Process Safety Management of Highly Hazardous & Explosive Chemicals

Management of Change
What if Our PHA’s Reveal the Need to Change Something In our System to Minimize the Potential for Release…

We Must Use Management of Change (MOC)
Management of Change

1910.119(I)

The employer shall establish and implement written procedures to manage changes (except for "replacements in kind") to process chemicals, technology, equipment, and procedures; and, changes to facilities that affect a covered process.
Management of Change - Why?

- Many of the catastrophic accidents over the past few decades can be traced, in large part, to a management of change system that was not in place or was not functional (e.g., Flixborough, Bhopal).
Case Study: Flixborough

- Vapor cloud explosion - fueled by release of 30 tons of cyclohexane
- Largest single loss by fire or explosion in the United Kingdom
  - killed 28 people
  - injured 89 others
  - $63 million in property damage
MOC Cause: Temporary Modification
Why did the Bypass Piping Fail

- No safety review and inadequate supervision
- Job was beyond professional capabilities of the workers
- Only drawing was a full-size sketch in chalk on the workshop floor.
- No one understood the forces that would be imposed on the pressurized piping
What Was Learned?

- A proper MOC procedure could have prevented this accident.
- One of Main recommendations from inquiry
  - Any modification should be designed, constructed, tested, and maintained to the same standards as the original plant.
Focus of MOC

- To prevent catastrophic accidents and to properly evaluate the concerns of safety and health and to accomplish this review in a timely manner.
Failures in MOC

- Vapor cloud explosion and major fire within a refinery
  - 7 deaths
  - 13 injuries
  - $35 million in losses (half in property damage, half in business interruption)

- Cause: Hidden Change to a valve
Failures in MOC

- Storage tank containing flashing, flammable fluid.
- Tank was connected to process unit via 10” line.
- Corrosion attacked valve bonnet bolts and weakened them.
- Bonnet was blown off and an uncontrolled, catastrophic release occurred.
Performing Management of Change

The Keys to Success
Management of Change (MOC)…Our Program Must

- Explain the purpose of MOC
- Set the provisions to be considered for temporary change
- Define and give example of change in equipment that requires MOC
- Define and give examples of changes in procedures when need
- Define and give examples of change in process technology
Management of Change (MOC)…Our Program Must

- Define and give example of a major change
- Define and give example of a minor change
- Define and give examples of "replacement in kind"
- Describe and list the procedures required for initiating and completing a MOC
Management of Change

Important March 31, 2009 Letter From OSHA:

“Some organizational changes such as changes resulting from mergers, acquisitions, reorganizations, staffing changes or budget revisions, may affect PSM at the plant level and would therefore trigger a PSM MOC procedure.
MOC
Replacement in Kind

- A replacement that satisfies the design specifications.

Examples
- raising reactor temp. within safe operating envelope
- replacing equipment or piping meeting the same specifications as the original
MOC-What is a Change?

- Change is an alteration or adjustment to any component, variable or property within an existing system (except those within clearly defined boundaries or responsibilities).

- Examples
  - changes that alter production rates
  - changes involving safety relief or vent systems
  - deteriorating materials
Management of Change
Are These Change or Replacement in Kind?

- Changing metallurgy of a piping system.
- Recalibrating instruments
- Operating with a heat exchanger out of service
- Replacement of gate valves with ball valves (within the plant valve specifications)
What Type of Stainless? What type of Nozzle?

Coded Metal
MOC Application

- Management of Change should be Completed on BOTH:
  - Temporary
  - Permanent Changes
MOC Emergency Procedures

- Emergencies may require changes without formal MOC.
- Contingency plans should be in place.
- When normal operations resume, complete MOC should be implemented.
MOC Program Elements

- Identification System
- Change Control Mechanism
- Training - Employees & Contractors
- Information Management System to Manage & Track All MOC Projects
- Auditing of the MOC Program Performance
Identification System

- Screening process for identifying changes.
  - Includes risk ranking process based on effect item could have on safety of process

- Requires clear, written, definition of system boundaries and what constitutes “change”
Change Control Mechanism

- Explains how to manage the change.
- Must clearly identify:
  - the work flow procedures (MOC Forms & Process)
  - Responsibility and Authority Required to Implement Change
  - Approval Levels Required to Start MOC Process
Anyone who could affect a change must be properly trained in the Management of Change system.

Commitment from all levels of management and staff.

