1

INTRODUCTION

Process safety management is widely credited for reductions in major accident risk and improved process industry performance. Process safety practices and formal safety management systems have been in place in some companies for many years. Over the past 20 years, government mandates for formal process safety management systems in Europe, the U.S., and elsewhere have prompted widespread implementation of a management systems approach to process safety management.

However, after an initial surge of activity, process safety management activities appear to have stagnated within many organizations. Incident investigations continue to identify inadequate management system performance as a key contributor to the incident. And audits reveal a history of repeat findings indicating chronic problems whose symptoms are fixed again and again without effectively addressing the technical and cultural root causes. Table 1.1 lists some of the reasons that process safety management programs may have plateaued or declined.

While all of these issues may not have occurred in your company, they have all happened to some degree in other companies. Left unchecked, such issues can do more than cause stagnation, they can leave organizations susceptible to losing their focus on process safety, resulting in a serious decline in process safety performance or a loss of emphasis on achieving process safety excellence. This is one of the reasons the Center for Chemical Process Safety (CCPS) created the next generation process safety management framework – ***Risk Based Process Safety (RBPS).***

TABLE 1.1. Possible Causes of Process Safety Management Performance Stagnation

- In the U.S., process safety management has become synonymous with OSHA's PSM regulation, 29 CFR 1910.119, resulting in a minimum cost, compliance-based approach to managing process safety . . . "If isn't a regulatory requirement, I'm not going to do it!"
- Since worker injuries are much more frequent and are easier to measure, company resources are sometimes disproportionately focused on personal safety instead of process safety.
- Since worker injury rates are steadily declining at most facilities, management assumes this also indicates that the risk of low-frequency, high-consequence process safety incidents must likewise be declining.
- Process safety management was developed by and for big companies. Small companies often do not have the capability to implement similar systems.
- Organizations lack a thorough understanding of recognized and generally accepted good engineering practices and are inconsistent in interpreting and applying them.
- Process safety management was implemented as a separate, stand-alone system that was not integrated into the organization's overall management system.
- Process safety management was implemented as a one-time project instead of an ongoing process.
- Management systems are overemphasized while the technical aspects of process safety, which actually control the hazards and manage risk, are neglected.
- No consistent, widely recognized measurement systems are available for process safety.
- Auditing costs are high and audits have focused on symptoms of problems; they have failed to identify underlying causes.
- Management does not understand or apply risk-based decision processes.
- The legal system inhibits the application of risk-based decision processes.
- Engineering curricula often do not include or emphasize process safety.
- Verbal support for implementation is inconsistent with financial support.
- Diminishing resources are devoted to process safety; facilities face increased pressure to achieve short-term financial objectives.
- Mergers, acquisitions, and divestitures have decreased organizational stability.
- Senior management lacks plant/process operating experience, resulting in a perceived (or real) lack of commitment to process safety management.
- Success has led to complacency – the absence of major accidents lessens a company's sense of vulnerability; statistics continue to demonstrate that worker safety in the process industries is better than almost all other industrial sectors.
- Process safety professionals communicate poorly with senior management, or management does not receive and act on the messages.

1.1 PURPOSE OF THESE GUIDELINES

The purpose of these *RBPS Guidelines* is to help organizations design and implement more effective process safety management systems. These *Guidelines* provide methods and ideas on how to (1) design a process safety management system, (2) correct a deficient process safety management system, or (3) improve process safety management practices. The RBPS approach recognizes that all hazards and risks in an operation or facility are not equal; consequently, apportioning resources in a manner that focuses effort on greater hazards and higher risks is appropriate. Using the same high-intensity practices to manage every hazard is an inefficient use of scarce

resources. A risk-based approach reduces the potential for assigning an undue amount of resources to managing lower-risk activities, thereby freeing up resources for tasks that address higher-risk activities.

