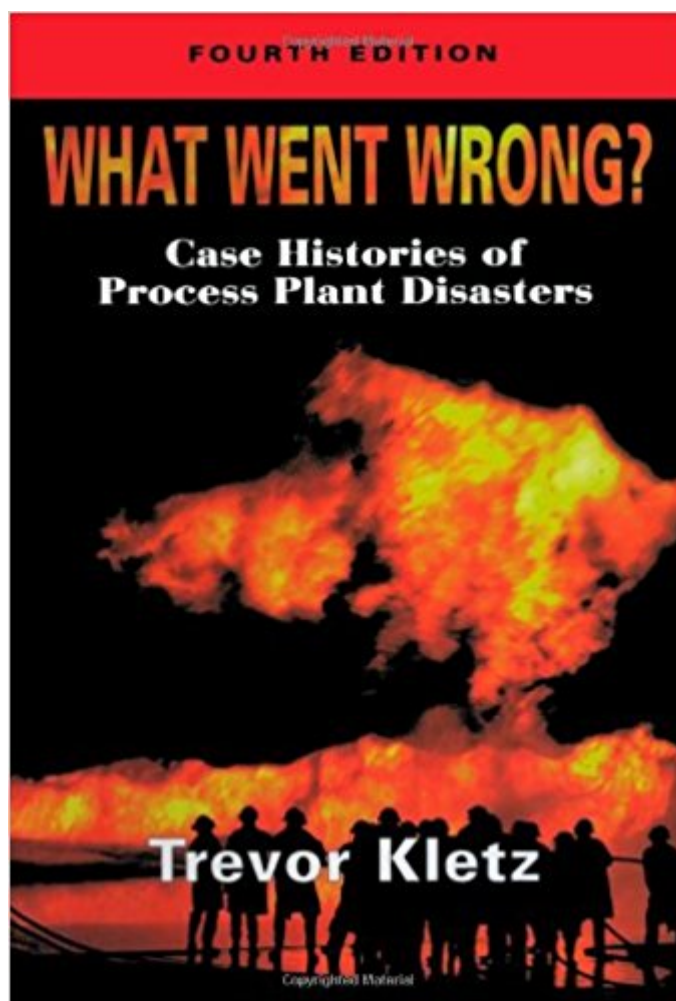


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# What Went Wrong?, Fourth Edition: Case Studies Of Process Plant Disasters



## Synopsis

Expert Trevor Kletz examines the causes and aftermaths of numerous plant disasters--almost every one of which could have been prevented. Case histories illustrate what went wrong, why it went wrong, and then guide you in how to circumvent similar tragedies. Learn from the mistakes of others. This invaluable and respected book examines the causes and aftermaths of numerous plant disasters - almost every one of which could have been prevented. Case histories illustrate what went wrong and why it went wrong, and then guide you in how to circumvent similar tragedies. \* Learn from the mistakes of others with this important book! \* Examines the causes and aftermaths of numerous plant disasters - most of which could have been prevented\* Case histories illustrate what went wrong, why it went wrong, and then guide you in how to circumvent similar tragedies

## Book Information

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## Customer Reviews

The examples were very clear and graphic, with good sketches or pictures. Without a doubt, I strongly recommend this book as required reading for every engineer and supervisor in the process industry and suggested reading for others. - AFE Facilities Engineering Journal  
The incidents described could occur in many types of plants, and should therefore be of interest to a wide variety of plant operators. The new fourth edition contains considerable new material, with extensive references. - Mechanical Engineering  
This book is recommended for generalists with an interest in industrial safety and safety/process who wish to gain some insight into the realities of plant operations. - IChemE-Institute Of Chemical Engineers  
This book should be read by every health and

safety advisor and all managers and engineers who work in the chemical and petrochemical industries. It should also be used by those who provide training courses in these industries. - The Safety & Health Practitioner, July 2002

Trevor Kletz, OBE, D.Sc., F.Eng., a process safety consultant, has published more than a hundred papers and nine books on loss prevention and process safety, including most recently *Lessons From Disaster: How Organizations Have No Memory and Accidents Recur* and *Computer Control and Human Error*. His experience includes thirty-eight years with Imperial Chemical Industries Ltd., where he served as a production manager and safety adviser in the petrochemical division, and membership in the department of chemical engineering at Loughborough University, Leicestershire, England. He is currently senior visiting research fellow at Loughborough University and an officer of the Order of the British Empire.

