



GUIDELINES FOR PROCESS SAFETY KNOWLEDGE MANAGEMENT



Guidelines for Process Safety Knowledge Management

Center for Chemical Process Safety
American Institute of Chemical Engineers
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WILEY

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Guidelines for
Process Safety Knowledge Management

This book is one in a series of process safety guidelines and concept books published by the Center for Chemical Process Safety (CCPS). Please refer to wiley.com/go/ccps for a full list of titles in this series.

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Acronyms and Abbreviations

AIChE	American Institute of Chemical Engineers
API	American Petroleum Institute
CCPS	Center for Chemical Process Safety
CRW	Chemical Reactivity Worksheet
DIKW	Data-Information-Knowledge-Wisdom
HAZID	Hazard Identification
HAZOP	Hazards and Operability Study
KM	Knowledge Management
KPI	Key Performance Indicators
MOC	Management of Change
MOOC	Management of Organizational Change
PHA	Process Hazards Analysis
PSI	Process Safety Information
PSK	Process Safety Knowledge
PSKM	Process Safety Knowledge Management
RACI	Responsible, Accountable, Consulted, and Informed chart
RAGAGEP	Recognized and Generally Accepted Good Engineering Practices
RBPS	Risk Based Process Safety (CCPS)
SDS	Safety Data Sheet

Glossary

This Glossary contains Process Safety terms significant to this CCPS publication, which are current at the time of publication. For other CCPS Process Safety terms and updates to these terms, please refer to the CCPS Process Safety Glossary [1].

Term	Definition
Accident precursors [2]	Events that must occur for an accident to happen in each scenario but have not resulted in an accident so far
Cause (Incident)	An event, situation, or condition which results, or could result (Potential Cause), directly or indirectly in an accident or incident [1].
Chief Knowledge Officer	Person accountable for the overall PSKM strategy, planning and implementation (Highest position within PSKM)
Contributing Cause	Factors that facilitate the occurrence of an incident such as physical conditions and management practices (also known as contributory factors) [1].
Key Performance Indicators (KPI)	A quantifiable way to monitor the health of the overall PSKM System and proactively identify potential issues early to be corrected or improved. KPIs tell an organization how effective their PSKM is at supporting their RBPS program.
Logic Model	A logic model is a tool that can be used to develop and implement the PSKM System [3]. Logic models are graphic illustrations of the PSKM Implementation Plan and show the relationship between the planned work and anticipated results.
Management of Organizational Change (MOOC)	Framework for managing the effect of new business processes, changes in organizational structure or cultural changes within an organization

Term	Definition
Process Safety Knowledge (PSK)	Knowledge is related to information, which is often associated with policies, and other rule-based facts. It includes work activities to gather, organize, maintain, and provide information to other process safety elements. Process Safety Knowledge primarily consists of written documents such as hazard information, process technology information, and equipment-specific information.
Process Safety Knowledge Management (PSKM)	System for capturing, organizing, maintaining, and providing the right Process Safety Knowledge to the right people at the right time to improve process safety in an organization
Process Safety Knowledge Management Focus Chart	A chart divided into three columns that depict causes and other factors related to the incident, and four rows that show elements of the PSKM System (i.e., Capture, Organize, Maintain, and Provide).
Process Safety Knowledge Management System	A tool that makes necessary Process Safety Knowledge available to everyone who needs it, when they need it, and at the right level of detail
Proximate Cause	The cause factor which directly produces the effect without the intervention of any other cause. The cause nearest to the effect in time and space [1].
PSKM Audit	A PSKM audit expands on a regulatory audit such that it covers not only availability of documents but their content, accuracy, system/process to create/update, and how the information is shared and utilized. A PSKM audit benefits an organization by identifying gaps in the system and improvement opportunities.
PSKM Champions	A PSKM Champion will promote PSKM in the workplace and facilitate Communities of Practice.

