

ANQUAN GONGCHENG XILIE ANQUAN GONGCHENG XILIE ANQUAN GONGCHENG XILIE
高等教育安全工程系列“十一五”规划教材



安全工程 专业英语

司 鹄 主编
吴 超 主审



机械工业出版社
CHINA MACHINE PRESS



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本书选编了安全工程学科涉及的科技英语文章,内容包含安全管理学、系统安全工程、安全人机工程、工业卫生、职业疾病、危险源辨识、事故调查等以及相关行业安全(机械安全、电气安全、矿山安全、建筑安全、核安全、消防安全等),专业面广,涉及了本学科大量的专业词汇;每个单元皆有课文生词和一些短语的注解。同时本书还介绍了科技英语的特点,较为系统和详细地讲解了科技英语的翻译技巧,简单介绍了科技论文英文摘要和结论的写作要点,列举了大量的例句,有利于理解和掌握。该书无论是在内容选材还是内容编写上都具有专业特色和学术价值,是安全工程专业本科生的一本实用教材,也可供安全工程专业的研究生及从事安全工程专业的技术及管理人员学习参考。

图书在版编目(CIP)数据

安全工程专业英语/司鹤主编. —北京:机械工业出版社, 2007. 6
高等教育安全工程系列“十一五”规划教材
ISBN 978-7-111-21450-2

I. 安... II. 司... III. 安全工程—英语—高等学校—教材
IV. H31

中国版本图书馆CIP数据核字(2007)第065198号

机械工业出版社(北京市百万庄大街22号 邮政编码100037)
责任编辑:冷彬 封面设计:张静 责任印制:洪汉军
中国农业出版社印刷厂印刷
2007年6月第1版第1次印刷
169mm×239mm·7.5印张·281千字
标准书号:ISBN 978-7-111-21450-2
定价:21.00元

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序

“安全工程”本科专业是在1958年建立的“工业安全技术”、“工业卫生技术”和1983年建立的“矿山通风与安全”本科专业基础上发展起来的。1984年，国家教委将“安全工程”专业作为试办专业列入普通高等学校本科专业目录之中。1998年7月6日，教育部发文颁布《普通高等学校本科专业目录》，“安全工程”本科专业（代号：081002）属于工学门类的“环境与安全类”（代号：0810）学科下的两个专业之一。据“安全工程专业教学指导委员会”1997年的调查结果显示，自1958~1996年底，全国各高校累计培养安全工程专业本科生8130人。近年，安全工程本科专业得到快速发展，到2005年底，在教育部备案的设有安全工程本科专业的高校已达75所，2005年全国安全工程专业本科招生人数近3900名。

按照《普通高等学校本科专业目录》（1998）的要求，原来已设有与“安全工程专业”相近但专业名称有所差异的高校，现也大都更名为“安全工程”专业。专业名称统一后的“安全工程”专业，专业覆盖面大大拓宽。同时，随着经济社会发展对安全工程专业人才要求的更新，安全工程专业的内涵也发生很大变化，相应的专业培养目标、培养要求、主干学科、主要课程、主要实践性教学环节等都有了不同程度的变化，学生毕业后的执业身份是注册安全工程师。但是，安全工程专业的教材建设与专业的发展出现尚不适应的新情况，无法满足和适应高等教育培养人才的需要。为此，组织编写、出版一套新的安全工程专业系列教材已成为众多院校的翘首之盼。

机械工业出版社是有着50多年历史的国家级优秀出版社，在高等学校安全工程学科教学指导委员会的指导和支持下，根据当前安全工程专业教育的发展现状，本着“大安全”的教育思想，进行了大量的调查研究工作，聘请了安全科学与工程领域一批学术造诣深、实践经验丰富的教授、专家，组织成立了“安全工程专业教材编审委员会”（以下简称“编审委”），决定组织编写“高等教育安全工程系列‘十一五’规划教材”。并先后于2004.8（衡阳）、2005.8（葫芦岛）、2005.12（北京）、2006.4（福州）组织召开了一系列安全工程专业本科教材建设研讨会，就安全工程专业本科教育的课程体

