Safety and Environmental Management

Daniel Della-Giustina

Government Institutes

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Government Institutes
An imprint of
THE SCARECROW PRESS, INC.
Lanham, Maryland • Toronto • Plymouth, UK
2007

Published in the United States of America
by Government Institutes, an imprint of The Scarecrow Press, Inc.
A wholly owned subsidiary of
The Rowman & Littlefield Publishing Group, Inc.
4501 Forbes Boulevard, Suite 200
Lanham, Maryland 20706
http://www.govinstpress.com/

Estover Road
Plymouth PL6 7PY
United Kingdom

British Library Cataloguing in Publication Information Available

Library of Congress Cataloging-in-Publication Data

Della-Giustina, Daniel.
Safety and environmental management / Daniel Della-Giustina. — 2nd ed.
p. ; cm.
Includes bibliographical references.
ISBN-13: 978-0-86587-176-2 (cloth : alk. paper)
ISBN-10: 0-86587-176-0 (cloth : alk. paper)
1. Industrial safety—Management. 2. Hazardous substances—Management. I. Title.
[DNLM: 1. Safety Management—methods. 2. Accidents, Occupational—prevention & control. 3. Safety Management—organization & administration. WA 485 D357s 2007]
T55.D44 2007
620.8—dc22

2007008198

The paper used in this publication meets the minimum requirements of American National Standard for Information Sciences—Permanence of Paper for Printed Library Materials, ANSI/NISO Z39.48-1992.
Manufactured in the United States of America.

This second edition is dedicated to my parents Augusto and Catina Della-Giustina,
who worked diligently to provide education for all their children.

Contents

List of Figures and Tables vii

Preface ix

1 Hazard Communication and Hazardous Materials 1

2 Accident Investigation 83

3 Emergency Response 117

4 Fire Safety 157

5 Lockout/Tagout 187

6 Ergonomics 219

7 Confined Spaces 233

8 Putting It All Together 249

Index 259

List of Figures and Tables

Figures

2.1. OSHA 300 Form 114
2.2. OSHA 300A Form 114
2.3. OSHA 301 Form 115
4.1. Smoke Detector 165
4.2. Alarm Panel 165
4.3. Pull Box 166
4.4. Horn and Strobe 166
4.5. Stairwell Standpipe 167
4.6. OSY Valve 168
4.7. Siamese and Fire Pump Connection 168
4.8. Sprinkler Room 2 168
4.9. Sprinkler Head 169
4.10. Elevated Water Tank 2 174

Tables

1.1. Material Safety Data Sheet Checklist 6
1.2. Sample Letter Requesting an MSDS 7
1.3. Sample Hazardous Chemicals Inventory List 8

1.4. Types of Potentially Hazardous Chemicals That May Be Present in the Workplace 10
1.5. Material Safety Data Sheet (MSDS Study Guide) 24
1.6. Material Safety Data Sheet (Training Purposes Only) 25
1.7. Chemical Information Audit 30
3.1. Fire Drill Report 132
3.2. Bomb Threat Call Checklist 133
5.1. Lockout/Tagout Implementation 189
5.2. Employee Lockout/Tagout Sheet 192
5.3. Equipment Lockout/Tagout Form 193
5.4. Energy Sources 196
5.5. Lockout/Tagout Procedure Checklist 199
7.1. Permit-Required Confined-Space Program Mandatory Elements 235
7.2. Duties of Involved Employees 238
7.3. Confined Space Pre-entry Checklist 239
7.4. Entry Permit 241
8.1. ISO 9000 Components 256

Preface

With the real presence of the Occupational Safety and Health Act of 1970, coupled with the "age of risk management," captive insurance companies, and large self-retention of risk by major corporate entities, there has developed a greater need for the contemporary safety manager to provide a complete and comprehensive safety and environmental program. In past years, there appears to have existed a general feeling that protection of plants and the maintenance of a plant's integrity could be left to a very small staff or to an individual who might have a less than adequate background in the safety area. Now, with greater retention of risk corporations and the tremendous investments that are involved in many facilities, there is a need for many more people, at the very least, to have somewhat more than a superficial knowledge of the safety and environmental world.

