Guidelines for

Process Hazards Analysis, Hazards Identification & Risk Analysis











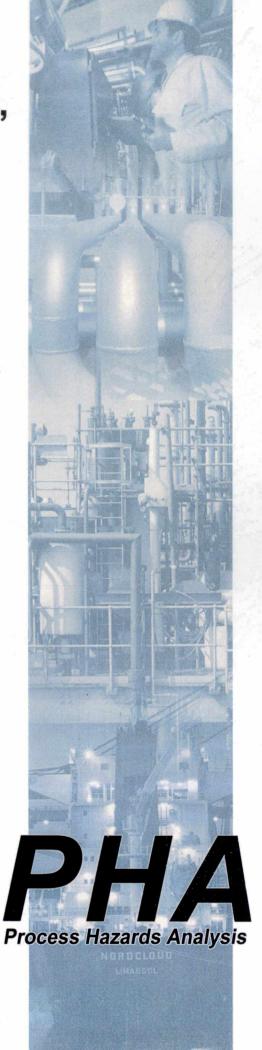


Table of Contents

Introduction

CHAPTER 1	1-1
Risk Concepts	
Hazardous Event	1-1
What is Risk?	1-1
Typical Incidents that Concern Us	1-2
Industrial Incidents of Major Significance	1-2
CHAPTER 2	2-1
Regulatory Developments	
North America	2-1
Bodies and Regulatory Developments in North America	2-1
Individual States Legislation in the USA	2-2
Occupational Safety and Health Administration (OSHA), Process Management of Highly Hazardous Regulations – 29 CFR 1910.119	2-3
Environmental Protection Agency (EPA), Risk Management Plan (RMP) Rule – 40 CFR Part 68	2-9
United Kingdom	2-12
European Commission (EC)	2-13
CHAPTER 3	3-1
Risk Terminology	



CHAPTER 4	4-1
Process Hazards & Risk Management Alternatives	
Hazards that Concern us	4-1
What Increases the Potential for Industrial Facilities to Become More Hazardous?	4-2
What Makes Transportation of Dangerous Goods More Hazardous?	4-3
How are Process Risks Analyzed?	4-3
Principle and Practice of Risk Analysis via Quantitative Risk Assessment	4-7
Risk versus Safety: a Comparative View	4-9
Risk Management Alternatives for New (Proposed) & Existing Hazardous Facilities	4-11
CHAPTER 5	5-1
Identification of Hazards and Structured Hazards Analysis Tools	
How do we identify Hazards?	5-1
Widely Used Methodologies to Identify Hazards	5-1
Preliminary Hazards Analysis (PrHA)	5-2
Hazards And Operability Analysis (HAZOP)	5-2
Failure Mode and Effects Analysis (FMEA)	5-7
What If Analysis	5-8
Checklist Analysis	5-9
Use of Risk Matrix With Hazards Identification	5-10
Example: Liquefied Petroleum Gas (LPG) Rail Car Loading Terminal	5-11
CHAPTER 6	6-1
Basics of HAZOP	
What Did we Do Before HAZOP Came Along?	6-1
How Do We Know If a Plant Is Safe?	6-1
HAZOP Methodology	6-2
Methodology for Generating Deviations	6-3
What Type of HAZOP Should You Use?	6-4

Steps in the HAZOP Process	6-5
Variations in HAZOP Types	6-7
Preparation of HAZOP Reports	6-10
HAZOP Example	6-12
CHAPTER 7	7-1
Pitfalls with HAZOP, Optimization of PHAs & Sizing of Nodes	
Pitfalls with HAZOP	7-1
Optimization: When to Do What	7-5
Choosing & Sizing of Nodes for HAZOP	7-6
CHAPTER 8	8-1
What If/Checklist	
What If	8-1
Checklist	8-3
What If Example	8-9
CHAPTER 9	9-1
Failure Mode and Effects Analysis	
What Is FMEA?	9-1
Reasons for Using FMEA	9-1
When and Where to Use It?	9-2
Regulatory Compliance	9-2
Different Types of FMEAs	9-4
Methodology	9-4
Risk Analysis (prioritizing risks)	9-5
FMEA Worksheet Format	9-10
FMECA	9-11
Benefits of FMEA and FMECA	9-12
Pitfalls with FMEA and FMECA	9-13
FMEA Terminology	9-13
Sample of FMEA Report Using Software	9-16





CHAPTER 10	10-1
Screening Level Risk Analysis (SLRA)	
Basis	10-1
Purpose	10-1
When to Use SLRA	10-1
SLRA Methodology	10-2
Results	10-4
Example of SLRA Worksheet	10-4
CHAPTER 11	11-1
PHA Revalidation	
Overview	11-1
Objectives of PHA Revalidation	11-1
Considerations of PHA Revalidation	11-2
Determination of the Scope of PHA Revalidation Study – 6-Step Approach	11-3
PHA Revalidation Checklist of Suggested Items	11-11
CHAPTER 12	12-1
Management of Change (MOC)	
Introduction	12-1
Changes Justifying PHAs	12-3
MOCs Implementation	12-6
CHAPTER 13	13-1
Estimation of Time Needed for PHAs	
How to estimate the time	13-2
CHAPTER 14	14-1
Management of Hazards Associated with Location of Process Plant Buildings	
Overview	14-1
Major Concerns	14-1

