

## Book reviews

**Sam Mannan (Ed.), *Lees' Loss Prevention in the Process Industries: Hazard Identification, Assessment and Control, vol. II, third ed., Elsevier, Butterworth, Heinemann, Burlington, MA, 2005, three-volume set, US\$ 476.00, 1071 pp., ISBN 0-7506-7555-1 (three-volume set), 0-7506-7858-5 (vol. II).***

The second volume of this series contains much information published in past editions plus five new chapters and three new appendices. “The five new chapters address incident investigation, inherently safer design, reactive chemicals, safety instrumented systems, and chemical security. The three new appendices address process safety management regulation in the United States, risk management program regulation in the United States, and incident databases.”

Mannan notes in the preface that “The chapter on inherently safer design addresses options and issues that can be considered with regard to the design and operation of plants.” He also writes, “The chapter on reactive chemicals provides an overview of this critical issue and provides guidance on management systems as well as experimental and theoretical methods for analyses of chemical reactivity hazards.” The last or the two new chapters in this volume are described as follows: “The chapter on safety instrumented systems addresses systems and procedures that need to be in place with regard to this area of safety and instrumentation.” Finally, he describes the chapter on chemical security which “. . . deals with this new and critical element of the management of a process facility following the events of September 11, 2001.”

As common with my other reviews, I provide a list of the chapter titles:

17. Explosion
18. Toxic release
19. Plant commissioning and inspection
20. Plant operation
21. Equipment maintenance and modification
22. Storage
23. Transport
24. Emergency planning
25. Personal safety
26. Accident research
27. Information feedback
28. Safety management systems
29. Computer aids

30. Artificial intelligence and expert systems
31. Incident investigation
32. Inherently safer design
33. Reactive chemicals
34. Safety instrumented systems
35. Chemical security

A plethora of accidents are noted. The first table that caught my attention reported on over 100 incidents involving vapour cloud fires and vapour cloud explosions (VCEs). The next table of personal interest was one discussing BLEVEs, many of which I have seen on films I used in my class on Hazardous Chemical Spills. The graphic nature of a BLEVE certainly caught the attention of my students. Among the incidents recorded in the book that I am familiar with were explosions at Crescent City, IL, and Waverley, TN. Another common hazard discussed in this chapter was the explosion of dust, an explosion potential which exists wherever flammable dusts are handled such as grain elevators.

Discussion of explosive gases goes far beyond BLEVEs and, in common with the rest of the book, a thorough, a very thorough, theoretical discussion of explosions is given in this 310-page chapter.

The next chapter deals with a topic commonly covered in the Journal of Hazardous Materials—Toxic Releases. The authors quote a 1976 report which states: “With toxic materials, the sudden release of very large quantities could conceivably cause even larger numbers of casualties than a flammable escape. In theory such a release could, in certain weather conditions, produce lethal concentrations in places 20 miles from the point of release but the actual number of casualties (if any) would depend on the population density in the path of the cloud and the effectiveness of the emergency arrangements that might include evacuation.”

A major part of this chapter is devoted to toxic gases: chlorine, acrylonitrile, bromine, ammonia, phosgene, and methyl isocyanate. Toxic gas releases are discussed in depth with Bhopal, not surprisingly, taking the center stage. Chlorine, because of its ubiquitous use and large-scale production, comes in for special attention.

The following chapters, as already noted in the list of chapters, deal with plant commissioning and inspection, plant operations (emergency procedures with respect to leaks and spills are reviewed) and equipment maintenance and modification.

Since the largest quantities of chemicals are found in storage facilities, the prevention of loss therein is extremely important. The chapter discussing storage contains a thorough description of storage tanks with a particular emphasis on petroleum products.

Since the Bhopal accident, there has been a revolution in emergency planning, especially in the United States. This topic is reviewed. Especially important for chemical plants, in my estimation, is the development of an emergency plan to address both onsite and offsite chemical incidents. Twelve pages are devoted to this topic which, although are an adequate number in general, could have easily been expanded with more detail provided.

