

New Concerns for Toxic Exposure and Process Safety in Air Pollution Control Reagents EPGA 2005 Power Generation Conference Hershey, PA

William H. (Bill) Barnes, PE
Manager of Consulting Engineering
Avogadro Environmental Corporation
Easton, PA
(610) 559-8776

bbarnes@avogadro.net
www.avogadro.net

Avogadro Environmental
Corporation

Power Plants are looking more like Chemical Plants

- Single and Multi-Pollutant APC Technologies increasingly are utilizing chemical reactions to pre-treat stack gases to increase capture
- Reagents now introduced are typically hazardous substances themselves such as ammonia, propylene, and hydrogen peroxide
- The challenge is the safe introduction and use of environmentally hazardous substances to accomplish even greater environmental benefit
- Understanding perceived risks by communities and emergency responders

A Quick Overview

- Understanding the Regulatory Programs for managing hazardous substances
- Understanding challenges to technology developers and APC vendor E&C firms to support safe and successful implementation
- Understanding challenges to generator startup and operations teams to maintain compliance with new rules unfamiliar to the industry

EPA and OSHA Regulatory Programs:

- The Clean Air Act Amendments of 1990 – Two Major Regulatory Programs addressing Chemical Accidental Releases:
 - OSHA's Process Safety Management (PSM)(1992) regulations to protect employees from highly hazardous chemicals (29 CFR 1910.119)
 - EPA's Risk Management Programs (RMP) for Chemical Accidental Release Prevention regulations to protect the community from highly hazardous chemicals (40 CFR Part 68)

RMP and PSM Applicability:

- OSHA has defined a list of highly hazardous substances including Aqueous Ammonia over 44% concentration and 15,000 pounds found in a single process.
- The EPA has defined a list of regulated substances and thresholds, including Aqueous Ammonia over 20% concentration and 20,000 pounds found in a single process.
- Aqueous Ammonia to be used in the SCR Process is 29% concentration with a storage capacity in typical tank farms of >20,000 pounds
- RMP Rule applies but PSM not required BUT many aspects of PSM are integrated into the RMP Program.

What's Required

- If a process exceeds specified thresholds, registration with the EPA is required.
- Development/implementation of a Risk Management Plan (RMP) including:
 - Hazard Assessment
 - Prevention Program (Similar to PSM)
 - Emergency Response Program

What's Required

- Implement a Process Safety Management (PSM) Program including:

Employee Participation	Mechanical Integrity
Process Safety Information	Hot Work Permits
Process Hazard Analysis	Management of Change
Operating Procedures	Incident Investigation
Training	Emergency Planning and Response
Contractors	Compliance Safety Audits
Pre-Startup Safety Reviews	Trade Secrets

Hazard Assessment – Off-Site Consequence Analysis

- Worst Case Scenario
 - The release of the largest quantity of a regulated substance from a single vessel or process line failure that results in the greatest distance to a specified toxic endpoint.
- Alternate Case Scenario
 - The release of a regulated substance that may be more likely to occur than the worst case that would reach an endpoint offsite unless no such scenario exists.
- Toxic Endpoint
 - Concentration of regulated substance where irreversible harm would not occur for exposures less than 1 hour (a.k.a. ERPG-2) (considered a reasonable level where shelter or evacuation could occur)

RMP Level 2

Accident Prevention Program

- Seven Required Elements:
 - Process Safety Information
 - Hazard Review
 - Standard Operating Procedures
 - Training
 - Maintenance Program
 - Compliance Audit
 - Incident Investigation
- Three Additional elements often in place:
 - Employee Participation
 - Hot Work Procedure
 - Contractor Control Procedures

Process Safety Information

- Listing of covered process equipment
- Information pertaining to the hazards of reagents.
- Process technology information
- A study of the consequences of deviations otherwise known as a Process Hazard Analysis (PHA).
- Process equipment information including a discussion of the materials of construction, piping and instrumentation diagrams (P&IDs), electrical hazard reviews, design code references, control systems and relief systems design aspects and standard operating procedures (including emergency operations and O&M Manual).
- Emergency and first aid equipment and response procedures.