API 752 – Management of Hazards Associated with Location of Process Plant Buildings	14-4
Considerations in Hazards Identification	14-5
Analysis Process for an Explosion	14-8
Analysis Process for a Fire	14-11
Analysis Process for a Toxic Release	14-13
API 752 Building Checklist	14-15
Facility Siting Checklists	14-16
CHAPTER 15	15-1
PHA Protocols and Administrative and Engineering Controls	
PHA Protocols	15-1
Administrative and Engineering Controls	15-2
Administrative and Engineering Controls as Safeguards	15-21
Consequences of Failures of Administrative and Engineering Controls	15-22
CHAPTER 16	16-1
Human Factors	
Introduction	16-1
Human Factors in Relation to PHAs	16-1
CHAPTER 17	17-1
Loss of Containment	
Examples of Loss of Containment	17-3
Loss of Containment Calculations	17-6
Nomenclature	17-15





CHAPTER 18	18-1
Managing and Justifying Recommendations	
The Dilemma for Management	18-1
How to Proceed with Presenting Specific Recommendations to Management	18-2
Correct Descriptions of Recommendations	18-2
The Role of Risk Matrices in Indicating Viability of Recommendations	18-3
Validity of Risk Matrices	18-4
Use of Financial Risk Matrix	18-6
Justification of New Risk Measures	18-9
CHAPTER 19	19-1
PHA Team Leadership	
Objectives of PHA	19-1
Opposition of PHAs	19-2
Driving Forces Behind PSM	19-3
Role of PHA Leader (Facilitator)	19-3
PHA Team	19-4
Choice of PHA & Factors in Determining Choice	19-5
Manage the Time Spent on PHAs	19-11
Preparation Before PHA Sessions	19-11
PHA Leadership: Responsibility	19-13
Analyze Your Performance	19-22
Steps for Performance PHA	19-23
Main Goal of the PHA: Recommendations & Remedial Actions	19-27
Auditing of PHAs	19-30
CHAPTER 20	00.4
	20-1
Safety Integrity Levels	00.1
Standards Safety Life Cycle	20-1
Safety Life Cycle	20-4
SIL Assignment Methodologies	20-8

	New and Existing Systems	20-16
	SIL Verification	20-17
	Important Aspects of SIL Application	20-20
CHAP	PTER 21	21-1
ayer	of Protection Analysis	
	Introduction	21-1
	Scenario Development	21-6
	Consequences and Severity Estimation	21-14
	Initiating Events and Frequency Estimation	21-18
	Independent Protection Layers	21-22
	Applications of LOPA	21-30
CHAP	PTER 22	22-1
Quan	titative Risk Assessment	
	Assessing and Managing Risk	22-1
	Risk Analysis	22-2
	Calculation of Total Risk	22-7
	Risk Measurement	22-7
	Risk Estimation & Acceptability Criteria	22-8
	Comparative Risk	22-9
	Uncertainty in Risk Estimation	22-10
	Risk Assessment Results and Land Use Planning	22-13
	Risk Acceptability Criteria	22-15
	Comparative Common Risks	22-15
	Risk Control (Risk Mitigation)	22-19
	Relationship between Events (incidents) and Effects (impacts)	22-22
	True Risk versus Potential Risk	22-26
	Fault Tree Analysis	22-28
	Failure Rate Estimation and Reliability Data	22-42
	Introduction to Consequence Analysis	22-45
	Consequence Mechanisms	22-49





Fire & Explosion Effects	22-51
Explosion Modeling Methods	22-54
Consequence Analysis Calculations	22-62
Specific Release Scenarios	22-79
Use of Consequence Analysis	22-80
Appendix I	I-1
Deriving Deviations from First Principles	
Introduction	I-1
Critique of Current Methods of Structured Hazards Analysis	1-2
Component Functional Analysis	1-3
Component Functionality: a Pivotal Benchmark for establishing Failure Modes and Deviations	1-4
Use and Advantages of Component Functional Analysis over other methods of Structured Hazards Analysis	1-5
Determination of HAZOP Deviations for Parameters and Operations	I-6
Appendix II	11-1
Different Types of HAZOP	
A. Parametric Deviation Based HAZOP	II-1
B. "Creative Identification of Deviations & Disturbances" Methodology for Performing HAZOPs	11-4
C. Procedural HAZOP	11-6
D. Knowledge Based HAZOP	II-14
References	III-1
Regulations and Recommended Practices	III-1
Books and Publications	111-4
Index	

