
 - Update relevant documents, possibly including
 - PSI (such as P&IDs)
 - PHA analysis
 - SOPs



Common Deficiencies

- Failure to follow “replacement in kind”
 - A change in the original equipment manufacturer (OEM) specs is a change
- MOC process not complete prior to change
 - **MOC should not be after-the-fact paperwork**
- PSI, SOPs, etc. not updated accordingly
 - If not done, delays PHA process



Pre-Startup Safety Review (PSSR)

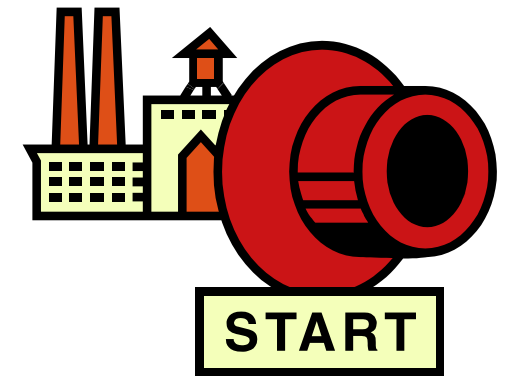
- Pre-startup safety reviews are necessary for
 - New stationary sources
 - Modified stationary sources whenever modifications require change in PSI



Applicable Process Change



Pre-startup Safety Review



Startup



PSSRs Should Confirm That

- Construction and equipment is in accordance with design specifications
- Safety, operating, maintenance, and emergency procedures are in place
- A PHA has been performed for new stationary sources and recommendations have been resolved



PSSRs Should Confirm That (cont.)

- Changes to existing stationary sources have been reviewed under MOC requirements
- Employee training is completed
- Confirmations must occur **before** introducing a regulated substance to a new or modified process
 - Failure to do so can **AND DOES** cause accidents



Common Deficiencies

- Not conducted prior to startup of the process
- Construction and equipment not per design
- PSI not updated



Employee Participation

- 40 CFR 68.83 requires owner or operator to
 - Develop **written** plan of action for employee participation
 - Consult with employees on development of PHA and other elements of process safety and the prevention program
 - Provide access to PSI, PHAs, SOPs, and any other pertinent program information



Common Deficiencies

- No written employee participation program
- Employees not involved in development of PHAs and other elements
- Written employee participation program not followed
- Employees do not know how to access documents



Hot Work

- **Hot work:** work involving electric or gas welding, cutting, brazing, or similar flame or spark-producing operations
- EPA's requirements (40 CFR 68.85) are similar to OSHA's



Common Deficiencies

- Permits not fully completed and maintained according to procedures
- Note: once hot work is completed, there is no regulatory requirement to maintain copy of permit



Contractors

- 40 CFR 68.87 requires the owner or operator to obtain and evaluate information regarding contract owner or operator's safety performance and programs ***before*** selecting contractor



Facility Responsibilities

- Provide safety and hazard information to contractors
 - Potential fire, explosion, or toxic release hazards
 - Facility's emergency response activities as they relate to the contractor's work and process
- Ensure safe work practices (e.g., hot work permits, lock-out/tag out) to control activities of contractors in covered process areas
- Periodically evaluate contractor in meeting their responsibilities





Common Deficiencies

- Safety performance and programs not evaluated by facility
- Facility does not ensure contractor trained in facility's procedures