Implementation of Process Safety Standards in an R&D Environment

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Basell Polyolefins
Research and Development Center

- Part of North American Headquarters Site
- 100 total R&D employees
  - Product Development
  - Polymer Characterization
  - Limited Process Development / Process Support
- Process Development Equipment
  - “Littleford” batch reactor.
  - Continuous Interloy Pilot Plant
  - Polymerization Lab
- Our process safety is supported by
  - A commercial plant organization that supports full compliance with PSM
  - An active safety department at our R&D site
  - Detailed R&D safety standards and practices

OSHA Process Safety Management Standard

(29 CFR 1910.119)

- The standard was phased in during the mid 1990's.
- Generally 10,000 pound Threshold for flammables
  - Some highly toxic substances as low as 100 lbs
- The Process Safety Standard has 14 separate requirements

OSHA Process Safety Management Standard

(29 CFR 1910.119)

Employee Involvement

Process Safety Information

Process Hazard Analysis

Operating Procedures

Training

Contractors

Pre-Startup Safety Review

Mechanical Integrity

Non-routine Work Authorizations

Management of Change

Incident Investigation

Emergency Planning and Response

Compliance Audits

Trade Secrets

For Each Standard:

- What OSHA would require if the PSM standard were applicable
- What Basell R&D is doing in our small processes
- A realistic look at costs and benefits
- Suggested implementation strategy

PSM Process Safety Information

"The compilation of written process safety information is to enable the employer and the employees involved in operating the process to identify and understand the hazards posed by those processes involving highly hazardous chemicals."

Process Safety Information

OSHA groups PSI into three categories:

- Hazards of the chemicals and flammables in the process
- Information related to the technology of the process
- Information related to the equipment in the process

Basell R&D Process Safety Information

- For a lab or single piece of equipment, all information is often contained in a ***SOP*** (***S***tandard ***O***perating ***P***rocedure).
  - Posted on company intranet
  - Copy at equipment
- For a pilot plant, book and a CD including ***P&ID***'s (***P***iping and ***I***nstrumentation ***D***iagram)
  - Library, engineers, and safety department copies
  - Local postings of individual applicable items

Polymerization Laboratory Process Safety Information List

- P&ID
- Valve, Instrument, and Line List (Excel)
- Control system logic listing
- Interlock Listing with safe operating limits
- Plot Plan with electrical classification areas
- Operating Procedures
- Emergency Plans
- Chemical inventory / MSD's
- PM schedule
- Equipment Vendor data (PDF if possible)
- Process Design Calculations
  - Relief system design
  - Deviations from applicable standards
- Polyolefin Polymerization Process training materials

Process Safety Information Minimum Recommendations

- Develop a P&ID for any process
  - CAD is not necessary; hand drawn or *Visio* will work
- Develop valve and instrument lists from the P&ID. Use *Excel* to organize the list
- Print out or document computerized control programs
- Put together an expected chemical inventory, print out MSD's and put them in a 3-ring binder
- As equipment arrives, verify that manuals are included and put them someplace safe
- **Remember--everything else proceeds from good process information**

PSM Process Hazard Analysis

"The process hazard analysis shall be appropriate to the complexity of the process and shall identify, evaluate, and control the hazards involved in the process."

PSM Process Hazard Analysis

- PHA includes discussion of
  - Facility
  - Human Factors
  - Previous incidents
  - Mitigating controls and their possible limitations
- A System must be in place for resolving the recommendations of the PHA team
- PHA's must be periodically reviewed

Basell R&D Process Hazard Analysis: Polymerization Lab

- A process hazard Analysis includes
  - Preparation
  - Review Meeting(s)
  - Follow-up
- Team Composition
  - A leader trained in Leading PHA
  - Safety Professionals (Site and Process)
  - Operators & Maintenance
  - Engineers and Group Leaders
- PHA Method used—What if
  - Detailed preparation in advance
- Documentation with PHA-Pro6
  - Documentation includes who attended meetings
- Follow-up

PHA Recommendations

- Be aware of significant time investment
  - Even without a formal review, some of this time would be expended
- Chose a method that suits your situation
- Preparation and well-qualified leadership payback
- Review may “bog down” in non-process issues
- Document as you go

PSM Operating Procedures

"The employer shall develop and implement written operating procedures that provide clear instructions for safely conducting activities involved in each covered process consistent with the process safety information"

PSM Operating Procedures

- Procedure Steps
  - Initial Startup
  - Shutdown
  - Temporary startup and shutdown
  - Emergency shutdown
- Implementation of hazardous energy isolation
- Recertify once per year

Basell R&D Operating Procedures

- Types:
  - Single unit: “SOP” Document
  - Pilot Plant:
    - Work Instruction Set for routine operations
    - Contingency and Emergency Procedures
    - PM Procedures
- All Basell R&D Procedures Contain
  - Step by Step instructions
  - Valve numbers and Instrument tags

Advantages of Written Procedures

- In General:
  - Consistency of Operation
  - Training Tool
  - Tracking Tool
- Specifically
  - We saw a huge increase in operability in multi-shift operation from enforcement of procedures
  - Consistent batch operation
  - Ease of integrating new experimental methods or control system components

Written Procedures Recommendations

- Some type of written procedures are required for any experimental design
- Decide what level of detail is required in the procedure for consistent operation based on the hazards present and the skill of the operator(s)
- Consistent use of procedures is an ongoing leadership issue
- Formally recertifying procedures reinforces their importance

Pre-Startup Safety Review

"The employer shall perform a pre-startup safety review for new facilities and for modified facilities when the modification is significant enough to require a change in the process safety information."