Term	Definition
PSKM Editors	A PSKM Editor is someone who knows where PSKM is located and manages format and language of knowledge so users can easily use it.
PSKM Navigators	Navigators connect people who need knowledge with systems and people who have knowledge.
PSKM Project Manager	An executive who manages the implementation of the PSKM initiatives
PSKM Stewards	A steward is responsible for ensuring PSKM updates are made following Management of Change and track changes for follow-up and validation.
Root Cause	A fundamental, underlying, system-related reason why an incident occurred that identifies a correctable failure(s) in management systems. There is typically more than one root cause for every process safety incident [1].

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Subcommittee Members:

Michelle Brown, Chair	FMC
Denise Albrecht, Co-Chair	3M
Jennifer Brittain	AdvanSix
Brian Farrell	CCPS Consultant
Linus Hakkimattar	ReVizions
Mark Hall	Mallinckrodt Pharmaceuticals
Dan Hannewald	BASF
Rainer Hoff	Gateway Group
Allison Knight	3M
Jennifer Mize	Eastman chemical
Steve Murphy	Syngenta
Mohammad Nashwan	Saudi Aramco
Ravi Ramasamy	Nghi Son Refinery & Petrochemical LLC
Jeffery Todd	Holly Frontier
Florine Vincik	BASF
Jerry Yuan	IRC Risk
Hafeez Ahmad Zeeshan	Tronox Management Pty Ltd

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Peer Reviewers:

Jack Chosnek	Knowledge One
Raj Dahiya	AIG
Emmanuelle Hagey	NOVA
Trish Kerin	ICHEM E
Joompote Ketkeaw	SCG Chemicals
Shannon Ross	Chevron
Juliana Schmitz	Linde
Herve Vaudrey	Dekra

Dedication

This book is dedicated to:

Kenneth E. Tague, CCPSC, CSP



Ken Tague is a Rose-Hulman Institute of Technology graduate with a career spanning over 38 years in chemical operations. His many roles have included Production Manager and Plant Manager. Before retirement, he was the CCPS Technical Steering Committee (TSC) representative for Archer Daniels Midland Company (ADM) and was on the CCPS Planning Board. His experience and presentation skills have made him a sought-after instructor for CCPS's flagship course, *Foundations of Risk Based Process Safety*. He has contributed to the AIChE SACChE and RAPID education programs by developing e-learning courses related to process safety.

Ken also served on CCPS book committees, contributing to the development of two CCPS books: *Dealing with Aging Process Facilities and Infrastructure* and *Recognizing and Responding to Normalization of Deviance*. Based on his hands-on experience, he also significantly contributed to the web-based training on *Process Safety for Maintenance Workers and Operators*.

He is a strong proponent of process safety, having shared his commitment to Process Safety at the 2018 Global Congress on Process Safety in the session "When PSM Hit Home." Preventable incidents continue to stir his passion for sharing his experiences to strengthen the expertise of engineers new to and within the Process Safety field.

Ken is a CCPS Certified Process Safety Professional (CCPSC), a Certified Safety Professional (CSP) in the Safety, Health, and Environmental (SH&E) field, and was an active member of the CCPS Pharma, Food, and Fine Chemicals (PFFC) Committee before he retired. In addition, he holds Patent 9,481,609 as a co-inventor of the process to make *Heteromorphic Lysine Feed Granules*.

CCPS is delighted to dedicate this book to Ken in recognition for his past, present, and continuing support of CCPS and the global Process Safety community.

Louisa A. Nara, CCPSC
Global Technical Director, CCPS

Anil Gokhale, Ph.D.
Chief Operating Officer, CCPS

Preface

The Center for Chemical Process Safety (CCPS) has been the world leader in developing and disseminating information on process safety management and technology since 1985. The CCPS, an industry technology alliance of the American Institute of Chemical Engineers (AIChE), has published over 100 books in its process safety guidelines and process safety concepts series, and over a hundred courses, including 33 training modules through its Safety in Chemical Engineering Education (SAChE) series. CCPS is supported by the contributions and voluntary participation of more than 250 companies globally.