系、课程教学内容、教材建设等问题反复进行了研讨,在总结以往教学改革、教材编写经验的基础上,以推动安全工程专业教学改革和教材建设为宗旨,进行顶层设计,制订总体规划、出版进度和编写原则,计划分期分批出版近30余门课程的教材,以尽快满足全国众多院校的教学需要,以后再根据专业方向的需要逐步增补。

由安全学原理、安全系统工程、安全人机工程学、安全管理学等课程构成学科基础平台课程,已被安全科学与工程领域学者认可并达成共识。本套系列教材编写、出版的基本思路是,在学科基础平台上,构建支撑安全工程专业的工程学原理与由关键性的主体技术组成的专业技术平台课程体系,编写、出版系列教材来支撑这个体系。

本系列教材体系设计的原则是,重基本理论,重学科发展,理论联系实际,结合学生现状,体现人才培养要求。为保证教材的编写质量,本着“主编负责,主审把关”的原则,编委会组织专家分别对各门课程教材的编写大纲进行认真仔细的评审,教材初稿完成后又组织同行专家对书稿进行研讨,编者数易其稿,经反复推敲定稿后才最终进入出版流程。

作为一套全新的安全工程专业系列教材,其“新”主要体现在以下几点:

体系新。本套系列教材从“大安全”的专业要求出发,从整体上考虑各门课程的内容安排,构建支撑安全工程学科专业技术平台的课程体系,按照教学改革方向要求的学时,统一协调与整合,形成一个完整的、各门课程之间有机联系的系列教材体系。

内容新。本套系列教材的突出特点是内容体系上的创新。它既注重知识的系统性、完整性,又特别注意各门学科基础平台课之间的关联,更注意后续的各门专业技术课与先修的学科基础平台课的衔接,充分考虑了安全工程学科知识体系的连贯性和各门课程教材间知识点的衔接、交叉和融合问题,努力消除相互关联课程中内容重复的现象,突出安全工程学科的工程学原理与关键性的主体技术,有利于学生的知识和技能的发展,有利于教学改革。

知识新。本套系列教材的主编大多由长期从事安全工程专业本科教学的教授担任,他们一直处于教学和科研的第一线,学术造诣深厚,教学经验丰富。在编写教材时,他们十分重视理论联系实际,注重引入新理论、新知识、新技术、新方法、新材料、新装备、新法规等理论研究、工程技术实践成果和各校教学改革的阶段性成果,充实与更新了知识点,增加部分学科前沿方面的内容,充分体现了教材的先进性和前瞻性,以适应时代对安全工程高级专业技术人才的培育要求。本套教材中凡涉及安全生产的法律法规、技术标准、行业规范,全部采用最新颁布的版本。

安全是人类最重要和最基本的需求，是人民生命与健康的基本保障。一切生活、生产活动都源于生命的存在。如果人们失去了生命，生存也就无从谈起，生活也就失去了意义。全世界平均每天发生约 68.5 万起事故，造成约 2200 人死亡的事实，使我们确认，安全不是别的什么，安全就是生命。安全生产是社会文明和进步的重要标志，是经济社会发展的综合反映，是落实以人为本的科学发展观的重要实践，是构建和谐社会的有力保障，是全面建设小康社会、统筹经济社会全面发展的重要内容，是实施可持续发展战略的组成部分，是各级政府履行市场监管和社会管理职能的基本任务，是企业生存、发展的基本要求。国内外实践证明，安全生产具有全局性、社会性、长期性、复杂性、科学性和规律性的特点，随着社会的不断进步，工业化进程的加快，安全生产工作的内涵发生了重大变化，它突破了时间和空间的限制，存在于人们日常生活和生产活动的全过程中，成为一个复杂多变的社会问题在安全领域的集中反映。安全问题不仅对生命个体非常重要，而且对社会稳定 and 经济发展产生重要影响。党的十六届五中全会首次提出“安全发展”的重要战略理念。安全发展是科学发展观理论体系的重要组成部分，安全发展与构建和谐社会有着密切的内在联系，以人为本，首先就是要以人的生命为本。“安全·生命·稳定·发展”是一个良性循环。安全科技工作者在促进、保证这一良性循环中起着重要作用。安全科技人才匮乏是我国安全生产形势严峻的重要原因之一。加快培养安全科技人才也是解开安全难题的钥匙之一。