 Contractors if Affected, Must be Included.
MOC - Information Management System

- Method to Track MOC Documentation and Actions
- Software/documentation that tracks all changes and their progress if Preferred
- Allows access to most current information
  - eg. If two changes are inter-related they will be aware of one another
MOC - Auditing

- Ensures That System is Working as Designed
- MOC system should be constantly evolving and improving in efficiency and effectiveness
- Verifies changes are assessed accurately & tracked
Flowchart of a MOC Program

1. Identify Change
2. Determine Significance of Change
   - Low
   - Uncertain
   - Medium/High
3. Review with Team Leader
4. Appropriate Risk Assessment
5. Approval
6. Training and Communication
7. Implement Change
8. Follow-up
9. Simple Risk Assessment
   - Low Risk
A MOC form is used by most companies to guide employees through the procedure. The MOC form should include:

- Description, purpose, and tech. basis for the change
- Assigned level of risk
- Safety, Environmental, and Health impacts
- Necessary time period for the change
- Authorization for the proposed change
- Interfaces with the PSSR program
Examples of yes/no questions to determine the hazard level:

- Does the change introduce a significant source of energy (chemical, mechanical, thermal, electrical)?
- Does the change result in any increase of toxic, flammable, or reactive material?
- Does the change significantly increase the potential for personnel exposure to a hazardous material?
Examples of yes/no questions used to determine potential severity level:

- Could the change take the process outside the safe operating envelope?
- Does the change significantly alter the heat and material balance?
- Does the change introduce new molecules?
Remember - Risk Analysis

Risk Ranking Matrix

- Frequent
- Likely
- Unlikely
- Rare
- Extraordinary

Severity:
- Negligible
- Minor
- Major
- Severe
- Disastrous

Significant Risk
Insignificant Risk
Can PHA Recommendations Affect MOC’s?

- Any Changes in Defense Designs, or System Engineering will Require Management of Change
  - P&ID
  - Equipment Lists
  - Inspection/Testing/Maintenance Procedures
  - PHA’s
Can MOC’s Affect Everything in Our Program?

Might Affect:
- Process Information
- Process Toxicity
- Technology of the Process
- Equipment in the Process
- Mechanical Integrity
- Inspection & Testing
- Quality Assurance

Might Affect:
- PHA’s
- Operating Procedures
- Safe Work Practices
- Training for Both Employees & Contractors
- Compliance Audits

Basically….Everything!
Process & Goals of Management of Change

Both Pre & Post
Management of Change (MOC)

- MOC procedure should ensure that equipment and procedures are returned to their original conditions at the end of a temporary change.
- MOC forms/clearance sheets are acceptable control methods of tracking changes.
- More complex changes require a more "formal hazard evaluation" than simple changes (PHA not specifically mentioned).
Management of Change (MOC) - Pre-Modification Issues

- Check codes, standards, internal engineering specifications
- Complete design review
- Perform reactivity testing for new substances
- Add materials to TSCA/SARA inventories
- Complete safety and health impact review
- Comply with safety and loss prevention requirements

Remember all the Codes We Have Already Discussed
Management of Change (MOC) - Pre-Modification Issues

- Complete maintenance review/revise spare parts list
- Evaluate change against vent, relief, and flare capability
- Complete industrial hygiene review
- Review change against existing environmental permits
- Obtain required approvals from
Management of Change (MOC)  
Post-Modification Issues

- Completed Process Safety Systems Review (PSSR)
  - Also References Pre-Start Up Safety Review
- Completed training on change for affected employees
- SOPs marked-up
- P&IDs, PFDs, plot plans and other affected Process Safety Information (PSI) marked-up
- Training program modifications identified
- Preventive maintenance program modifications identified
Management of Change
Summary

- We must establish and implement written procedures to manage changes except "replacements in kind" for a covered process.
- If a Change in Design or Components is Required, Management of Change Must be Employed, Tracked, and Analyzed.
- All PHA’s, P&ID’s & Required Procedures Must be Revised
- Work-site employees and contract employers must be informed and trained on the changes prior to start-up.
Consider the Use of Technology to:

- Perform
- Document
- Track
- Adjust
- Maintain

The PSM Program
NASA High Pressure Gas Plant

Management of Change
Case Study
Team Exercise
Nitrogen & Helium Plant
Team Exercise

- With the Information to Follow in The NASA Case Study Video, Presentation & Notebook,

- With Your Team Members, Perform the Following Exercises & Answer the Following Questions:
Case Study Exploration

1. When is Management of Change Required?
2. What Authorizations must be Obtained Before Beginning MOC?
3. If A Repair of the Shell Plate of Hydrogen Tank V267-LH Was Necessary, Would the repair be Governed Under MOC?
4. If the Software Program that Manages the High Pressure Gas Plant Was Changed, Would the Project be Governed Under MOC?
5. If a Change in the Design of the Piping between the Pumps and the Tank Was Required by the Recommendations in a PHA, Would the Project be Governed Under MOC?
6. What Codes might Govern the Change of the Pipe Design?
7. What MOC Team Members Would You Suggest be Involved in the Re-Design of the Piping Between the Pumps?

We will Discuss the Findings of Each Team in the Class
What’s Next

- Are There Procedures Required to Operate any Covered Process?

Operating Procedures