GUIDELINES FOR

Integrating Process Safety Management, Environment, Safety, Health, and Quality
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Integrating
Process Safety Management,
Environment, Safety,
Health, and Quality
This *Guidelines* is one of a series of publications available from the Center for Chemical Process Safety. A complete list of titles appears at the end of this book.
GUIDELINES FOR

Integrating Process Safety Management, Environment, Safety, Health, and Quality
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The Center for Chemical Process Safety (CCPS) has recognized since its inception that enhancements in chemical process technologies, taken alone, are not sufficient to prevent catastrophic events. It is obvious that successful chemical process management technologies need the commitment and participation of top management. Therefore, with the support from its advisory and managing boards, CCPS established a multifaceted program to address the need for technical management commitment and technical management systems to reduce the potential for exposures to the public and to the environment.

Through a series of publications, CCPS has addressed the requirements and implementation of process safety management (PSM) programs. These were covered initially in the brochure *A Challenge to Commitment* which was sent to over 1500 CEOs in the chemical industry. *Guidelines for the Technical Management of Chemical Process Safety* was then published and it expanded on the elements of PSM. The third publication *Plant Guidelines for Technical Management of Chemical Process Safety* provided detailed examples and programs that could be implemented at plant levels. The fourth publication *Guidelines for Implementing Process Safety Management Systems* described the design, development and installation of PSM systems. CCPS appreciates that process safety management has considerable overlap with other environmental, safety, and health programs and that there are opportunities to share resources between these programs.

Quality management approaches are being applied widely in the chemical industry. CCPS has recognized that quality management approaches can be used to integrate process safety management and environmental, safety and health programs. These Guidelines will provide a
framework and examples for integration of management systems designed to achieve continuous improvement in process safety, environmental, safety and health management. This book guides managers through the process of designing and implementing integrated programs.
Acknowledgments

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Both quality management and environment, safety and health have specialized vocabularies. In some instances, different practitioners use the same word or words but assume different meanings. In this glossary we explain our use of these phrases.

**Customer** in quality management terms is the next person in the management process; of necessity it includes the ultimate customer who benefits from the final product. Each person in the management process is supplied with information, equipment, product, or raw material which must be worked on and then passed to the next "customer" for further refinement. A supplier is someone who provides information, equipment, product, or raw material. Thus a management process consists of a series of suppliers and customers.

**Environment, Safety, and Health** in this book generally refers to all programs intended to protect the environment, employees and third parties from any harm as a result of an upset condition in the operation of a facility using, processing, handling, or storing hazardous chemicals. In particular these include occupational safety, industrial hygiene, and all environmental protection programs. In this publication ESH is considered to exclude PSM.

**Fishbone Diagrams** are “cause-and-effect diagrams” used in quality management to help describe all the activities that can influence the management process and its outcome. These diagrams show the relationship between different activities and how they are grouped around specific types of activity.
Management Process in quality management refers to the activities conducted by all those involved in delivering the ESH or PSM program. It is not the process of chemical manufacturing, or the automated handling of raw materials, intermediates, or final products.

Pareto Diagrams are used in quality management programs to reveal the pattern of variation in performance and any predominant tendency. The data are displayed in the form of a histogram.

Process Safety Management (PSM) is the application of management systems to identify, understand, and control chemical and manufacturing process hazards and to prevent process-related injuries and incidents.

Quality Management is any approach to developing and implementing management systems that results in management processes which focus on what the supplier must deliver to meet customer requirements at every step of the process.

Stakeholder is a person or group that has a legitimate interest in the facility. For a facility handling hazardous chemicals, examples could be employees, neighbors, the board of directors, shareholders, and the regulatory community.

Total Quality Management (TQM) is a widely used quality management program (see Quality Management)

Acronyms

Throughout this book various acronyms and terminologies are used. We have attempted to explain these at the first occurrence. However, as it is generally impossible to rediscover the first occurrence quickly, this section provides a single point of reference to the puzzled reader.

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIChe</td>
<td>American Institute of Chemical Engineers</td>
</tr>
<tr>
<td>CCPS</td>
<td>Center for Chemical Process Safety of the American Institute of Chemical Engineers</td>
</tr>
<tr>
<td>ESH</td>
<td>Environment, Safety and Health</td>
</tr>
<tr>
<td>ISO</td>
<td>International Organization for Standardization</td>
</tr>
<tr>
<td>PSM</td>
<td>Process Safety Management</td>
</tr>
<tr>
<td>QM</td>
<td>Quality Management</td>
</tr>
<tr>
<td>TQM</td>
<td>Total Quality Management</td>
</tr>
</tbody>
</table>
Introduction

Since its founding in 1985, the Center for Chemical Process Safety (CCPS) of the American Institute of Chemical Engineers (AIChE) has promoted the enhanced management of chemical process safety. The CCPS program has always recognized that good safety performance is achieved through a combination of technology and management excellence.

In many organizations, the management programs for process safety, environmental, safety, health, and quality have developed separately. Yet these programs have many similarities and common needs. In an era when resources are becoming more scarce, managers may apply additional pressure to merge these management systems in order to provide more efficient and effective management of these issues. CCPS has recognized that Quality Management approaches have been widely adopted in the industry and believes that using Quality Management to integrate Process Safety Management (PSM) and other Environmental, Safety, and Health (ESH) programs and elements will provide significant benefits.