高等院校安全工程专业是培养现代安全科学技术人才的基地。我深信，本套系列教材的出版，将对我国安全工程本科教育的发展和高级安全工程专业人才的培养起到十分积极的推进作用，同时，也为安全生产领域众多实际工作者提高专业理论水平提供了学习资料。当然，由于这是第一套基于专业技术平台课程体系的教材，尽管我们的编审者、出版者夙兴夜寐，尽心竭力，但由于安全学科具有在理论上的综合性与应用上的广泛性相交叉的特性，开办安全工程专业的高等院校所依托的行业类型又涉及军工、航空、化工、石油、矿业、土木、交通、能源、环境、经济等诸多领域，安全科学与工程的应用也涉及到人类生产、生活和生存的各个方面，因此，本套系列教材依然会存在这样和那样的缺点、不足，难免挂一漏万，诚恳地希望得到有关专家、学者的关心与支持，希望选用本套教材的广大师生在使用过程中给我们多提意见和建议。谨祝本系列教材在编者、出版者、授课教师和学生的共同努力下，通过教学实践，获得进一步的完善和提高。

“婴其鸣矣，求其友声”，高等院校安全工程专业正面临着前所未有的发展机遇，在此我们祝愿各个高校的安全工程专业越办越好，办出特色，为我

国安全生产战线输送更多的优秀人才。让我们共同努力，为我国安全工程教育事业的发展作出贡献。

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冯长根

2006年5月

前 言

随着科学技术的迅猛发展和经济的快速增长，安全问题越来越受到社会的关注。提高安全质量，是保持社会安定、促进经济可持续发展、改善人民生活水平的基础。

当今国际交流日益增多，要求安全工程专业的人才不仅要具备扎实的专业知识，还要有良好的英语能力。本书正是为了满足安全工程及相关专业学生的培养以及企业安全人才的培训需要而编写的。

本书在借鉴国内外同类专著、教材的基础上编写而成。全书有较强的整体性和系统性，使得读者不仅对安全学科的认识和理解更为明确，同时书中对科技英语特点、翻译技巧以及英文摘要与结论的书写等内容的系统介绍，使得读者对科技英语的认识更为清晰，有利于读者的英语阅读和写作能力得到提高和扩展。

本书由重庆大学资源及环境科学学院安全工程系司鹤教授主编，重庆大学资源及环境科学学院安全工程系张东明副教授、谢波副教授、严波教授，中原工学院安全工程系高洪亮副教授参加编写。其中，单元一、二、三的英文课文由高洪亮编写，单元十一、十二、十三的英文课文由张东明编写，单元五、十四、十五的英文课文由谢波编写，单元四、六、七、八、九、十、十六的英文课文以及科技英语摘要与结论的书写要点由司鹤编写，科技英语文章的特点和科技英语翻译技巧由司鹤和严波合作编写。

全书由司鹤负责统稿。中南大学资源与安全工程学院的吴超教授担任主审，对本教材进行了全面、认真、严格、细致的审查，提出了许多宝贵的修改意见和建议。中原工学院的王新泉教授对本书的编写亦提出了宝贵的建议。本书的编审工作是在安全工程专业教材编审委员会的指导下进行的。教材大纲的编制、审定以及相关内容的取舍，