Pre-Startup Safety Review

More than just a walk-thru, the pre-startup safety review confirms that prior to the introduction of highly hazardous chemicals to a process:

- Construction and equipment is in accordance with design specifications;
- Safety, operating, maintenance, and emergency procedures are in place and are adequate;
- PHA recommendations have been resolved
- Training of each employee involved in operating a process has been completed.

PSSR Recommendations

- Prepare thoroughly; Allow time for follow-up
- Develop a *systematic* method to check construction to specifications
  - Prepare as-built P&ID
  - Tag valves and instruments
- Verify “Paper Work” in order:
  - PHA action items
  - Training
  - PM plans
  - Procedures
  - Emergency Plans

PSM Mechanical Integrity

"There must be a program in-place to ensure the integrity of key equipment involved in PSM processes. This program must be preventive in nature and not be triggered by breakdown in the equipment."

PSM Mechanical Integrity

Covered Items

- Pressure vessels and storage tanks
- Piping systems and valves
- Relief and vent systems
- Emergency shutdown systems
- Controls (including monitoring devices and sensors, alarms and interlocks, fire detection and protection systems)
- Rotating equipment (pumps, compressors, blowers, etc.)

Inspection Program

- Written Procedures
- Training and qualification of Maintenance workers
- Definition inspections, or maintenance.
  - Generally accepted good engineering practices
  - Adjustment of frequency based on experience.
- Documentation
- Correct deficiencies before further use
- Verify proper selection and installation of equipment

Mechanical Integrity Recommendations

- Prepare a Covered Items List
- For each item, establish tasks
- Set up a Reminder System
- Document and Include in PSI
- Verify at the PSSR

PSM Management of Change

“Change includes all modifications to equipment, procedures, raw materials and processing conditions other than "replacement in kind." These changes need to be properly managed by identifying and reviewing them prior to implementation of the change.”

At Basell R&D MOC Required for every change that meets criteria:

- Process chemistry
- Raw materials or additives
- Established safe operating limits (temperature, pressure,
- charge quantities, order of addition, or experimentation)
- Operating procedures
- Additions, deletions or bypasses of equipment piping or instrumentation (including new equipment)
- Area electrical classification
- Computer software or hardware
- Alarms, interlocks, or relief setpoints
- Materials of construction
- Design specifications
- Operating state (i.e., decommissioning)

Basell R&D MOC Form

- Describes, in detail, the process change that triggers the “MOC”
- Outlines actions that may be required to institute change
  - Process Hazards Analysis
  - Retraining
  - Changes to PSM
  - PSSR
- Approval of form from area manager and safety department
- Form Filed with Process Safety Information and the safety department

Management of Change Recommendations

- Declare and document a baseline
- Develop a self guided form that enables proposal, documentation, and approval with one document
- Get in the habit of using the form to document your work.
- “Approval” may consist of discussing with a colleague. Set approval requirements in advance based on your situation

PSM Emergency Planning and Response

"A written plan must be in-place to respond to emergencies involving applicable processes. A site may decide not to get involved in an incident and let local emergency response personnel handle it. In this case, the emergency action plan will focus on evacuation and notification."

Basell Polylab Emergency Planning and Response

- Clear, Written Policies regarding when
  - Employees may fight fires
  - Employees may clean up spills
  - Employees may attempt to mitigate releases
- Basell has chosen to use local emergency response personnel except for the smallest of incidents.
- Periodic rehearsals with lab and site personnel
- Separate training for security guards, instructions posted

Simple Emergency Response Recommendations

- Decide and document your plan in advance
  - Hazards involved
  - Skill level(s) of involved personnel
- Review with all involved personnel yearly
- Maintain responder equipment (spill cleanup materials, fire extinguishers) as part of your PM.
- Require sticking with the plan when something goes wrong—no heroes
- Maintain complete chemical inventory Lists

None of these steps should have significant cost or time commitment if a low response level is chosen

A Systematic Approach to Process Safety

- A Systematic Approach can be applied what ever the size of the equipment.
- Everything Proceeds from Good Process Safety Information
- Preparation will make safety reviews cost less and accomplish more
- Good Documentation of Changes Makes Your Work Easier in the Long Run
- The Benefits in Improved Safety and Operation are Worth the Investment.

OSHA PSM as a Framework for Process Safety

- You don't have to reinvent the wheel, independently outlining a safety design process.
- You will be less likely to completely ignore an essential issue.
- You can use the same software tools (PHA for example) used for PSM implementation at large facilities.
- You will speak the same language as your colleagues in commercial plants as well as safety professionals.
- There is a wealth of free information on the internet, in safety publications, and engineering periodicals referring to PSM issues. Many courses and books are available as well.

Resources for Understanding the Process Safety Standard

- Standard 1910.119
- Appendix C of Standard
- Outside Training
  - Online Courses
- Your own organization's HSE policies probably mirror the OSHA Standard

“Every engineer's goal is to retire without being blamed for a major catastrophe”