This approach is a paradigm shift that will benefit all industries that manufacture, consume, or handle hazardous chemicals or energy by encouraging companies to:

- Evolve their approach to accident prevention from a compliance-based to a risk-based strategy.
- Continuously improve management system effectiveness.
- Employ process safety management for non-regulatory processes using risk-based design principles.
- Integrate the process safety business case into an organization's business processes.
- Focus their resources on higher risk activities.

This new framework for process safety builds upon the original process safety management ideas published by the CCPS in the late 1980s, integrates industry lessons learned over the intervening years, applies the management system principles of "plan, do, check, act", and organizes them in a way that will be useful to all organizations – even organizations with relatively lower hazard activities – throughout the life cycle of a process or operation.

An RBPS management system addresses four main accident prevention pillars (Table 1.2).

Authentic ***commitment to process safety*** is the cornerstone of process safety excellence. Management commitment has no substitute. Organizations generally do not improve without strong leadership and solid commitment. The entire organization must make the same commitment. A workforce that is convinced that the organization fully supports safety as a core value will tend to do the right things, in the right ways, at the right times, even when no one is looking. This behavior should be consistently nurtured, and celebrated, throughout the organization. Once it is embedded in the company culture, this commitment to process safety can help sustain the focus on excellence in the more technical aspects of process safety.

TABLE 1.2. RBPS Management System Accident Prevention Pillars

• Commit to process safety
• Understand hazards and risk
• Manage risk
• Learn from experience

Organizations that ***understand hazards and risk*** are better able to allocate limited resources in the most effective manner. Industry experience has demonstrated that businesses using hazard and risk information to plan, develop, and deploy stable, lower-risk operations are much more likely to enjoy long term success.

Managing risk focuses on three issues: (1) prudently operating and maintaining processes that pose the risk, (2) managing changes to those processes to ensure that the risk remains tolerable, and (3) preparing for, responding to, and managing incidents that do occur. Managing risk helps a company or a facility deploy management systems that help sustain long-term, incident-free, and profitable operations.

Learning from experience involves monitoring, and acting on, internal and external sources of information. Despite a company's best efforts, operations do not always proceed as planned, so organizations must be ready to turn their mistakes – and those of others – into opportunities to improve process safety efforts. The least expensive ways to learn from experience are to (1) apply best practices to make the most effective use of available resources, (2) correct deficiencies exposed by internal incidents and near misses, and (3) apply lessons learned from other organizations. In addition to recognizing these opportunities to better manage risk, companies must also develop a culture and infrastructure that helps them remember the lessons and apply them in the future. Metrics can be used to provide timely feedback on the workings of RBPS management systems, and management review, a periodic honest self-evaluation, helps sustain existing performance and drive improvement in areas deemed important by management.

Focusing on these four pillars should enable an organization to improve its process safety effectiveness, reduce the frequency and severity of incidents, and improve its long-term safety, environmental, and business performance. This risk-based approach helps avoid gaps, inconsistencies, over work, and under work that can lead to system failure. For process safety management to work most effectively, companies should integrate their RBPS practices with other management systems, such as those for product quality, equipment and human reliability, personnel health and safety, environmental protection, and security.

These *Guidelines* offer two central strategies for how companies can succeed in applying the above principles:

- ***Use RBPS criteria to design, correct, or improve process safety management system elements.*** Review the work activities associated with each element and update them based on (1) an understanding of the risks associated with the facilities and operations, (2) an understanding of the demand for process safety activities and the resources needed for these activities, and (3) an understanding of how

process safety activities are influenced by the process safety culture within the organization.

- ***Focus on process safety effectiveness as a function of performance and efficiency.*** Use metrics to measure performance and efficiency so that finite resources can be applied in a prioritized manner to the large number of competing process safety needs. Use management reviews to verify that the organization is doing the right things well in its journey toward process safety excellence.

To help companies implement these strategies, these RBPS *Guidelines* offer a set of "new and improved" technical approaches:

- New process safety management elements.
- New activities for traditional process safety management elements.
- New ways to organize and improve process safety management practices.