均经过编审委员会的反复讨论定夺，而且编审委员会也曾多次组织专家对书稿进行审稿工作。在此，对上述专家、同仁的辛勤工作表示衷心的感谢。

本书的编写参考了国内外安全管理学、安全系统工程、安全人机工程、职业安全与健康管理等与安全相关的文章和有关书籍，在此，谨对原作者和研究者表示最诚挚的谢意。

编写本书的过程也是一个不断学习、不断提高的过程。由于编者的水平有限，不当与错误之处在所难免，敬请广大读者及相关专家批评指正。

编 者

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accident than others. The first model was created in 1919, based on statistical examinations in a munitions factory. This model dominated the safety thinking and research for almost 50 years, and it is still used in some organizations. As a result of this thinking, accident was blamed solely on employees rather than the work process or poor management practices. Since investigations to discover the underlying causal factors were felt unnecessary and/or too costly, a little attention was paid to how accidents actually happened. Employees' attitudes towards risks and risk taking have been studied, e. g. by Sulzer-Azaroff. According to her, employees often behave unsafely, even when they are fully aware of the risks involved. Many research results also show that the traditional promotion methods like campaigns, posters and safety slogans have seldom increased the use of safe work practices. When backed up by other activities such as training, these measures have been somewhat more effective. Experiences on some successful methods to change employee behavior and attitudes have been reported. One well-known method is a small-group process used for improving housekeeping in industrial workplaces. A comprehensive model of accident causation has been presented by Reason who introduced the concept of organizational error. He stated that corporate culture is the starting-point of the accident sequence. Local conditions and human behavior are only contributing factors in the build-up of the undesired event. The latent organizational failures lead to accidents and incidents when penetrating system's defenses and barriers. Groeneweg has developed Reason's model by classifying the typical latent error types. His TRIPOD model calls the different errors as General Failure Types (GFTs). The concept of organizational error is in conjunction with the fact that some organizations behave more safely than others. It is often said that these organizations have good safety culture. After the Chernobyl accident, this term became well-known also to the public.

Loss prevention is a concept that is often used in the context of hazard control in process industry. Lees has pointed out that loss prevention differs from traditional safety approach in several ways. For example, there is more emphasis on foreseeing hazards and taking actions before accidents occur. Also, there is more emphasis on a systematic rather than a trial and error approach. This is also natural, since accidents in process industry can have catastrophic consequences. Besides the injuries to people, the damage to plant and loss of profit are major concerns in loss prevention. The future research on the ultimate causes of accidents seems to focus on the functioning and management of the organization. The strategic management, leadership, motivation, and the personnel's visible and hidden values are some issues that are now under intensive study.

2. Safety Management as an Organizational Activity



Safety management is one of the management activities of a company. Different companies have different management practices, and also different ways to control health and safety hazards. Organizational culture is a major component affecting organizational performance and behavior. One comprehensive definition for an organizational culture has been presented by Schein who has said that organizational culture is “a pattern of basic assumptions—invented, discovered, or developed by a given group as it learns to cope with its problems of external adaptation and internal integration—that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems”. The concept of safety culture is today under intensive study in industrialized countries. Booth & Lee have stated that an organization’s safety culture is a subset of the overall organizational culture. This argument, in fact, suggests that a company’s organizational culture also determines the maximum level of safety the company can reach. The safety culture of an organization is the product of individual and group values, attitudes, perceptions, competencies, and patterns of behavior that determine the commitment to, and the style and proficiency of, an organization’s health and safety management. Furthermore, organizations with a positive safety culture are characterized by communications founded on mutual trust, by shared perceptions of the importance of safety, and by confidence in the efficacy of preventive measures. There have been many attempts to develop methods for measuring safety culture. Williamson et al. have summarized some of the factors that the various studies have shown to influence organization’s safety culture. These include: organizational responsibility for safety, management attitudes towards safety, management activity in responding to health and safety problems, safety training and promotion, level of risk at the workplace, workers’ involvement in safety, and status of the safety officer and the safety committee.

Organizations behave differently in the different parts of the world. This causes visible differences also in safety activities, both in employee level and in the management level. Reasons for these differences are discussed in the following. The studies of Wobbe reveal that shop-floor workers in the USA are, in general, less trained and less adaptable than those in Germany or Japan. Wobbe claims that one reason for this is that, in the USA, companies providing further training for their staff can expect to lose these people to the competitors. This is not so common in Europe or in Japan. Furthermore, for unionized companies in the USA, seniority is valued very highly, while train-

ing or individual's skills and qualifications do not effect job security, employment, and wage levels very much. Oxenburgh has studied the total costs of absence from work, and found that local culture and legislation has a strong effect on absenteeism rates. For example, the national systems for paying and receiving compensation explain the differences to some extent. Oxenburgh mentions Sweden as a high absenteeism country, and Australia as a low absenteeism country. In Sweden injuries and illnesses are paid by the state social security system, while in Australia, the employer pays all these costs, including illnesses not related to work. Comparison of accident statistics reveals that there are great national differences in accident frequencies and in the accident related absenteeism from work. Some of the differences can be explained by the different accident reporting systems. For example, in some countries only absenteeism lasting more than three working days is included in the statistics. The frequency of minor accidents varies a lot according to the possibility to arrange substitutive work to the injured worker. Placing the injured worker to another job or to training is a common practice for example in the USA and in the UK, while in the Scandinavian countries this is a rarely used procedure.