"What Went Wrong?" is a well thought-out book on practical safety in the chemical processing industry. The book recounts numerous actual process plant accidents and incidents, includes causes and effects, and avoidance and mitigation practices. Some of the accidents in this book are familiar to most people (Bhopal, etc.), but most are not; this exposure to "new" material is a real strength. Another strength is the focus on "minor," seemingly inconsequential, actions that have major effects. For instance, on page 62, a company was concerned that because heating had to be shut down over a weekend that water lines would freeze, so water was replaced with alcohol. When a fire occurred the sprinklers then fed the fire. This seems obvious in retrospect, but Kletz is trying to develop foresight rather than hindsight. Kletz also includes examples of human error accidents from other fields. (An excellent example concerning radiological medicine is on pages 92-93.) Kletz always avoids simplistic "human error" diagnoses and diligently pursues root causes; he asserts correctly that in human error accidents it is "unfair to put all the blame on the person who adds the last straw." Chapter seven concerns leaks. Thomas Fuller was right in 1732 when he said "A small leak will sink a great ship." Leaks are easy to discount as minor and routine annoyances. This chapter does an excellent job of discussing most leak-related issues. The section on "Drain Valves and Vents" is particularly well-developed, as is the section titled "Small Cocks," which makes the point that they should never be used as the sole source of isolation (especially for flammable materials above their atmospheric boiling points.) Likewise his remarks at the end of the chapter (page 162) about measurements are insightful: "Whenever possible we should measure directly what we need to know and not some other property from which it can be deduced." This was, of

course, one of the major problems that triggered the Three Mile Island accident. Chapter eight is titled "Liquefied Flammable Gases," and is an extension of chapter seven in many ways (leaks play a role in many LFG incidents.) Kletz also has an excellent discussion of the hazards of Boiling Liquid Expanding Vapor Explosions (BLEVEs) including dramatic examples from Feyzin, France and Duque de Caxias, Brazil. A great example (a crack propagation problem in a low temperature, nine percent nickel steel tank in Qatar) of how to mitigate and trap problems in a large-scale LFG system is on page 172, and discusses the pros and cons of different types of dike wall construction. Chapter nine is on pipe and vessel failures. There is a good discussion of vapor cloud explosions, and while I am amazed at the scope of the author's data, even I was surprised (and amused) to find that Table 9-1 included in "transport container" column for vapor cloud explosions the note "Includes 1 zeppelin." Now that's thorough! The book also discusses ancillary fittings (like flanges and gaskets) and equipment (like centrifuges and pumps), their common failure modes and hazard prevention methods. There is an especially good discussion of heat exchangers, furnaces, and cooling towers in chapter ten. Especially enlightening is the discussion of damage by water hammer, and the example given (see Figure 10-11, "Condensate in the steam...knocked off the impingement plate and damaged calandria tubes") illustrates the folly of ignoring precursor incidents in an accident prevention strategy. In section 10.7 Kletz discusses furnaces, and makes the statement "Never say, 'It must be safe because we have been doing it this way for years and have never had an accident'" which is an axiom that any safety professional should embrace. Chapter eleven concerns entry into vessels, and notes that in the US each year about 63 people are killed after being overcome in inadequately prepared vessels. Of these, 40 are would-be rescuers. Any business with this type of exposure must insure that they have excellent equipment and training (including recurrent training) for people undertaking these tasks. No matter what training occurs, though, you can't protect from bad judgment. On page 232 an incident is discussed where a worker was trying to shrink-fit a bearing onto a shaft in a pit with an acetylene torch while the shaft was cooled by another worker hosing liquefied petroleum gas onto the shaft with the expected fatal results. Chapter twelve discusses the hazards of common materials. Many situations in this book concern the misuse of water resulting in boilover, slopover, foamover, frothover, puking, or many other steam or vaporization related accidents. Compressed air is another underappreciated hazard, and is also discussed at length. Especially emphasized are reactions of air and oil mixtures and the importance of using Type 3A molecular sieves, which can avoid issues encountered in operations that dry or purify compressed air. Nitrogen is also discussed. While it is inert, Kletz makes it clear that it is not harmless using several insightful examples, including an unusual liquid nitrogen