Companies, whether novices or veterans in process safety management practices, will benefit from examining, adapting, and incorporating the risk-based process safety management approach throughout the entire life cycle of their operations. The RBPS design and implementation process described in this book can be used to develop and implement a practical process safety management system that has a level of detail and effort commensurate with the hazards associated with the facility.

The RBPS management system is not meant to represent the sole path for compliance with process safety regulations, nor is it meant to establish new performance-based requirements for process safety. Nonetheless, in some sense, the RBPS approach does establish new risk-based expectations for process safety management.

The RBPS element guidance is meant to be thoughtfully evaluated by companies, which by using the RBPS criteria, may elect to implement some aspects of these practices while ignoring others. Not all companies, even those with facilities in similar circumstances, will elect to adopt the same elements or implement a given RBPS element or work activity in the same way. Company- and facility-specific circumstances may give rise to very different RBPS activities based on the perceived needs, resource requirements, and the existing process safety culture of the facility.

1.2 BACKGROUND

Causes of chemical process incidents can be grouped in one or more of the following categories:

- Technology failures
- Human failures
- Management system failures
- External circumstances and natural phenomena

For many years, companies focused their accident prevention efforts on improving the technology and human factors. In the mid-1980s, following a series of serious chemical accidents around the world, companies, industries, and governments began to identify management systems (or the lack thereof) as the underlying cause for these accidents. Companies were already adopting management systems approaches in regard to product quality, as evidenced by various Total Quality Management initiatives, with widely reported success (Ref. 1.1). Companies developed policies, industry groups published standards, and governments issued regulations, all aimed at accelerating the adoption of a management systems approach to process safety. Thus, the initial, somewhat fragmented, hazard analysis and equipment integrity efforts were gradually incorporated into integrated management systems. The integrated approach remains a very useful way to focus and adopt accident prevention activities. More recently, inclusion of manufacturing excellence concepts has focused attention on seamless integration of efforts to sustain high levels of performance in manufacturing activities. Done well, manufacturing excellence deeply embeds process safety management practices into a single, well-balanced process for managing manufacturing operations.

The American Institute of Chemical Engineers' Center for Chemical Process Safety was established in 1985 as one of the U.S. chemical industry's reactions to a major chemical accident in Bhopal, India. In 1988, the CCPS published a motivational advertisement for its forthcoming process safety management structure, *Chemical Process Safety Management – A Challenge to Commitment* (Ref. 1.2). This item was intended to educate chief executives in the chemical industry about the importance of implementing process safety management activities into their company operations and to motivate them to adopt a management systems approach.

In 1989, the CCPS began to publish a series of guidelines, beginning with *Guidelines for Technical Management of Chemical Process Safety*, to encourage its members to pursue accident prevention in more integrated, holistic ways (Ref. 1.3). Since then, the CCPS has published more than 100 guidelines, tools, and concepts books covering a wide range of topics related to process safety management. Table 1.3 lists a few of the key guidelines and tools that have paved the way for companies seeking to adopt, implement, and improve process safety management systems for chemical accident prevention.

TABLE 1.3. CCPS Guidelines and Tools for Chemical Process Safety Management

- *Guidelines for Technical Management of Chemical Process Safety*, 1989 (Ref. 1.3)
- *Plant Guidelines for Technical Management of Chemical Process Safety*, 1992, 1995 (Ref. 1.4)
- *Guidelines for Auditing Process Safety Management Systems*, 1993 (Ref. 1.5)
- *Guidelines for Implementing Process Safety Management Systems*, 1994 (Ref. 1.6)
- *Guidelines for Integrating Process Safety Management, Environment, Safety, Health and Quality*, 1996 (Ref. 1.7)
- *ProSmart: Performance Measurement of Process Safety Management Systems*, 2001 (Ref. 1.8)

Other industry groups and government agencies also developed process safety management frameworks. Tables 1.4 and 1.5 list a sampling of these initiatives. Most of the frameworks are similar in construction, include identical or similar safety management system elements, and promote similar process safety work activities. Differences exist in the frameworks, however, particularly the newer ones. In many cases, the sponsoring country or organization wisely looked around the world and then built its process safety structure on current best practices within the industry.