Incident investigation is one of the newly added chapters. This chapter is one clearly written in the United States as the author notes the chapter is based on:

- process industry best practices for incident investigation;
- investigation concepts from the Mary K. O'Connor Process Safety Center Root Cause Investigation Course;
- Ted Ferry's book on accident investigation;
- Kuhlman's *Professional Accident Investigation*;
- CCPS (AIChE) *Guidelines for Incident Investigation*;
- NFPA 921 Standard for investigation of fires and explosions;
- American Chemistry Council Responsible Care code (CARE);
- US National Safety Council investigation guidelines.

These references contain descriptions of the best practices for incident investigation and those factors that lead to accidents. Key to the analysis is the identification of root causes that allowed event sequences to progress to their ultimate consequences.

The chapter on inherently safer design addresses options and issues that can be considered with regard to the design and operation of plants. It is a philosophy that focuses on either the reduction of hazards or their total elimination.

Chapter 33 discusses reactive chemicals. It is the only chapter in the three-volume series that specifically cites the contributors. In this chapter, the authors provide an overview of the hazards posed by reactive chemicals and provide guidance on management systems as well as experimental and theoretical methods for the analysis of chemical reactivity hazards.

The final chapter in this volume is clearly a post-September 11, 2001 response. It deals with chemical security. The chapter is a short eight pages, a length I am certain will be increased in future volumes.

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**Sam Mannan (Ed.), Lees' Loss Prevention in the Process Industries: Hazard Identification, Assessment and Control, vol. III, third ed., Elsevier, Butterworths, Heinemann, Burlington, MA, 2005, three-volume set, US\$ 476.00, 1071 pp.), ISBN 0-7506-7555-1 (three-volume set), ISBN 0-7506-7589-3 (vol. III).**

Volume III in this series contains a variety of appendix matter plus a complete citation of all the references for all three volumes. Let me start my review with the latter, which I estimate to number approximately 2400. Clearly, this number of reference citations represents a vast amount of material. The current best-known safety guru is Trevor Kletz; he is cited over 200 times. Even this reviewer is cited as many of the prior *Journal of Hazardous Materials* editors including Frank Feates and Clive Nussey as well as members of the Editorial Advisory Board, past and present.

The first chapter in this volume sets the stage for several following chapters as it focuses on Incident Case Histories. One of the early tables in this chapter gives the following data for 551 incidents which include some of the major accidents in the process industries: date (starting with an incident in Glasgow in 1911 and ending with one in Ukhta, Russia in 1995), location, plant/transport, chemical involved, event type, deaths/injuries, cost (US\$), and references. I understand the difficulty it might present, but it would have been helpful if the table had been updated to at least the year 2000.

Following this table there are short reviews of approximately 150 of the incidents that are well known and involved the loss of life and/or property; the physical events involved are noted. Short case histories are given for almost 150 incidents. Many of these reports are for incidents with which I was not familiar and include events occurring up to the year 2001; clearly this table is up-to-date.

The several chapters following this appendix describe in detail the most famous (or should I say the most infamous) chemical spills/releases/exposures:

- Flixborough, cyclohexane;
- Seveso, dioxin (TCDD);
- Mexico City, LPG;
- Bhopal, methyl isocyanate;
- Pasadena, isobutane.

Next in the book come reports of hazard assessments:

- *Canvey reports*. These reports discuss the potential hazards from operations in the Canvey Island/Thurrock area. The references to LPG production and storage.

- *Rijnmond report*. This report is an assessment of risk posed by six potentially hazardous industrial sites in the Rijnmond area (petrochemical complex).

The next chapters address a potpourri of topics such as: laboratories, pilot plants, safety, health and the environment, noise, safety factors for simple relief systems, failure and event data, earthquakes, transport hazards and offshore process safety.

Four appendix chapters deal with nuclear energy in general and related accidents such as Three Mile Island and Chernobyl in particular. Discussed in this section is the Rasmussen Report which is a comprehensive hazard assessment of nuclear power plants in general.

Approximately the last half of the book is devoted to information resources:

- Institutional publications are listed in Appendix 28; AIChE, for example is noted as many of its publications including water, an annual volume of water pollution related papers that this reviewer edited for many years. Unfortunately, that volume is long out-of-date.
- Units and unit conversions are found in Appendix 30.
- Process safety management (PSM) regulation in the United States (Appendix 31).
- Risk management program regulation in the United States (Appendix 32).
- Incident databases (Appendix 33).
- Web links (Appendix 34).
- References: this section is 486 pages long.