1.1. The Need for Integration

In almost every region and country, regulations are being introduced that require formal PSM and ESH management programs. In the United States, OSHA has implemented the PSM rule, and the EPA is extending these requirements with the proposed Risk Management Program rule. SARA Title III already imposes environmental management standards on many operations. In the European Union, the Seveso Directive and its successors introduced the need to identify and assess hazards and are now requiring
formal management programs. Several countries on the Pacific rim have introduced regulations modeled on those in the United States and Europe.

In addition to regulations, public, owner, and political pressures require ever-better safety and environmental performance. Yet, at the same time, every company needs to find ways to reduce all costs in order to stay competitive. In the face of these apparently conflicting pressures, companies are looking for new ways to manage PSM and ESH issues.

Many corporations have adopted Quality Management programs throughout their organization. So far, these have been applied largely to discrete ESH programs and elements, and not to overall systems. For example, Quality Management approaches may have been used to develop the Process Hazards Assessment or Management of Change elements of PSM. A good example of this in practice is Dow Chemical Company’s ESH auditing program, where a single process has been developed for all aspects of PSM and ESH. Another example is the Westinghouse Electric Corporation Management of Change program. In only a very few instances has there been an attempt to use Quality Management to integrate all PSM and ESH programs and elements into a single management system.

In manufacturing activities, the cost of poor quality is obvious: off-specification material, rework costs, scrap, wasted raw material, energy costs, equipment downtime and so on. Although some aspects of poor ESH management are obvious (injuries, business interruption, litigation costs, fines, clean-up costs, waste disposal) others are less visible. These less visible costs include: inefficient use of PSM and ESH manpower, time spent investigating and explaining incidents, lost stock value following a major incident, cost of installing “end-of-pipe” solutions rather than “designing-in” solutions.

In this book we will show that many aspects of ESH and PSM management systems are similar, including: auditing, hazard identification, equipment integrity and chemical hazards data. These programs and elements are part of every PSM and ESH program. Some organizations have started integrating these programs and elements with the intent of continuing down this path until all PSM and ESH programs and elements are included. The next step is to develop one integrated management system covering all the programs and elements; this is the subject of these guidelines.

The reward for successful integration is reduced cost of operation and more effective programs. The lower cost of delivery is achieved by developing management processes with fewer steps and no duplication of effort. Program effectiveness improves by adopting best available practices during the redesign. Finally programs designed using Quality Management approaches re-
1.2. Purpose of Guidelines

These guidelines present a process through which your organization could develop an integrated Process Safety, Environmental, Safety, and Health management system. This process is based on Quality Management approaches. Quality Management approaches are now widespread and most organizations have adopted a standard system, such as Total Quality Management or ISO 9000. The approach described in these guidelines uses the existing Quality Management and PSM and ESH expertise within your organization to develop an integrated system. This approach will provide a management system that is consistent with your company’s culture and management style.

**Purpose of Guidelines**

- Presents an effective process for integrating PSM and ESH systems into one overall Quality Management system.
- Demonstrates that this integration improves efficiency and reduces costs.

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**The Need for Integration**

- Increasing and overlapping regulatory demands
  - Documentary and record-keeping requirements
  - Formal and demonstrable programs
  - Improved performance (particularly in areas such as emissions standards)
- Pressure to reduce cost of operation and at the same time improve performance
  - To maintain and improve competitive position
  - To avoid costs of poor performance
- Pressure to continuously improve ESH performance and stop taking “continuous corrective action” by correcting the underlying systematic failure. Another aspect of this is the tendency to continuously rework the same issues over and over again. Well-designed management systems should prevent this.
- Recognition that other business activities have benefited from integrating faster, at less cost and more effectively to new demands. Permanent fixes are installed to address what were previously recurring problems; “continuous corrective action” is eliminated or minimized. This is most clearly seen in areas such as inventory control and information systems.
There are already a few companies that have wholly or partially integrated Quality Management into their ESH functions; the following examples illustrate the savings achieved by several of these organizations.

\textbf{Examples of Cost Savings Achieved Using Quality Management Approaches}

<table>
<thead>
<tr>
<th>Company</th>
<th>Program</th>
<th>Savings Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xerox Corporation (Ref. 1)</td>
<td>Environmental Leadership Program</td>
<td>$100+ million/year</td>
</tr>
<tr>
<td>3M Corporation (Ref. 1)</td>
<td>Pollution Prevention Pays</td>
<td>cumulative first-year savings of $506 million, 1975–1989</td>
</tr>
<tr>
<td>Unocal Chemicals (Ref. 3)</td>
<td>Safety Improvement Process</td>
<td>10% reduction in recordable incidents in first year</td>
</tr>
<tr>
<td>Tennant Company (Ref. 2)</td>
<td>Integrating Quality and Hazard Management</td>
<td>roughly 60% reduction in both injuries and defects</td>
</tr>
</tbody>
</table>

In addition each of these companies reports large reductions in waste and effluents.

\subsection{1.3 Scope of Guidelines}

These guidelines will show how a Quality Management system can be used to integrate PSM and ESH programs and elements. However, it is not our intention to introduce or describe Quality Management systems; other publications have addressed this comprehensively. You and your team should familiarize yourself with your company’s Quality Management program by reading internal company publications or consulting standard references. A short and partial list of references is provided below. Our intention is to show you how you can extend your company’s existing Quality Management system to provide an integration framework for PSM and ESH.

If your organization does not have a Quality Management system, you can still apply many of the concepts described in these guidelines. However, you will still need to identify a pervasive, consistent management system within which to conduct the integration.