Prior to publishing these *RBPS Guidelines*, the CCPS published a motivational paper for industry executives similar to the original *Challenge to Commitment*. This paper acknowledges that, while industry has made great progress since the CCPS began publishing its process safety management guidelines series, serious accidents continue to occur. This paper challenges companies to recommit to continuous improvement and process safety excellence.

TABLE 1.4. North American Industry Process Safety Management Initiatives

- Canadian Chemical Producers Association: Responsible Care program, 1986
- American Chemistry Council (formerly Chemical Manufacturers Association): Responsible Care initiative Process Safety Code of Management Practices, 1987
- AIChE Center for Chemical Process Safety: Technical Management of Chemical Process Safety, 1989
- American Petroleum Institute: Recommended Practice 750 – Management of Process Hazards, 1990
- ISO 14001:1996 and 2001 – Environmental Management System
- Organization for Economic Cooperation and Development: Guiding Principles on Chemical Accident Prevention, Preparedness, and Response, 2003
- American Chemistry Council: Responsible Care Management Systems and RC 14001, 2004

These items are all referenced in Chapter 4.

TABLE 1.5. Partial List of Worldwide Governmental Accident Prevention and Process Safety Management Initiatives

- European Commission: Seveso I Directive, 1982 and Seveso II Directive, 1997
- U.S. Occupational Safety and Health Administration: Process Safety Management of Highly Hazardous Chemicals (29 CFR 1910.119), 1992
- U.S. Clean Air Act Amendments: Section 112(r) – Accident Prevention, 1992
- U.S. Environmental Protection Agency: Risk Management Program rule (40 CFR 68), 1996
- Mexico: Integral Security and Environmental Management System (SIASPA), 1998
- United Kingdom: Health and Safety Executive COMAH regulations – The Control of Major Accident Hazards Regulations, 1999
- Australia: Occupational Health and Safety Act 1985 Occupational Health and Safety (Major Hazard Facilities) Regulations 1999 (SR 1999). National Standard for the Control of Major Hazard Facilities [NOHSC:1014(1996)]
- Canada: Canadian Environmental Protection Act – Environmental Emergency Regulation, Section 200 Part 8, 1999
- Republic of Korea: Korean OSHA PSM standard, Industrial Safety and Health Act – Article 20, Preparation of Safety and Health Management Regulations. Korean Ministry of Environment – Framework Plan on Hazardous Chemicals Management, 2001-2005
- Brazil: ANG Oil & Gas industry accident prevention regulations
- Malaysia: Department of Occupational Safety and Health, Ministry of Human Resources, Section 16 of Act 514

These items are all referenced in Chapter 4.

Companies are seeking new ways to improve process safety management activities based on the following strategies:

- Decreasing unnecessary process safety management work, based on risk judgments.
- Performing process safety management activities more efficiently.
- Using the same resources, but using better practices to generate improved results.
- Getting better process safety management results, but with fewer resources.
- Extending existing process safety management practices into new areas.
- Extending existing process safety management practices throughout the life cycle.
- Adding new process safety management activities to existing process safety management elements.
- Creating new process safety management elements.
- Restructuring the process safety management system.

This RBPS *Guidelines* book proposes a management system structure, offers examples of emerging effective practices, and defines a risk-based strategic implementation process that can help companies find effective ways to break through their process safety management barriers to become more effective and to operate safer processes.