In the wake of the September 11, 2001, attacks on the United States, businesses must now become proactive in their own security and planning for emergencies of any nature—man-made or natural disasters. That day changed life in the United States and throughout the world.

This safety and environmental text focuses on eight areas, comprising the following comprehensive programs: 1) Hazard Communication and Hazardous Materials, 2) Accident Investigation, 3) Emergency Response, 4) Fire Safety, 5) Lockout/Tagout, 6) Ergonomics, 7) Confined Spaces, and 8) Putting It All Together. Each year a tremendous amount of industrial resources (human, property, and efficacy) are lost because of management's failure to create and maintain a comprehensive safety and environmental program. It is the employers' responsibility to provide a safe place for their employees to work, along with safe work systems, safe plants and machinery, adequate training and supervision, adequate welfare facilities, and a range of other safety-, health-, and environment-oriented provisions. Employers must also ensure that whatever risk is created within the establishment will not spill over into the outside world, to the detriment of the general public.

Therefore, we can say that employers are primarily responsible for what happens to their employees in the workplace. Today, OSHA considers terrorism to be a workplace problem. Based on this premise, employers then dictate policy; make the rules;

initiate work practices; ensure that people are properly trained; provide adequate supervision, a safe plant, and safe premises; and maintain adequate health, safety, and environmental standards. The eight areas mentioned earlier are necessary aspects of any safety, health, and environmental plan, and each should be applied to help complete any safety and environmental program. It becomes the employers' responsibility to see that these policies are implemented and that the mechanics of the safety program are functioning in a properly organized and supervised manner.

The purpose of the Hazard Communication Program is to provide employees with information concerning the presence and potential hazards of chemicals in the workplace. Each accident situation in the program should be designed to suit the needs of the individual company in which it is used. Every accident, no matter how minor, should be investigated. This investigation will provide for preventive measures in the future. Also, in the case of a minor incident, a visit to the scene and a discussion of the event with the victim will lead to some type of remedy in order to prevent future occurrences. Therefore, a formal accident investigation program will only benefit a company in its efforts to counteract danger and prevent loss to its resources.

Experience in peacetime disasters has shown repeatedly that when emergency plans and procedures are known and followed by those persons who are responsible to perform essential tasks before, during, and following an emergency, reaction times are reduced, coordination is improved, and overall response and recovery measures are considerably enhanced. The development of written plans is not an end in itself. A written emergency action plan does not guarantee that an actual operation will be effective; however, the process plan is extremely valuable. Companies must also become proactive in their own security and planning for a disaster of any nature. Few events in history have had the unparalleled impact on the world in which we live as the events of September 11, 2001. It has significantly changed how we view the importance of safety and security. The objective of a company is to use available resources and capabilities to effectively deal with natural, civil, or war-related emergencies or disorders. It should be realized that a well-coordinated emergency plan that fully capitalizes on currently available assets to combat the effects of any emergency is a very desirable resource. The payoff of lives saved and property preserved results from persons performing essential tasks properly before, during, and following an emergency.

Anyone who operates machinery should be protected by personal protective equipment and by guards on all machinery. Yet if that equipment is shut down for maintenance or repair, the protection of those guards is often removed. There is only one sure way you can protect a worker from unexpected operation of a piece of equipment, and that is to lock it out. A lockout is simply a lock on a power source to prevent accidents that might occur when someone is in the wrong place at the wrong time. The lockout/tagout program will describe in detail how to properly perform a lockout or a tagout.

The final section of this book addresses management technique issues and discusses numerous management styles. It is necessary for managers to find a style or a combination of styles that best fits in their organization. The consistent application of management principles is more important to the safety programs' success than is the style itself.

A great many people and organizations assisted in the preparation of this text. It would be difficult to recognize them all, but I would like to acknowledge the assistance of the following groups and individuals.

