14.1. OVERVIEW

A management system for any chemical process safety program should look for continuous improvement in the management of storing, using, or manufacturing hazardous materials. Enhancement of the knowledge of the management of process safety is essential to create a dynamic program that builds on the experiences and knowledge within the company and incorporates the technological advances that are constantly emerging throughout the industry. The knowledge that a company gains through accident/incident reports, maintenance records, case histories, and trend analysis of upset conditions provides basic information and changes that can help prevent catastrophic events. Collection and use of this information can also lead to improved profit and productivity. All the components and elements of the preceding chapters provide opportunities for improvement and enhancement of the management of process safety.

14.2. QUALITY CONTROL PROGRAMS AND PROCESS SAFETY

Many chemical companies are now dedicated to improving quality through leadership at all levels of their organization, and these companies are devoting the necessary resources, time, and capital for the implementation of their quality programs. Quality programs and process safety programs are similar, as both are based on the principle of continuous improvement. Both quality
control programs and process safety programs contain similar elements, such as communication, training, improvements in design, and teamwork. The goals or results of quality control programs are usually measured in customer satisfaction and reduction of rejected materials. The goals of a chemical process safety program are the health and safety of employees, the environment, the surrounding community and protection of assets and continuity of operations. Similar goals of these programs are also increased productivity and profitability. Integrating the enhancement of the management of chemical process safety with a quality program offers opportunities since the synergistic effects will increase and enrich the goals of continuous improvement of quality and process safety.

14.3. PROFESSIONAL AND TRADE ASSOCIATION PROGRAMS

Technological advances in the area of chemical process safety occur constantly, and it is vital that a management system address the methodology and resources necessary to remain on the leading edge of these advances. Process safety is a subject that commands international interest; and numerous symposia, seminars, and educational courses on the subject are frequently scheduled throughout the world. The Center for Chemical Process Safety (CCPS) is an active proponent of safety education; CCPS concentrates primarily on promoting good practices and bringing to the forefront developments that have occurred in various fields that have a bearing on the safety of chemical plants.

Appendix 14A contains a listing of selected sources of information from professional and trade associations that can provide invaluable materials for the enhancement of chemical process safety. In addition, there are a number of consultants and consulting firms that may be hired to supply process safety information. Consultants can be especially valuable for special problems or unusual situations where they may have unique capabilities. CCPS has published a directory of consultants including specialties and subject matters (see Appendix 14B).

14.4. CCPS PROGRAM

The Center for Chemical Process Safety was established in 1985, shortly after the Bhopal incident, to:

- Establish and publish the latest scientific and engineering practices (not standards) for prevention and "mitigation of catastrophic incidents," involving toxic and/or reactive materials
- Encourage the use of such information by broad dissemination
through publications, seminars, symposia, and continuing education programs for engineers

• Advance the state of the art of engineering practices through research in prevention and mitigation of catastrophic events
• Develop and encourage the use of undergraduate education curricula that will improve the safety knowledge and consciousness of engineers.

Appendix 14B is a listing of the CCPS Guidelines and conferences.

14.5. RESEARCH, DEVELOPMENT, DOCUMENTATION, AND IMPLEMENTATION

When research programs are identified, management systems should include a method to assure that these research programs include process safety inputs, when applicable, from all areas in the plant, from departments such as safety, environment, operations, engineering, and maintenance. These research programs may be internal or external to a company. Many times, these research needs can be funneled into existing external organizations and users groups such as the Design Institute for Emergency Relief Systems (DIERS) and the Design Institute for Physical Properties Research (DIPPR) Users Group. Data supplied from all research projects should be documented, available to all who need to know, and communicated to plant operations to assure that new knowledge is incorporated into the enhancement of process safety.

14.6. IMPROVED PREDICTIVE SYSTEMS

Within a company, there are important data that can be collected and analyzed, which can lead to the enhancement of process safety knowledge. The information contained in accident/incident reports, equipment failures, and maintenance records, which are properly cataloged and analyzed, represent opportunities for continued improvement in process safety. In addition, AIChE’s DIPPR data bank, while not specifically intended for safety, contains a number of valuable safety parameters. Systems should be established to review this information and use it as part of the process safety system. These techniques should constantly be under review for continuous improvement of process safety.

