Inherently Safer Chemical Processes

A LIFE CYCLE APPROACH

A CCPS CONCEPT BOOK

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This book is available at a special discount when ordered in bulk quantities. For information, contact the Center for Chemical Process Safety of the American Institute of Chemical Engineers at the address shown above.

It is sincerely hoped that the information presented in this document will lead to an even more impressive safety record for the entire industry; however, the American Institute of Chemical Engineers, its consultants, CCPS subcommittee members, their employers, their employers' officers and directors disclaim making or giving any warranties or representations, express or implied, including with respect to fitness, intended purpose, use or merchantability and/or correctness or accuracy of the content of the information presented in this document. As between (1) the American Institute of Chemical Engineers, its consultants, CCPS subcommittee members, their employers, their employers' officers and directors and (2) the user of this document, the user accepts any legal liability or responsibility whatsoever for the consequence of its use or misuse.
I had the good fortune to become involved in process safety at the right time. It was the right time for me personally as without my previous 16 years in production, I would not have had the right experience. It was also the right time in another sense as, in 1968, the subject was poised for take-off. The chemical industry was coming to realize that safety needed a technical input and was not just something that could be left to an elderly foreman.

There was much to do. What should we do first? My colleagues and I used what we now call quantitative risk assessment (QRA) to help us decide priorities—which risks to reduce first; which to leave alone for the time being. Our calculations were crude but within a couple of decades the technique had advanced so much that sophisticated computerized programs for estimating risk were available.

We put a lot of effort into improving safety by adding protective equipment onto our plants, new and old: gas detectors, emergency isolation valves, interlocks, steam curtains, fire insulation, catchment pits for LPG storage tanks, and so on. We also introduced new procedures, such as hazard and operability studies and modification control, or persuaded people to follow old ones, such as permits-to-work and audits.

According to Section 6.5 of this book, operators may need an hour or more to diagnose a fault. I am not a quick thinker and it took rather
longer before a particular penny dropped. It was 1974, the time of Flixborough, before I realized that we ought, when possible, to be removing hazards rather than controlling them; that we ought to be reducing our inventories or using safer materials instead of toxic or flammable ones. Compared with QRA the idea was slow to catch on, but the last few years have seen a great growth of interest. The seed that took so long to germinate has now flowered and in this book has produced the finest bloom so far. The finest fruit will come when more people follow its advice and design and build more inherently safer plants—but the flowers have to come first.

This book is well written, logically developed, and easy to read. I hope it will be widely read, not just by designers, but by everyone involved with the design of new plants, including chemists who choose the reactions to be used. Above all, I hope it will be read by senior managers, as they are in a position to influence the policy and culture of the company and are inclined to ask why we carry out so many studies on new projects instead of getting on with the detailed design. This book will tell them why. I can think of no better Christmas present for your company president.

—Trevor Kletz
Preface

For over 30 years the American Institute of Chemical Engineers (AIChE) has been involved with process safety and loss control issues in the chemical, petrochemical, hydrocarbon process and related industries and facilities. AIChE publications and symposia are information resources for the chemical engineering and other professions on the causes of process incidents and the means of preventing their occurrences and mitigating their consequences.

The Center for Chemical Process Safety (CCPS), a Directorate of the AIChE, was established in 1985 to develop and disseminate technical information for use in the prevention of major chemical process incidents. With the support and direction of the CCPS Advisory and Managing Boards, a multifaceted program was established to address the need for Process Safety Management systems to reduce potential exposures to the public, the environment, personnel, and facilities. This program involves the development and publication of Guidelines relating to specific areas of Process Safety Management; organizing, convening and conducting seminars, symposia, training programs, and meetings on process safety-related matters; and cooperation with other organizations, both internationally and domestically, to promote process safety. Recently, CCPS has extended its publication program to include a "Concept Series" of books. These books are focused on more specific topics and are intended to comple-
ment the longer books in the *Guidelines* series. CCPS activities are supported by funding and professional expertise by over 90 corporations. Several government agencies and academic institutions also participate in CCPS endeavors.

In 1989, CCPS published the *Guidelines for Technical Management of Chemical Process Safety*, which presented a model for Process Safety Management characterized by twelve distinct, essential, and interrelated elements. The Foreword to that book stated:

For the first time, all the essential elements and components of a model of a technical management program in chemical process safety have been assembled in one document. We believe the Guidelines provide the umbrella under which all other CCPS Technical Guidelines will be promulgated.

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