In summary, there is little to add to these very long reviews of the three massive, well-written, vitally important books. Even these three reviews, as extensive as they are, do not do credit to the amount of information provided in this series. Mannan and Elsevier are to be congratulated on this publication. I hope that future editions will be published periodically updating the material.

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**Shelley L. Armsworthy, Peter J. Cranford, Kenneth Lee (Eds.), Offshore Oil and Gas Environmental Effects Monitoring: Approaches and Technologies, Battelle Press, Columbus, OH, 2005, 644 pages, US\$ 87.50, ISBN 1-57477-146-9**

This book contains 27 peer-reviewed papers selected from the 62 papers presented at the Offshore Oil and Gas Environmental Effects Monitoring Workshop held in Dartmouth, Nova Scotia, Canada in 2003. The conference papers were presented by scientists from Canada, the United States, Norway, the United Kingdom, Italy, Mexico, and Brunei with Canadian scientists being more prevalent.

The book addresses issues related to past, present and future environmental effects monitoring (EEM) for operations related to offshore oil and gas operations, many of which take place in some of the world's most biologically productive oceanic waters.

The papers published are divided equally into three major topic areas:

- Environmental management
- Approaches and technologies
- Applications and regional experience

Some of the topics discussed in the book are the following:

- Cost-effectiveness and utility of modelling pollution effects before they occur
- Plans for the management of environmental accidents
- Improving environmental management methodologies by linking EEM with ecological risk assessment
- Techniques used for detecting contaminants and predicting their fates
- Methodologies used for estimating biological effects
- Concerns regarding seismic activity effects on living resources
- Approaches to oil and gas development in sensitive and deep-sea environments
- Effective experimental designs for offshore EEM
- Regional experiences from past and ongoing EEM programs
- Environmental management issues including risk assessment and decision-making processes
- Development of risk assessment models
- New approaches and technologies for monitoring potential alterations in benthic, pelagic, and tropospheric ecosystem components
- Design of offshore EEM programs

Given society's desire to discover and utilize new sources of oil and gas but with a mission to protect the environment, this book will be of major use to scientists and others who are involved in that process.

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**Mannan Sam (Ed.), Lees' Loss Prevention in the Process Industries: Hazard Identification, Assessment and Control, third ed., Elsevier Butterworths Heinemann, Burlington, MA, 2005, three-volume set, 0-7506-7857-7 (vol. I), US\$ 476.00 (for three-volume set), 1439 pp., ISBN 0-7506-7555-1.**

This book is the first of a three-volume series which, given its size (3671 pages), demands a separate review of each volume. However, no review I could write describing this effort can adequately express my admiration of the scope and coverage of the topic. The amount of information contained in each book is almost incomprehensible.

The first edition of this book series appeared in 1979. It was written by Frank Lees who based it on lectures given to students at Loughborough University (UK) over a period of years. This edition had 28 chapters with appendices discussing incidents at Flixborough and Seveso.

Between the first and second editions, the release of methyl isocyanate at Bhopal and the incident at San Carlos, Mexico, occurred. These accidents resulted in new laws and regulations in many countries that govern chemical plant operations. Appearing in the new edition are chapters on new hazards, albeit in brief, on nuclear power and oil and gas platforms.

The editorship moved from the UK across the ocean to the United States to Sam Mannan of the Chemical Engineering Department at Texas A&M University. He writes, "This third edition of Loss' Prevention in the Process Industries represents a combination of appropriate revisions of the essential compilations put together by Frank P. Lees, along with several new chapters and additions on new areas that deserve attention and discussion. The third edition includes five new chapters and three new appendices. The five new chapters address incident investigation, inherently safer design, reactive chemicals, safety instrumented systems, and chemical security".

Mannan notes that safety is no easy task, but it makes sense economically by reducing workman compensation payment and other accident related benefits.

Volume I has 16 chapters (listed below) of varying lengths:

1. Introduction
2. Hazard, incident and loss
3. Legislation and law
4. Major hazard control
5. Economics and insurance
6. Management and management systems
7. Reliability engineering
8. Hazard identification
9. Hazard assessment
10. Plant siting and layout
11. Process design
12. Pressure system design
13. Control system design
14. Human factors and human error

15. Emission and dispersion
16. Fire

In the first chapter, the following discussion is found: "Over the last three decades there has been developed in the process industries a distinctive approach to hazards and failures that cause loss of life and property. This approach is commonly called loss prevention. It involves putting much greater emphasis on technological measures to control hazards and on trying to get things right the first time. An understanding of loss prevention requires some appreciation of its historical development against a background of heightened public awareness of safety, and environmental problems, of its relation to traditional safety and also to a number of other developments". The author then refers to selected references.