TABLE 1.6. Some Factors that Motivated the CCPS RBPS Project

- Process safety management has become a mature activity for many chemical manufacturing companies with few new drivers for innovation and improvement.
- Innovative practices have emerged from facilities that have been challenged to improve performance despite diminishing process safety resources – achieving better results with fewer resources.
- Much experience, good and bad, has been accumulated on process safety management implementation that should be shared across industry.
- The CCPS process safety management elements are more than 15 years old; many companies and many countries have improved on the CCPS's original structure and contents.
- Some companies have done everything they reasonably could to minimize PSM regulatory coverage, but failed to address their general duty obligations to protect workers, the public, and the environment.
- Many companies are attempting to integrate safety, health, and environmental management systems with security management systems; however, few have succeeded in achieving the efficiency improvements promised by such integration.
- Process safety management costs, and subsequently, value, are often questioned by management.
- Society demands improved process safety performance; serious accidents are not acceptable.

1.3 IMPORTANT TERMINOLOGY

The Glossary defines many terms used within these *Guidelines*. This section emphasizes several terms of particular importance that are used frequently in these *Guidelines*.

Risk. Risk is the combination of: What can go wrong?, How bad could it be?, and How often might it happen? When the term **risk** is used in connection with **evaluating risk,** whether qualitatively or quantitatively, all three questions are typically addressed in some way to generate a risk picture (Ref. 1.9). However, in these *Guidelines*, the term **risk-based** is used more generally to portray one or more **risk attributes** of a process, activity, or facility. In this context, considering any one of the three risk questions can be viewed as a risk-based activity. For example, when considering the hazards of a substance or a process in deciding how much rigor to build into an operating procedure, the term risk-based design is used rather than hazard-based design, even though understanding the hazard attributes was the primary determinant in the design of the procedure. So, for simplicity, rather than use the independent terms hazard-based, consequence-based, or frequency-based, the single term **risk-based** is used to mean any one or a combination of these terms.

Process Safety Management. A management system that is focused on prevention of, preparedness for, mitigation of, response to, or restoration from catastrophic releases of chemicals or energy from a process associated with a facility.

OSHA Process Safety Management, 29 CFR 1910.119 (OSHA PSM). This regulatory standard requires use of a 14-element management system to help prevent or mitigate the effects of catastrophic releases of chemicals or energy from a covered process containing a threshold quantity of specific highly hazardous chemicals.

Risk-based process safety. RBPS is the CCPS's process safety management system approach that uses risk-based strategies and implementation tactics that are commensurate with the demand for process safety activities, availability of resources, and existing organizational culture to design, correct, and improve process safety management activities.

Life cycle. The life cycle consists of the stages that a physical process or a management system goes through as it proceeds from birth to death. These stages include conception, design, deployment, acquisition, operation, maintenance, decommissioning, and disposal.

Facility. Facility, as used in these *Guidelines*, refers to the physical place where the management system activity is performed. In early life cycle stages, a facility may be the company's central research laboratory or the engineering offices of a technology vendor. In later stages, the facility may be a typical chemical plant, storage terminal, distribution center, or corporate office.

Effectiveness. Effectiveness is the combination of process safety management performance and process safety management efficiency. An effective process safety management program produces quality results with minimum consumption of resources.

Measurement and metrics. These measures of process safety management performance include outcome oriented lagging indicators (e.g., incident rates) and predictive leading indicators (e.g., rate of improperly performed line-breaking activities). A combination of leading and lagging indicators is typically needed to provide a complete picture of process safety effectiveness.

Improvement. Improvement means doing better in performance or efficiency, or both, with respect to a starting point or a goal.

1.4 MANAGEMENT SYSTEMS CONCEPTS

In this book, the term **management system** means:

> ***A formally established and documented set of activities designed to produce specific results in a consistent manner on a sustainable basis.***

These activities must be defined in sufficient detail for workers to reliably perform the required tasks.

For process safety management, the CCPS initially compiled a set of important characteristics of a management system, which were published in Appendix A of the *Guidelines for Technical Management of Chemical Process Safety*. The CCPS gleaned those important characteristics from interactions with its member companies and traditional business process consulting firms that had significant experience in evaluating management systems. Those guidelines were the first generic set of principles to be compiled for use in designing and evaluating process safety management systems.