Some organizations are more aware of the importance of health and safety at work than others. Clear development stages can be found in the process of improving the management of safety. Waring has divided organizations to three classes according to their maturity and ability to create an effective safety management system. Waring calls the three organizational models as the mechanical model, the socio-technical model, and the human activity system approach. In the mechanical model, the structures and processes of an organization are well-defined and logical, but people as individuals, groups, and the whole organizations are not considered. The socio-technical model is an approach to work design which recognizes the interaction of technology and people, and which produces work systems that are technically effective and have characters that lead to high job satisfaction. A positive dimension in this model is that human factors are seen important, for example, in communication, training and emergency responses. The last model, the human activity system approach focuses on people, and points out the complexity of organizations. The strength of this approach is that both formal (or technical) paradigms and human aspects like motivation, learning, culture, and power relations are considered. Waring points out that although the human activity approach does not automatically guarantee success, it has proven to be beneficial to organizations in the long run.

3. Safety Policy and Planning

A status review is the basis for a safety policy and the planning of safety activities. According to BS 8800 a status review should compare the company's existing arrangements with the applicable legal requirements, organization's current safety guidelines, best practices in the industry's branch, and the existing resources directed to safety activities. A thorough review ensures that the safety policy and the activities are developed specifically according to the needs of the company.

A safety policy is the management's expression of the direction to be followed in the organization. According to Petersen, a safety policy should commit the management at all levels and it should indicate which tasks, responsibilities and decisions are left to lower-level management. Booth and Lee have stated that a safety policy should also include safety goals as well as quantified objectives and priorities. The standard BS 8800 suggests that in the safety policy, management should show commitment to the following subjects:

- Health and safety are recognized as an integral part of business performance;
- A high level of health and safety performance is a goal which is achieved by using the legal requirements as the minimum, and where the continual cost-effective improvement of performance is the way to do things;
- Adequate and appropriate resources are provided to implement the safety policy;
- The health and safety objectives are set and published at least by internal notification;
- The management of health and safety is a prime responsibility of the management, from the most senior executive to the supervisory level;
- The policy is understood, implemented, and maintained at all levels in the organization;
- Employees are involved and consulted in order to gain commitment to the policy and its implementation;
- The policy and the management system are reviewed periodically, and the compliance of the policy is audited on a regular basis;
- It is ensured that employees receive appropriate training, and are competent to carry out their duties and responsibilities.

Some companies have developed so-called "safety principles" which cover the key areas of the company's safety policy. These principles are utilized as safety guidelines

that are easy to remember, and which are often placed on wall-boards and other public areas in the company. As an example, the DuPont company's safety principles are the following:

- All injuries and occupational illnesses can be prevented.
- Management is responsible for safety.
- Safety is an individual's responsibility and a condition of employment.
- Training is an essential element for safe workplaces.
- Audits must be conducted.
- All deficiencies must be corrected promptly.
- It is essential to investigate all injuries and incidents with injury potential.
- Off-the-job safety is an important part of the safety effort.
- It is good business to prevent injuries and illnesses.
- People are the most important element of the safety and occupational health program.

The safety policy should be put into practice through careful planning of the safety activities. Planning means determination of the safety objectives and priorities, and preparation of the working program to achieve the goals. A company can have different objectives and priorities according to the nature of the typical hazards, and the current status of hazard control. However, some common elements to a safety activity planning can be found. According to BS 8800, the plan should include:

- appropriate and adequately resourced arrangements, competent personnel who have defined responsibilities, and effective channels of communication;
- procedures to set objectives, devise and implement plans to meet the objectives, and to monitor both the implementation and effectiveness of the plans;
- description of the hazard identification and assessment activities;
- methods and techniques for measuring safety performance, and in such way that absence of hazardous events is not seen as evidence that all is well.

In the Member States of the European Union, the "framework" Directive 89/391/EEC obligates the employer to prepare a safety program that defines how the effects of technology, work methods, working conditions, social relationships and work environment are controlled. According to Walters, this directive was originally passed to harmonize the overall safety strategies within the Member States, and to establish a common approach to the management and organization of safety at work. Planning of the safety activities is often done within the framework of quality and environmental management systems.