ENGLISH FOR SAFETY ENGINEERING

安全工程专业英语

樊运晓　编

化学工业出版社
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前　言

随着人类社会的进步和生活水平的提高，人们对于安全的需求增大，安全文化意识逐步提高。目前，由于各类安全生产事故的频发带来的惨重损失，国家加大了安全生产的监管力度，于2005年成立了国家安全生产监督管理总局，安全工作得到了前所未有的重视。此外，我国高校中许多有识之士充分认识到安全科技人才在预防和控制意外事故和损失中的重要作用，这使得越来越多的高校增设了安全工程专业，培养安全工程专业人才，以便更好地为安全生产工作服务。

笔者在多年的安全工程本科生、研究生的教学过程中发现，专业英语是安全工程专业学生所欠缺的。由于安全工程专业是新兴专业，目前国内缺乏优秀的教材，在专业英语方面还没有正式出版物。专业英语是了解国外安全工程学科发展的语言工具，为更好地了解国外的安全工程学科动态，借鉴一些先进的经验，笔者在多年安全工程专业英语教学经验基础之上，结合我国安全工程专业的培养方案，编写了这本安全工程专业英语教材。

由于安全工程专业所涉及的领域非常广泛，所跨行业也非常多，因而在本书编写过程中将行业内容通过事故案例来体现。本书内容分为三部分：第一部分为安全工程的基本理论，介绍什么是安全工程，它的历史以及在各行业中的应用，安全工程的技术手段和管理手段；第二部分为国内外各行业重大安全事故，包括印度博帕尔毒气泄漏事故、切尔诺贝利核事故等；第三部分以英、汉双语形式列出了安全工程专业词汇近500条。

笔者从良好和真诚的愿望出发，把安全工程专业中的诸多问题归纳成书，希望更多的安全工程专业的学生更加热爱这个专业，希望更多珍爱生命、关注安全的人们从这里更多了解安全工程专业的理论和实践。

本书参考了国内外安全工程专业方面的期刊、著作和报纸，

在此不一一列出，谨向原作者和出版社致以崇高的敬意和诚挚的感谢。

在本书的编写过程中，很多编写思路受益于中国地质大学（北京）安全研究中心主任罗云教授。我的研究生方梅花、黄小梅、陈晓波、张晓，本科生张琴、马飞、潘汉彬、李伟、殷勇等对资料进行了整理，官运华博士对全稿进行了校正。中国地质大学（北京）安全工程教研室程五一博士、颜峻老师和裴晶晶老师对本书的编写也给予了大力支持。同时化学工业出版社安全科学与工程出版中心的编辑给予了宝贵的参考指导意见，在此对以上人员表示诚挚的感谢。

由于作者水平有限，书中难免存在疏漏和错误，恳请专家学者和广大读者批评指正。

樊运晓

2005 年 10 月

内 容 提 要

本书共包括安全工程专业方面文章 27 篇，理论系统、案例经典，是一本内容丰富、层次分明的安全工程专业的英语读本。适合 60 学时左右的专业英语教学。

本书内容分为三部分：第一部分为安全工程的基本理论；第二部分为国内外各行业重大安全事故，包括印度博帕尔毒气泄漏事故、切尔诺贝利核事故等；第三部分以英汉双语形式列出了安全工程方面专业词汇近 500 条。

本书适合作为安全工程本科的专业英语教材，也可作为安全工程管理和技术人员的专业英语读本。

Contents

PART I

SAFETY ENGINEERING THEORIES

1 Why Do We Need Safety Engineering?

It is difficult to open a newspaper or turn on the television and not be reminded how dangerous our world is. Both large-scale natural and man-made disasters seem to occur on an almost daily basis. An accident at a plant in Bhopal, India, killed over 2,500 people. A nuclear power plant in the Ukraine exploded and burned out of control, sending a radioactive cloud to over 20 countries, severely affecting its immediate neighbors' livestock and farming.

