1. INTRODUCTION

The American Institute of Chemical Engineers (AIChE) has been involved with process safety and loss control for chemical and petrochemical plants for more than forty years. Through its strong ties with process designers, builders, operators, safety professionals, and academia, AIChE has enhanced communication and fostered improvements in the safety standards of the industry. Its publications and symposia on causes of accidents and methods of prevention have become information resources for the chemical engineering profession.

Early in 1985, AIChE established the Center for Chemical Process Safety (CCPS) to serve as a focus for a continuing program for process safety. The first CCPS project was the publication of a document entitled *Guidelines for Hazard Evaluation Procedures*. In 1987, *Guidelines for Use of Vapor Cloud Dispersion Models* was published, and in 1989, *Guidelines for Chemical Process Quantitative Risk Analysis* and *Guidelines for Technical Management of Chemical Process Safety* were published.

The first edition of this book was published in 1994, and it remains the most in-depth technical material produced in a CCPS project.

This current edition is intended to provide an overview of methods for practicing engineers to estimate the characteristics of a flash fire, vapor cloud explosion (VCE), pressure vessel burst (PVB), and boiling-liquid-expanding-vapor explosion (BLEVEs). This edition summarizes and evaluates these methods, identifies areas in which information is lacking, and provides an overview of ongoing work in the field. The arrangement of this book is considerably different from previous editions, including separating pressure vessel bursts into its own chapter.

For a person new to the field of explosion and flash fire hazard evaluation this book provides a starting point for understanding the phenomena covered and presents methods for calculating the possible consequences of incidents. It provides an overview of research in the field and numerous references for readers with more experience. Managers will be able to utilize this book to develop a basic understanding of the governing phenomena, the calculational methods to estimate consequences, and the limitations of each method.

Chapter 2 of this book was written for managers, and it contains an overview

of the hazards associated with flash fires, vapor cloud explosions (VCEs), pressure vessel bursts (PVBs), and boiling liquid expanding vapor explosions (BLEVEs). Chapter 3 provides a review of case histories involving these hazards. These case histories illustrate the conditions present at the time of the event, highlighting the serious consequences of such events and the need for evaluation of the hazards.

Chapter 4 provides an overview of the basic concepts associated with flash fires, VCEs, PVBs and BLEVEs. This chapter includes a discussion of dispersion, ignition, fires, thermal radiation, VCEs, and blast waves.

Chapters 5 through 8 separately address the phenomena of each type of hazard (i.e., flash fires, VCEs, PVBs and BLEVEs). These chapters include a description of the relevant phenomena, an overview of the related past and present experimental work and theoretical research, and selected consequence estimation methodologies. Each chapter includes sample problems to illustrate application of the methodologies presented. References are provided in Chapter 9.

The goal of this book is to provide the reader with an adequate understanding of the basic physical principles of flash fires and explosions and the current state of the art in hazard estimation methodologies. It is not the goal of this book to provide a comprehensive discussion of all of the experimental work and theoretical research that has been performed in the field of flash fire and explosion evaluation.

This book does not address subjects such as toxic effects, confined explosions (e.g., an explosion within a building), dust explosions, runaway reactions, condensed-phase explosions, pool fires, jet flames, or structural responses of buildings. Furthermore, no attempt is made to address frequency or likelihood of accident scenarios. References to other works related to these topics are provided for the interested reader.