CCPS is currently working on a research project that will attempt to measure the performance and effectiveness of the technical management of chemical process safety. This research program may lead to methods for quantitative measurements similar to what is measured in quality programs.
14.7. PROCESS SAFETY RESOURCE CENTER AND REFERENCE LIBRARY

The ability to readily access information required to perform safety studies and to design plants which operate safely is of the utmost importance. The difficulty in obtaining data may lead to many important decisions being based on poor information or certain features being ignored.

The successful implementation of many safety management systems may be enhanced by a good reference library. Implementation of a process safety library section will require more than simply purchasing reference books. It is important that a number of features be carefully considered:

- *Relevant* material must be included, bearing in mind the materials processed and the technology used.
- Journals and proceedings of conferences must be included to provide topical interest.
- A search facility must be available, either locally or through arrangement with some other organization (e.g., a large, local reference library).

This source of information requires that necessary resources and accountability are established, and is kept current and disseminated throughout the plant to those who need to know. Appendix 14B lists the current CCPS Guidelines available for process safety knowledge, and Appendix 14C lists some examples of the type of subject matters and information that should be maintained in the reference library.
Appendix 14A
Professional and Industry Organizations Offering Process Safety Enhancement Resources

ACS
American Chemical Society
1155 16th St., N.W.
Washington, DC 20036
(202) 872-4600
• Chemical Properties Referral Service
• Referral to Regulatory Agencies
• Chemical Safety Manual for Small Business
• Hazard Communication Standard Information
• Laboratory Safety and Design Information

AIChE
American Institute of Chemical Engineers
345 E. 47th Street
New York, NY 10017
(212) 705-7338
• Center for Chemical Process Safety (see Section 14.3)
• Design Institute for Emergency Relief Systems (DIERS)
• Design Institute for Physical Properties Research (DIPPR)
• Loss Prevention Symposia (Health and Safety Section)
• Continuing Education Short Courses

AIHA
American Industrial Hygiene Association
475 Wolf Ledges Pkwy.
Akron, OH 44311
(216) 762-7294
• Emergency Response Planning Guidelines
• Workplace Environmental Exposure Level Guides
• Hygiene Guides (Toxic Properties Surveys)
• Professional Development Seminars
• Short Courses at Annual Conferences

ANSI
American National Standards Institute
1430 Broadway
New York, NY 10018
(212) 354-3300
• Consensus Standards on Various Subjects

APCA
Air Pollution Control Association
P.O. Box 2861
Pittsburgh, PA 15230
(412) 621-1090

API
American Petroleum Institute
1220 L St., N.W.
Washington, DC 20005
(202) 682-8000
• Process Hazards Management Task Force
• Process Hazards and Process Safety Seminars
• Technical Standards (Fire Protection, Maintenance)
• Equipment Inspection Guides
• Operator and Maintenance Training

ASME
American Society of Mechanical Engineers
345 E. 47th Street
New York, NY 10017
(212) 705-7722
• Pressure Vessel Code
• National Board (Repair of Pressure Vessels and Safety Valves)
• Non-destructive Testing
ASSE
American Society of Safety Engineers
1800 E. Oakton Street
Des Plaines, IL 60016
(312) 692–4121
- Continuing Safety Education Courses
  - Introduction to System Safety
  - Recognition of Accident Potential
  - Chemistry of Hazardous Materials
  - Scientific Accident Investigation
  - Industrial Explosion Prevention
- Professional Development
  - SARA III
  - Emergency Preparedness
  - Safety Management
    (Fundamental and Advanced)

ASTM
American Society for Testing and Materials
1916 Race Street
Philadelphia, PA 19103-1187
(215) 299–5400
- Waste Compatibility Guide

CMA
Chemical Manufacturers Association
2501 M St., N.W.
Washington, DC 20005
(202) 887–1100
- National Chemical Referral and Information Center (including CHEMTREC)
- Community Awareness and Emergency Response (CAER)
- Management Guidelines
  - Process Safety Management Survey
  - Managers Guide to Quantitative Risk Assessment
  - Facility Inspection and Safety Program Evaluation