Process Hazard Analysis

- Identify Associated Risks
- Assess Impact of Equipment Malfunctions
- Assess Human Error Opportunities
- Assess Existing Safeguards
- Consider Ways to Detect/Monitor Releases
- Must Be Updated Every 5 Years

Process Hazard Analysis

- Information used in the PHA:
 - Up-to-date information on Physical and Chemical Hazards (MSDSs, minimum)
 - Equipment - specs, design
 - P&ID or other drawings are needed
 - Process Technology – chemistry, parameters
 - Material and Energy balances for new covered processes

Maintenance Program

- Maintain the on-going mechanical integrity of covered process equipment
- Three major components of program drawn from more rigorous Program Level 3 and/or PSM program requirements
 - Mechanical Integrity
 - Management of Change
 - Pre-Startup Safety Review

Mechanical Integrity

- Periodic Inspections of equipment
- Documentation of findings and recommendations for corrective action
- Implementation of corrective measures
- Training of Operations and Maintenance personnel to ensure that equipment performs and wears as designed within safe window

Periodic Inspections

- Equipment Includes:
 - Pressure Vessels and Storage Tanks
 - Piping Systems
 - Relief and Vent Systems
 - Emergency Shut Down Systems
 - Controls
 - Pumps
 - Standby Emergency Equipment
 - Electrical Grounding Systems

Management of Change

- Three Types of Replacement to Consider:
 - Replacement-In-Kind
 - Equivalent
 - Modification
- Consider duration of change:
 - Permanent
 - Temporary (emergencies or abnormal conditions of 30 days or less)

Compliance Audits

- Conduct periodic review (at least every three years) of RMP program for completeness/compliance, effectiveness and adequacy.
- Confirm SOPs and other Prevention Program elements are appropriate and followed.
- Corrective measures are implemented on a timely basis.

Incident Investigations

- RMP incidents involve catastrophic release of aqueous ammonia (potential to impact industrial, commercial or residential community)
- Investigations must be started within 48 hours and will typically involve external resources
- Documentation of event details including release information and any injuries or illnesses
- Combination of spill reporting and accident reporting

Employee Participation

- Involve employees in the operation, maintenance, modification and overall management of the covered process.
- Employees and any representatives of employees will be advised of RMP related activities in the covered process areas.
- They will be provided access to information regarding the standards and rules and changes that affect operations at the facility.

Hot Work Procedure

- A program for review of intended maintenance and/or repair activities for the use of safety precautions against fire, explosion or toxic hazards.
- Builds on existing principles of Hot Work program for fire/explosive hazards and additionally addresses toxic exposure hazards

Contractor Safety

- Many Generating Stations have a program in place for Contractor Safety and Control.
- Key elements of these programs include:
 - Contractor Selection and Evaluation
 - Contractor Safety
 - Contractor Control

Emergency Response Program

- Must have written plan of action
- Coordination with on-site personnel
 - Evacuation procedures
 - Protective procedures
- Coordination with off-site responders
 - Local Fire & Police Departments
 - Local LEPC & USCG
- Training (drills)
- Communications with the public

Challenges to Technology Developers and APC Vendors / E&C Contractors

- Participating in formal Process Hazard Analyses and mitigating risks in design
- Developing O & M Programs and Procedures that support PSM & RMP requirements
- Ensuring Management of Change (MOC), Mechanical Integrity, and Pre-Startup Safety Review (PSSR) elements are incorporated from conceptual phase through startup

Challenges to Plant Operations and Maintenance

- Maintaining RMP & PSM Program information:
 - Process Safety Information
 - Process Hazard Analyses
 - Training Records
- Conducting PHA and OCA completely
- Incident Investigations related to covered substances are now a combination of release and accident investigations

Challenges to Plant Operations and Maintenance

- Enhancing Hot Work Procedures
- Enhancing Contractor Management and Coordination in covered process areas
- Maintaining MOC/MI/PSSR programs
- Enhancing ER programs and Response Team capabilities from fuels to toxics
- Higher level of Public Relations than ever before
- Security Measures for Hazardous Materials

Managing Risks in the Community

- Intelligent discussions on risk, real and perceived
- Don't get too technical, use risk assessment tools are credible
- Coordinate with response organizations and publicize these events
- Communicate consequence analyses as needed but control distribution of information

Summary

- Use of hazardous substances in reactive chemistry has long been accomplished safely
- EPA and OSHA regulatory programs are mostly common sense design and startup review elements
- Emerging technologies need to prove to be safe in the workplace & community
- The alternative will be the end of your technology however promising it may seem