Although Appendix A of the *Guidelines for Technical Management of Chemical Process Safety* was groundbreaking, most readers overlooked it as a practical tool because the management systems concept was foreign to them. Since that time, most companies, including their chemical process safety professionals, have accumulated significant practical experience in implementing formal process safety, occupational safety, and environmental management systems.

Table 1.7 lists issues that have proven to be most important when designing, developing, installing, revising, operating, evaluating, and improving process safety management systems. A process safety management framework (such as RBPS) can address one or more or these issues on an element-by-element basis. For example, companies normally define the roles and responsibilities for a particular element within the written program for that element, rather than defining roles and responsibilities for the entire process safety management system within a single discrete system element. On the other hand, a single issue can be the sole focus of an individual element. For example, many companies choose to have a discrete *auditing* element rather than building the activity into each individual system element. In any case, the most important thing is that companies thoughtfully consider all of the issues in Table 1.7 when establishing a new management system, fixing an existing one, or improving a mature system.

TABLE 1.7. Important Issues to Address in a Process Safety Management System

- Purpose and scope
- Personnel roles and responsibilities
- Tasks and procedures
- Necessary input information
- Anticipated results and work products
- Personnel qualifications and training
- Activity triggers, desired schedule, and deadlines
- Necessary resources and tools
- Metrics and continuous improvement
- Management review
- Auditing

1.5 RISK BASED PROCESS SAFETY ELEMENTS

The CCPS RBPS subcommittee reviewed various accident prevention management system structures in place around the world (Tables 1.4 and 1.5), solicited ideas from member companies on new and improved process safety practices, and focused on addressing the process safety management weaknesses and concerns listed in Tables 1.1 and 1.6. The result of that activity was the development of the RBPS elements.

Table 1.8 lists the RBPS elements and compares them to the original CCPS process safety management and OSHA PSM and EPA RMP accident prevention elements (Refs. 1.10 and 1.11). Some of the element names have been changed or expanded to include enhanced activities. Gray shading in the original CCPS PSM or OSHA PSM Element columns indicates that the RBPS element is new.

Chapters 3 through 22 contain a complete description of each element in the management system framework. Because these *RBPS Guidelines* were built upon the original concepts behind the 12-element system described in the CCPS's 1989 process safety management publication, readers need not review the original system.

1.6 RELATIONSHIP BETWEEN RBPS ELEMENTS AND WORK ACTIVITIES

These *RBPS Guidelines* define a structure for the RBPS management system and its elements. Design and implementation of an effective RBPS management system should be based on a company's current risk understanding with regard to the processes to which the RBPS management system applies. Additional factors can influence the design and operation of the RBPS structure. These factors include (1) the rate at which the RBPS management system is used (for example, the number of management of change reviews performed at a facility), placing demand on facility resources and (2) the existing process safety culture at the facility.

Chapter 2 discusses the general application of the risk-based management system design principles to the creation, correction, and improvement of RBPS management systems, to help companies (1) implement RBPS management systems and elements, (2) repair deficient systems and elements, or (3) fine-tune existing systems and elements by continuously improving effectiveness. The information in Chapter 2 can also be used by corporate personnel responsible for establishing company-wide standards or guidelines for process safety management systems. The RBPS design and implementation process described herein allows management to develop and implement process safety management systems that are appropriate and practical at a level of detail and effort that is commensurate with the risk associated with the facility.