Compressed Gas Association
1235 Jefferson Davis Hwy.
Arlington, VA 22202
(703) 979–0900
- Guidelines for Compressed Gas Storage and Handling (i.e., Handbook of Compressed Gases, 1990 and Safe Handling of Compressed Gases in Containers)

FEMA
Federal Emergency Management Agency
500 C Street, S.W.
Washington, DC 20472
(202) 646–3923
- Handbook of Chemical Hazard Analysis Procedures

HMAC
Hazardous Materials Advisory Council
1012 14th St., N.W., Suite 907
Washington, DC 20005
(202) 783–7460

IChemE
The Institution of Chemical Engineers (U.K.)
165–171 Railway Terrace
Rugby, Warks CV 21 3HQ
(0788) 78214
TX: 311780
- Loss Prevention Bulletin (Case Histories)
- Information Exchange
- Training Modules
- Conference on Major Accident Prevention

IEEE
Institute of Electrical/Electronic Engineers
345 E. 47th Street
New York, NY 10017
(212) 644–7900
- IEEE Transactions on Reliability Special Issues: Chemical Process Reliability Safety and Risk Management

NAM
National Association of Manufacturers
1331 Pennsylvania Ave., N.W.
Suite 1500 N
Washington, DC 20004
(202) 637–3000
- Case Histories of Accident Causes and Prevention
- Computer Analysis of Accidents (NAM Safe System)
- Process Hazard Management Standard Review
- Process Hazard Task Force
- Hazard Training Task Force
NFPA
National Fire Protection Association
Battery March Park
Quincy, MA 02269
(617) 770-3000
- Consensus Standards Related to Fire and Explosion Prevention

NICS
National Institute for Chemical Studies
2300 MacCorkle Ave., S.E.
Charleston, WV 25304
(304) 346-6264
- Chronic Health Effects Study
- Voluntary Reduction of Routine Emissions
- Community Safety Assessment Program
- Emergency Response Database

NSC
National Safety Council
444 N. Michigan Avenue
Chicago, IL 60611
(312) 527-4800
- Accident Prevention Manual for Industrial Operations
- Safety Video Programs
  - Instruments and Controls
  - Fire Safety
  - Hazard Communications
  - Accident Investigation
- Safety Training Institute

SOCMA
Synthetic Organic Chemical Manufacturers Association
1330 Connecticut Ave. N.W., Suite 300
Washington, DC
(202) 659-0060
- Worker Training and Certification

SPI
The Society of the Plastics Industry
355 Lexington Avenue
New York, NY 10018
(212) 503-0600

SRA
Society for Risk Analysis
8000 Westpark Dr., Suite 400
McLean, VA 22102
(703) 790-1745
- Conferences on Risk Analysis

SSS
System Safety Society
P.O. Box 165
Washington, DC 20044

World Bank
International Bank for Reconstruction and Development
1818 H Street, N.W.
Washington, DC 20433
(202) 477-2001
- Manual of Industrial Hazard Techniques
- Workshop Procedures Safety Management and Risk Control
- Occupational Health and Safety Guidelines
Appendix 14B
Center for Chemical Process Safety Publications, Conferences, and Other Educational Materials

1. CCPS GUIDELINES BOOKS

A. Completed

Guidelines for Hazard Evaluation Procedures, Second Edition with Worked Examples
Guidelines for Safe Storage and Handling of High Toxic Hazard Materials
Guidelines for Vapor Release Mitigation
Guidelines for Use of Vapor Cloud Dispersion Models
Workbook of Test Cases for Vapor Cloud Source Dispersion Models
Guidelines for Chemical Process Quantitative Risk Analysis
Guidelines for Process Equipment Reliability Data, with Data Tables
Guidelines for Technical Management of Chemical Process Safety
Plant Guidelines for Technical Management of Chemical Process Safety
Guidelines for Evaluating the Characteristics of Vapor Cloud Explosions, Flash Fires, and BLEVEs
Guidelines for Preventing Human Error in Process Safety
Guidelines for Safe Automation of Chemical Processes
Guidelines for Chemical Reactivity Evaluation and Applications to Process Design
Guidelines for Engineering Design for Process Safety
Guidelines for Investigating Chemical Process Incidents
Guidelines for Fundamentals for General Plant Operations
Guidelines for Implementing Process Safety Management Systems
Guidelines for Auditing Process Safety Management Systems
Guidelines for Chemical Process Documentation
Guidelines for Chemical Transport Risk Analysis