induced explosion in a pork rind processing operation on page 254. Throughout the book Kletz emphasizes the importance of process change control, and that even slight modifications are thoroughly evaluated; this is true in all safety communities, not just the chemical processing industry. Excellent examples of training issues are throughout the book, but are specifically delineated in section 22.5 "Poor Training or Procedures." Appendix one contains a useful discussion of relative rates of different types of incidents, while Appendix two is perhaps the best in the book, as it discusses accident reporting (page 395) and gives five excellent reasons to publish accident reports, advice that is valid in all industries. "What Went Wrong?" is a well written book with many insights for safety professionals. It is written for the chemical industries, but is readable and useful to safety professionals in all industries. I deal largely with aviation safety (though I have a background in industrial chemical processing), and the parallels are manifold. I highly recommend this book, and look forward to reading other books by Trevor Kletz.

Having worked in the process industry for many years I consider this book essential reading for ALL new people. Technical, Managerial, Operations, and Maintenance. The examples here go a long way to keep you from gaining experience by making a mistake. It teaches you to appreciate asking the what can possibly go wrong and what can I do to mitigate it BEFORE initiating a simple or complex task. That attitude can even be applied to your everyday tasks around the house. A great companion to this is History Channel Engineering Disasters Video series and DVD's

What can go wrong? Lots! This book dissects all the myriad ways that things can go wrong in a variety of process plants. Did you know that static electricity from frozen carbon dioxide can spark and ignite a fire? Did you know that bacon frozen with liquid nitrogen can be cold enough to condense oxygen and create a bacon bomb? Did you know its a bad idea to weld over water? Do you realize that 3/4 of the atmosphere is a dangerous gas that can knock you unconscious in seconds? Have you ever considered a thousand gallon gasoline leak a piece of luck when it could have been something much worse, maybe vinyl chloride? Yeah, I didn't either. This book definitely played to my paranoid streak. I'm in computer software, so I'm pretty paranoid to begin with. After all, computers really are plotting to get us, but the chemical process guys have an all out active enemy, and sometimes the results aren't pretty. Still, it makes for great reading.

What I like most about this book is its index and table of contents. It is easy to find a type of accident. For example, when I turned to page 291, I found an exact, simple description of the

dangers resulting from the flow of a non-conducting liquid, i.e., one with a low dielectric constant --- like toluene (2.4 compared to water with a constant of 80). "The danger is that a spark could discharge between a body of liquid and grounded metal." In other words, a high voltage shock will knock you off your feet. If this review was helpful, please add your vote. This is an easy-to-read text and should be required reading for all chemical engineers entering the workforce. After you read it, you can move on to more detailed engineering text on the subject of safety such as Kletz's own book, or Mark Tweeddale, or Crowl and Louvar's text. These text are for calculations, "What Went Wrong," is for a clear understanding of the dangers you will be facing. If this review was helpful, please add your vote -- Thanks.

Mr Kletz offers engaging technical insights with case stories arising out of his long professional experience related to accidents causing small to large property damage and bodily injury including death and demonstrates that they just arise from silly mistakes made during everyday work or by having misconceptions about the laws of physics or process engineering. It is focused on occurrences in the chemical industry but the case stories serve as an example for property loss prevention in any industry (among the chapters it delves into are: maintenance, modifications, pressure pipes and vessels, hazard of materials, computers, human errors, storage tanks, labeling). It is a slow paced reading, written to focus on ideas and develop concepts to have something new to think about. Most suitable readers are loss control & process engineers and health and safety professionals working in any type of industry or doing field surveys for insurance companies.

Terrific compendium of case studies and industry wisdom on how to prevent loss of life and property. Absolutely vital to any designer, plant manager, or forensic engineer.

I have read this book before as a library loan and was so impressed that I wanted to have my own copy.

Product a little more used than the description implied. I expected real life example details.

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