The above notes that references are given on a variety of safety and loss prevention topics. References are a key component of this book and copious numbers are found throughout it in each and every section. Given in the text itself for each reference are simply the author and year of publication. Full reference citations are found in Volume III.

The two longest chapters in Volume I come at the end. They are by title and size, respectively: Emission and Dispersion (348 pages) and Fire (307 pages). Having lectured for years on air pollution topics, I was delighted to see the chapter on Emission and Dispersion.

Emissions of chemicals from processes are an important safety consideration as the three major chemical plant hazards, fire, explosion, and toxic chemical release are involved. A chemical release from containment usually followed by vaporization and dispersion often occur. This chapter treats all release modes.

As an example of the literature covered, I cite the categories of selected air emission references: liquid, gas and vapor flow; coefficient of discharge; friction factor; slow leaks; vessel drainage times; bund pipelines; two-phase flow; vessel venting, blowdown; pressure release valves; bursting discs; vessel rupture; pipeline rupture; fugitive emissions.

This chapter was indeed a comprehensive coverage of the topic. By itself, it would make a substantial book, a book based on theory and practice. Indeed, the theoretical (mathematical) treatment of the topic is one of the most extensive I have seen recently. For example, two-phase flow (a topic I have not looked at since my graduate study days) is discussed (it is also extensively referenced). Other topics include vessel depressurization, pressure relief valves, vessel blowdown, pipeline rupture, vaporization, etc. Generally, each section contains a list of references in addition to the list I noted above.

Conventional topics such as plume behavior and Pasquill's stability categories and dispersion modeling are discussed, not surprisingly. All discussions are well supported by excellent diagrams and mathematical analysis. As a final point of emphases to describe the comprehensive coverage of this chapter, I note that it has 81 tables, 161 figures and 24 pages of notation.

The second larger (and also the last) chapter in the first volume deals with Fire Safety, which the author notes is the first of the major hazards in plants as it causes more serious accidents than explosions or toxic releases, although the former generally results in the most deaths. Especially of concern are vapor cloud fires.

The coverage of fires, their impact, and prevention is extensive, starting with, not surprisingly, the fire triangle. Just to indicate the coverage, I will report the titles of the first few sections of the chapter: flammability of gases and vapors; combustion phenomena; flammability of aerosols; ignition sources; self-heating; static electricity, etc.

In conclusion, I will state what is probably obvious from my review: this is not simply a book of advice on safety programmes. It is a comprehensive treatment of all, and I mean all, aspects of plant safety, which this review is all too short to do justice to it.

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**Willis Jackie, Data Analysis and Presentation Skills: An Introduction for the Life and Medical Sciences, John Wiley & Sons, Ltd., Hoboken, NJ, 2004, 195 pp., US \$ 35.00, (paperback), ISBN 0-470-85273-9.**

While the second part of the title of this book might raise questions as to why it has been reviewed in the *Journal of Hazardous Materials*, this review focuses on the first part

of the title to answer: data analysis is a key component of environmental analysis and reporting.

The book's author states in the preface: "The approach taken in this book is to show how statistics may be applied and, by using the easily accessible functions in Excel, perform statistical analyses and explain the results that have been obtained".

The book has the following chapters:

1. Working in the Windows environment.
2. Researching and planning scientific investigations.
3. Presenting scientific data.
4. Preliminary data analysis.
5. Statistical analysis.
6. Presentation skills.

The writing is straightforward and the explanations provided by the author clearly illustrate with liberal inclusion of examples and computer printouts the material discussed. Exercise assignments for the student are found throughout the book in "boxed" sections. Additionally, Willis has provided a website that contains complete support for the material contained in the book. "Here the reader will be able to look at worked examples of problems, view PowerPoint presentations and find lists of useful links to other sites. The website will be regularly updated so there should always be something new to find to reinforce material in the book".

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