This book contains guidelines for companies to improve their process safety performance through the implementation of a Process Safety Knowledge Management (PSKM) system. The characteristics of a PSM system are defined and guidelines are shared on how to set up a PSM system to improve overall Process Safety performance. The underlying factors for success are presented which include leadership, employee involvement, and organizational culture with case studies used to illustrate key points and learnings. New perspectives on PSM are included along with strategies to overcome difficulties in transitioning from a process safety culture based on data and information to a culture based on knowledge and wisdom. Case studies with PSM-related lessons learned demonstrate the principles and practices described in the book.

1 Introduction

"A society grows great when old people plant trees whose shade they know they shall never sit in." Greek proverb

1.1 What Is Process Safety Knowledge Management (PSKM)?

This chapter introduces the key definitions for Process Safety Knowledge and Knowledge Management. Process Safety Knowledge Management (PSKM) is a subset of Knowledge Management focusing on building, disseminating, and sustaining Process Safety Knowledge (PSK) in an organization.

Knowledge Management has been defined by many authors over the years as collected and published by Girard and Girard [4]. One of the classic and most cited definitions of Knowledge Management is by O'Dell and Grayson [5]:

"Knowledge Management is a conscious strategy of getting the right knowledge to the right people at the right time and helping people share and put information into action in ways that strive to improve organizational performance."

CCPS defines Process Safety Knowledge (PSK) as follows [1]:

"Knowledge related to information, which is often associated with policies, and other rule-based facts. It includes work activities to gather, organize, maintain, and provide information to other process safety elements. Process Safety Knowledge primarily consists of written documents such as hazard information, process technology information and equipment-specific information."

Hence, Process Safety Knowledge Management (PSKM) is defined as:

"A system for capturing, organizing, maintaining, and providing the right Process Safety Knowledge to the right people at the right time to improve process safety in an organization."

PSKM includes methodologies, tools, processes, organizational structures, and human capital management strategies used to convert data to information, information to knowledge and knowledge to wisdom.

Process Safety Knowledge Management (PSKM) systems cover the entire life cycle of Process Safety Knowledge including development, implementation, and maintenance. The knowledge management system must ensure Process Safety Knowledge is easily accessible and understandable to the people who need it.

and that the knowledge shared is consistent, current, and accurate. We note that there is a special case with regards to Contractors and other outside entities which could impact this stated goal. A brief discussion is included in Section 4.5.

1.2 Purpose and Scope of this Book

This book is intended to be a resource for sharing industry-leading best practices on PSKM and for providing a blueprint for developing an effective PSKM program for companies. This book is divided into three sections:

1. Business case for an effective PSKM program and its relationship to PSM elements (Chapters 2 and 3)
2. Setting up a successful PSKM system and sustaining it (Chapters 4 and 5)
3. Sharing case studies illustrating the importance of an adequate and effective PSKM system (Chapter 6)

The principles of PSKM are transferable across industries. Examples contained within this book will provide guidance on how the knowledge obtained from past incidents, and current best practices from industry leaders, can be applied to many different organizations.

1.3 Historical Development of PSKM

Historically, the terms Process Safety Information (PSI) and Process Safety Knowledge (PSK) have been used interchangeably [6], [7]. As companies' maturity level in Process Safety Management (PSM) improves, there is a continuing focus in the industry to transition from information to knowledge.

Before the 1990's, the PSK resided in the organization as a core competency of chemical or process engineers. Analysis of serious process safety events such as the methyl isocyanate release at Bhopal, India in 1984 and explosions at a chemical complex at Pasadena, Texas in 1989, showed that while PSI resided within an organization, it did not consistently turn into knowledge at the operational level. Hence, the right knowledge was not available to the right people.

With the establishment of the US PSM Standard by Occupational Safety and Health Administration (OSHA) in 1992, the importance of PSI and informing all affected employees of PSI became a key requirement in US facilities. Regulation, however, left the importance of Process Safety Information at the information level without extending it to knowledge.