B. In Press and under Development

Guidelines for Effective Handling of Emergency Relief Effluents
Guidelines for Safe Process Operations and Maintenance
Guidelines for Storage and Handling of Reactive Materials
Guidelines for Reliability Engineering
Guidelines for Post-Release Mitigation Technology in the Chemical Process Industry
Guidelines for Safe Warehousing of Chemicals
Guidelines for Evaluating Process Plant Buildings for External Explosion and Fire
II. OTHER CCPS PUBLICATIONS

A. Completed


CCPS/AIChE Directory of Chemical Process Safety Services


Management of Change (CD ROM), 1994


B. Under Development and Proposed

Data Base for Chemical Process Equipment Reliability

Concentration Fluctuations in Toxic and Flammable Vapor Cloud Dispersion, and Recommendations for an Operational Hazard Assessment Model

III. CCPS SPONSORED AND COSPONSORED CONFERENCES

International Symposium on Preventing Major Chemical Accidents (Washington, D.C., February 1987)

International Symposium on the Use of Vapor Cloud Dispersion Models (Cambridge, MA, November 1987)


Flammable Dust Explosion Conference (St. Louis, MO, November 1988)

Symposium on Technical Management of Chemical Process Safety (Atlanta, January 1989)
International Symposium on Reactive Chemicals (Cambridge, MA, March 1989)
International Symposium on Loss Prevention (Oslo, Norway, June 1989)
International Chemical Process Safety Management Conference and Workshop (Toronto, Canada, May 1990)
NAM Process Safety Management Conference (Atlantic City, NJ, June 1991)
European Federation Loss Prevention Symposium (Taormina, Italy, May 1992)
Houston Engineering Conference (Houston, TX, February 1992)
International Process Safety Management Conference and Workshop (San Francisco, CA, September 1993)
International Symposium and Workshop on Safe Chemical Process Automation (Houston, TX, September 1994)

IV. CCPS RESEARCH PROJECTS

Research on Measuring the Effectiveness of Technical Management of Chemical Process Safety
Two-Phase High Momentum Release and Aerosol Model Development—Completed for Validation (1988)
Two-Phase High Momentum Release and Aerosol Model Validation and Testing, Fluorocarbons—Completed October 1989 in Oklahoma
Two-Phase High Momentum Release and Aerosol Model Validation and Testing II (1990 in Nevada)

V. CCPS EDUCATIONAL ACTIVITIES

Courses by AIChE Continuing Education Group based on CCPS Guidelines:
1. Vapor Cloud Dispersion Modeling
2. Prevention and Mitigation Techniques for High Toxic Hazard Releases
5. Auditing Process Safety Management Systems
6. Evaluating the Consequences of Vapor Cloud Explosions, Flash Fires, and BLEVEs
7. Investigating Process Safety Incidents
8. Engineering Design for Process Safety
9. Safe Automation of Chemical Processes
Appendix 14C
Examples of Subjects Covered in Process Safety Libraries

Accident/incident reports
Plant equipment design data
Hardware type and design practices (codes and standards)
Rules and regulations
Appropriate sections from the Code of Federal Regulations (CFR)
A subscription to a legislative and regulatory service consisting of basic text, monthly supplements, and newsletters
Relevant environmental organization newsletters
Trade association information
Chemical data, including properties, reaction kinetics, and safe handling information
Risk management techniques
Technical papers
Case histories concerning incidents that illustrate fundamental process safety principles or lessons with plant-specific application
News clippings that illustrate the importance of good risk management and communications practice
Safety Review Documentation Package
  P&IDs
  Operating procedures
  Materials data
  Safety reviews for the process, current and past
  Incident reports and reports of investigations

Appropriate reference books