A total of 6.7 million injuries and illnesses in the United States were reported by private industry in 1993. Two commuter trains in metropolitan Washington, DC, collided in 1996, killing numerous passengers. Large oil tankers ran aground in Alaska and Mexico, spilling millions of gallons of oil and despoiling the coastline. An automobile air-bag manufacturing plant exploded, killing one worker, after it had had over 21 fire emergencies in one year. Swarms of helicopters with television cameras were drawn to the plant after every call, creating a public relations nightmare and forcing the government to shut down the plant temporarily.

An airliner crashed into an apartment building in downtown Sao Paolo, Brazil, killing all on board and many in the apartment building. Another, airplane mysteriously dipped and spun into the ground in Sioux City, Iowa. Two airplanes collided on a runway in the Philippines. An airliner crashed into the Florida Everglades after an oxygen generator exploded in the cargo hold, killing all 110 people on board.

In 1995 the Fremont, California, Air Route Traffic Control Center lost power, causing radar screens covering northern California, western Nevada, and 18 million square miles of Pacific Ocean to go dark for 34 minutes while 70 planes were in the air, almost resulting in two separate midair collisions. In another incident, a worker in downtown Chicago cut into a cable and brought down the entire Air Route Traffic Control System for thousands of square miles.

Some of these accidents occurred many years ago. Some of them occurred very recently. Many of the accidents crossed international borders and affected millions of people in other countries. Many more did not extend beyond national borders but still affected a great number of people. And some of the accidents didn't kill anyone.

We all know how quickly technology is changing; as engineers, it is difficult just to keep up. As technology advances by leaps and bounds, and business competition heats up with the internationalization of the economy, turnaround time from product design to market launch is shrinking quickly. The problem quickly becomes evident: How do we build products with high quality, cheaply, quickly, and still safely?

An American Society of Mechanical Engineers national survey found that most design engineers were very aware of the importance of safety and product liability in designs but did not know how to use the system safety tools available. In fact, most of the engineers who responded said that the only safety analyses they used were the application of safety factors in design, safety checklists, and the use of compliance standards. Almost 80 percent of the engineers had never taken a safety course in college, and more than 60 percent had never taken a short course in safety through work. Also, 80 percent had never attended a safety conference and 70 percent had never attended a safety lecture.

So, how do engineers design, build, and operate systems safely if they have never really been prepared for it? And, to make matters worse, engineers are now more frequently called to testify in court about failures in their designs.

Like most engineering problems, this one does have a solution. And the solution is not that difficult to implement, nor costly. What it does entail is considerable forethought and systematic engineering analysis. Of course, system safety engineering is not difficult to apply—in fact, it is almost easy.

Words and Expressions

radioactive cloud 放射云

entail [in'teil] *v.* 使必需，使承担

2 A Brief History of Safety

Of course, the need for safety has always been with us. One of the earliest written references to safety is from the Code of Hammurabi, around 1750 B. C. His code stated that if a house was built and it fell due to poor construction, killing the owner, then the builder himself would be put to death. The first laws covering compensation for injuries were codified in the Middle Ages.

Around 1834, Lloyd's Register of British and Foreign Snipping was created, institutionalizing the concept of safety and risk analysis. In 1877 Massachusetts passed a law to safeguard machinery and also created employers' liability laws.

At the end of the 19th century, a rash of boilers exploding gave urgency and impetus to the American Society of Mechanical Engineers to create the Boiler and Pressure Vessel design codes and standards. Beginning in 1911 the United States saw safety groups forming, and the National Safety Council was founded in 1913.

Around the 1920s private companies started to create formalized safety programs. The early 1930s was the beginning of the implementation of accident prevention programs across the United States. By the end of the decade, the American National Standards Institute had published hundreds of industrial manuals.

Most of the current safety techniques and concepts were born at the end of World War Ⅱ. Operations research led the way, suggesting that the scientific method could be applied to the safety profession. In fact, operations research gave some legitimacy to the use of quantitative analysis in predicting accidents.