TABLE 1.8. Comparison of RBPS Elements to Original CCPS PSM Elements

RBPS Element	*Original CCPS PSM Element*	*OSHA PSM/EPA RMP Elements*
Commit to Process Safety		
Process Safety Culture	Accountability: Objectives and Goals	
Compliance with Standards	Standards, Codes, and Laws	Process Safety Information
Process Safety Competency	Enhancement of Process Safety Knowledge	
Workforce Involvement		Employee Participation
Stakeholder Outreach		
Understand Hazards and Risk		
Process Knowledge Management	Process Knowledge and Documentation	Process Safety Information
Hazard Identification and Risk Analysis	Capital Project Review and Design Procedures Process Risk Management	Process Hazard Analysis
Manage Risk		
Operating Procedures	Training and Performance Human Factors	Operating Procedures
Safe Work Practices		Operating Procedures Hot Work Permits
Asset Integrity and Reliability	Process and Equipment Integrity	Mechanical Integrity
Contractor Management		Contractors
Training and Performance Assurance	Training and Performance Human Factors	Training
Management of Change	Management of Change	Management of Change
Operational Readiness		Pre-startup Safety Review
Conduct of Operations		
Emergency Management		Emergency Planning and Response
Learn from Experience		
Incident Investigation	Incident Investigation	Incident Investigation
Measurement and Metrics		
Auditing	Audits and Corrective Actions	Compliance Audits
Management Review and Continuous Improvement		

Table 1.9 lists the work breakdown structure for each RBPS management system element described in Chapters 3 through 22. This structure is intended to simplify the application of these *Guidelines* when implementing the risk-based approach.

1.7 APPLICATION OF THESE *RBPS GUIDELINES*

In general, the RBPS management system is meant to address process safety issues in all operations involving the manufacture, use, or handling of hazardous substances or energy. Each company must decide which physical areas and phases of the process life cycle should be subject to RBPS, using the risk-based thought process to decide the depth of detail to use in meeting the process safety need. The following paragraphs describe technical issues that are addressed within or excluded from the scope of the RBPS elements.

TABLE 1.9. Generic Work Breakdown Structure for the RBPS System

Item	*Description*
Element	This basic division in a process safety management system correlates to the type of work that must be done, for example, *management of change* (*MOC*).
Key Principle	Elements are organized according to key principles, which may be generic in nature or specifically defined by the type of element (e.g., *identify potential change situations*).
Essential Feature	Key principles are met by adherence to such essential features as *manage all sources of change*.
Work Activity	Essential features are accomplished by completing activities that are risk-appropriate, for example, developing specific examples of changes and replacements-in-kind for each category of change, and using these in employee awareness training to minimize the chance that the MOC system is inadvertently bypassed.
Implementation Options	Implementation options represent a spectrum of how the work activities can be achieved (e.g., multiple examples of changes and replacements-in-kind are developed for all types of change in different manufacturing areas; they are updated based on MOC performance).

Total life cycle. The RBPS elements are meant to apply to the entire process life cycle. Some elements may not be active in early life cycle stages (e.g., during conceptual design there is little need for developing operating procedures). Other elements may be active, but the information available in early stages may not be very detailed; therefore, the work performed in that element would be more preliminary (e.g., hazard identification and risk analysis).

For some elements, however, the early life cycle stages provide a unique opportunity to minimize risk by identifying and incorporating inherently safer process characteristics. In later stages, such as decommissioning, some work activities may not be as important or may no longer be needed (e.g., maintenance), while others may still be necessary, but might be satisfied using a simpler approach (e.g., hazard reviews of decommissioning activities using checklists).

Fixed facilities, not transportation. The RBPS management system is meant to apply to fixed facilities. Transportation activities are only within the scope of these *Guidelines* when cargo vehicles, such as trucks, rail cars, containers, are connected to a fixed facility during loading and unloading or used as a storage vessel. Although risk-based principles and most RBPS elements and activities are relevant to transportation or maritime situations, the application to those operating environments was not considered when these *RBPS Guidelines* were developed. Thus, readers are cautioned that applying these *Guidelines* to transportation activities may require significant adjustment to, or expansion of, the process safety activities identified in these *Guidelines*.

Processes, not products. The RBPS management system is meant to be applied to process safety-related situations and not product safety issues. Some RBPS elements and activities may be relevant to product safety situations, but such issues were not considered when these *RBPS Guidelines* were developed. Thus, readers are cautioned that applying these *Guidelines* to product safety or consumer risk issues may require significant adjustment to the process safety activities identified in these *Guidelines*.