However, the system safety concept and profession really started during the American military missile and nuclear programs in the 1950s and 1960s. Liquid-propellant missiles exploded frequently and unexpectedly. During that period the Atlas and Titan programs saw many missiles blow up in their silos during practice operations. Some of the accident investigations found that these failures were due to design problems, operations deficiencies, and poor management decisions.

Because of the loss of thousands of aircraft and pilots during the same time frame, the U. S. Air Force started to pull together the concepts of system safety, and in April 1962 published BSD Exhibit 62-41, "System Safety Engineering for the Development of Air Force Ballistic Missiles."

Safety was also starting to enter the public mind. Ralph Nader publicized safety concerns during the mid-1960s and started making people aware of how dangerous cars really were with his book, *Unsafe at Any Speed* (published in 1965, Grossman, NY). He continued being a powerful voice to the U. S. Congress to bring automobile design under federal control and to regulate consumer protection.

In the United Kingdom in the early 1960s, Imperial Chemical Industries started developing the concept of the HAZOP study (a chemical industry safety analysis). In 1974 it was presented at an American Institute of Chemical Engineers conference on loss prevention.

The U. S. National Aeronautics and Space Administration (NASA) sponsored government-industry conferences in the late 1960s and early 1970s to address system safety. Part of this was safety technology transfer from the "man-rating" program—to develop ballistic missiles safe enough to carry humans into space—of the Mercury program.

In 1970 the Occupational Safety and Health Administration (OS-

HA) published industrial safety requirements. Later in the decade, the U. S. military published Mil-Std-882, "Requirements for System Safety Program for Systems and Associated Subsystems and Equipment." This document is still considered the cornerstone of the system safety profession. It is one of the most cited requirements in procurement contracts. Most of the safety analysis techniques were created during the heady days of safety from the 1950s to the 1980s.

OSHA published a process safety standard for hazardous materials in 1992. This is one of the strongest cross-fertilizations of system safety techniques taken from various industries and applied to the chemical industry.

It is obvious that the system safety engineering profession, like all professions, has evolved over time. In most cases, out of necessity—an unacceptable number of deaths, accidents, and loss of revenue—engineers have been forced to take a more serious approach to designing safety into both systems and products.

Words and Expressions

Lloyd's Register 劳埃德船级社

institutionalize [ˌinstiˈtjuːʃənəlaiz] *v.* 使制度化

Pressure Vessel 压力容器

liquid-propellant 火箭引擎中之液体燃料

Mil-Std-882 军标 882

cornerstone [ˈkɔːnəstəun] *n.* 基础

procurement contracts 采购合同

3 The Make-up of an Accident

We may all say accidents happen. However, their occurrence may not only take human lives, destroy millions of dollars in property and lost business, they may also cost us our jobs and reputations. The Bhopal, India, accident in 1984 released methyl isocyanate and caused over 2,500 fatalities. In 1986, the NASA Space Shuttle Challenger disintegrated in flight in front of millions of television viewers and killed seven astronauts, brought NASA to a standstill for two years, and cost the agency billions of dollars. A petroleum refinery blew up in Houston, Texas, in 1989, killing 23 workers, damaging property totaling US $750 million, and spewing debris from the explosion over an area of 9km. Many thought that after the Three Mile Island and Chernobyl nuclear power plant disasters we would finally get a handle on how to prevent accidents. U. S. government statistics indicate that more than 350 chemical accidents a year result in death, injury, or evacuation. In 1991 and 1992 fifteen major petrochemical accidents destroyed more than $1 billion in property.

Accidents don't just happen; they are a result of a long process, with many steps. Many times all of these steps have to be completed before an accident can occur. If the engineer can prevent one or more of these accident steps from occurring, then he can either prevent the mishap or at least mitigate its effects. Part of system safety strategy is to intervene at various points along that accident timeline.

An accident is an unplanned process of events that leads to un-