Related technical areas. Many companies and organizations use management system approaches to address complex issues. In some cases, companies, as well as industry organizations, promote the integration of management system activities into one system to achieve more efficient operation. For example, some companies have established an integrated environmental, safety, and health (ESH) management system. Other companies integrate similar activities across the ESH domain at an element or work activity level; in other words, management of change applies to changes that could impact the environment as well as process safety.

The RBPS management system focuses on process safety issues. Recognizing the potential overlaps, companies may want to consider possibilities for integration. However, these *RBPS Guidelines* were written to

address process safety as a stand alone issue and do not explicitly include the following related technical areas:

- Occupational health and safety
- Environmental protection
- Product stewardship
- Product distribution
- Security
- Quality

1.8 ORGANIZATION OF THESE *GUIDELINES*

These *Guidelines* are organized to facilitate their use for any of the following basic needs:

- Implementing the first process safety management policy within a company or process safety management system at a facility.
- Diagnosing and correcting an existing deficient process safety management element or system.
- Determining ways to continuously improve process safety management performance or efficiency.

Chapter 2 defines the risk-based process safety approach advocated in applying the RBPS elements to industrial operations. Chapters 3 through 22 provide the details of the management system framework for each RBPS element. Each element chapter has the same organization:

- Element overview.
- Key principles and essential features.
- Possible work activities and implementation options.
- Examples of ways to improve effectiveness.
- Element metrics.
- Management review.

Section 2.3 applies this roadmap to a spectrum of anticipated user needs and suggests which sections should be reviewed first by readers fitting that user/need category.

Chapter 23 covers approaches for initial implementation, corrective implementation, and ongoing improvement of the RBPS management system at a facility. Chapter 24 describes the current state of process safety practice and areas in which additional development is needed. The appendices provide tools and examples for companies to use in applying the RBPS principles contained in these *Guidelines*.

1.9 REFERENCES

1.1 Feigenbaum, A. V., *Total Quality Control,* McGraw-Hill, Inc., New York, New York, 1983.

1.2 Center for Chemical Process Safety, "Chemical Process Safety Management – A Challenge to Commitment," 1988.

1.3 Center for Chemical Process Safety, *Guidelines for Technical Management of Chemical Process Safety,* American Institute of Chemical Engineers, New York, New York, 1989.

1.4 Center for Chemical Process Safety, *Plant Guidelines for Technical Management of Chemical Process Safety,* American Institute of Chemical Engineers, New York, New York, 1992 (and revised edition, 1995).

1.5 Center for Chemical Process Safety, *Guidelines for Auditing Process Safety Management Systems,* American Institute of Chemical Engineers, New York, New York, 1993.

1.6 Center for Chemical Process Safety, *Guidelines for Implementing Process Safety Management Systems,* American Institute of Chemical Engineers, New York, New York, 1994.

1.7 Center for Chemical Process Safety, *Guidelines for Integrating Process Safety Management, Environment, Safety, Health, and Quality,* American Institute of Chemical Engineers, New York, New York, 1996.

1.8 ProSmart – The Tool You Need to Improve Process Safety, Center for Chemical Process Safety, American Institute of Chemical Engineers, New York, 2001, available at *www.aiche.org/ccps.*

1.9 *Evaluating Process Safety in the Chemical Industry – A Users' Guide to Quantitative Risk Assessment,* Center for Chemical Process Safety, New York, 2004.

1.10 Process Safety Management of Highly Hazardous Chemicals (29 CFR 1910.119), *U.S. Occupational Safety and Health Administration, May 1992,* available at *www.osha.gov.*

1.11 Accidental Release Prevention Requirements: Risk Management Programs Under Clean Air Act Section 112(r)(7), 40 CFR 68, U.S. Environmental Protection Agency, June 20, 1996, Fed. Reg. Vol. 61 [31667-31730], available at *www.epa.gov.*

This page intentionally left blank.