I wish to express my appreciation to the many agencies and educators who have contributed to this book. I am indebted to many sources for materials used, for which permission to reprint has been secured and proper credit given. Many thanks to my graduate students in the Safety Management Program in the College of Engineering and Mineral Resources at West Virginia University. Special thanks to the following individuals for their assistance with this publication: our departmental secretary Mickie McIntosh, Dr. Robert Costante, Lonnie Thacker, Robert Currier, and my son Daniel A. Della-Giustina, the manager of safety and risk control for Suffolk Construction Co. in Boston, Massachusetts.

Especially noteworthy were the contributions to this second edition by Fire Chief David W. Fetty of Morgantown, West Virginia, and graduate students Steven R. Sawyer and Abby D. Poling. Their commitment, persistence, and enthusiasm in adopting some new approaches to refine and expand the different chapters will make a difference in the reduction of injuries in the future. It is the work of these graduate students that has inspired and provided the understanding and long-term support for the needs of future safety practitioners.

A profound thank you to Dr. Daniel Hartley, a NIOSH (National Institute for Occupational Safety and Health) professional, for his unwavering dedication to the completion of this publication. His efforts in editing some of the chapters, including "Putting It All Together," are greatly appreciated. His industry experience and his master's degrees in industrial and labor relations and safety management added a unique perspective to the development of this publication.

Finally, I would like to thank Professor H. Ilkin Bilgesu, PhD, for his computer skills and for reorganizing the chapters into a coherent textbook. His efficiency and most especially his patience are greatly appreciated.

CHAPTER 1

Hazard Communication and Hazardous Materials

Contents of Chapter

Overview of Hazardous Materials
Introduction to Hazard Communication
Written Hazard Communication Program
Material Safety Data Sheets
Hazard Determination
Hazardous Chemicals List
Notification of Other Employers
Use of Labels
Is Control Banding Potentially the Answer to Our Problems?
Employee Information and Training
Nonroutine Task Training
Hazardous Chemical Release, Spill, or Exposure
Trade Secrets
Documentation
Employee Requirements
Management's Requirements
Summary
Reference A—Hazard Communication Program Lesson Plan
Reference B—MSDS Lesson Plan
Reference C—Employee Evaluation Hazard Communication Program
Reference D—Sample Chemical Inventory Sheet and Sample Chemical Information Audit
Reference E—Hazard Communication Standard 29 CFR §1910.1200
Reference F—MSDS Acronyms/Common Terms
Questions
Case Studies
Resources

Overview of Hazardous Materials

A quarter of a century has passed since the Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OSHA) were established. In 1975, the Department of Transportation (DOT) first documented hazardous materials, defining and regulating them in the Code of Federal Regulations (CFR), Title 49, Parts 100 to 199. Within this scenario, each hazard class is identified in Section 171.8 and referenced to its specific section in Section 173. It has been two decades since the DOT passed the Hazardous Materials Transportation Act.

The EPA has the primary authority to regulate hazardous materials and substances and hazardous wastes for the protection of human health and the environment. OSHA has the primary authority over employee health and safety and regulates the storage, handling, use, and employee exposures to hazardous materials and hazardous wastes. DOT is the primary regulator of the transportation of hazardous materials and wastes.

During the past two and a half decades, there has been a significant increase in public awareness of the harmful effects on human health and the environment from uncontrolled releases of hazardous substances and pollutants, on the land, into the air, and into our surface and groundwater resources.

During the 1970s, the seriousness of the hazardous waste problem became apparent. This awareness led to the development of a national waste-management strategy, which initially emphasized the control and cleanup of pollution by hazardous substances after they are generated and they no longer serve a useful function.

In 1976, Congress passed the Resource Conservation and Recovery Act (RCRA), which was the outgrowth of the Solid Waste Act of 1965 and the Resource Recovery Act of 1970. RCRA was the first law to deal with hazardous waste on the national level. When RCRA was amended in 1980, the EPA established a regulatory program requiring "cradle to grave" management of hazardous waste. The program established design requirements for hazardous waste landfills, including liners and leak detection systems. RCRA was amended again in 1984 by the Hazardous and Solid Waste Amendments of 1984 (HSWA).

In RCRA, Congress attempted to provide for the management of hazardous waste by imposing regulatory requirements upon generators of hazardous waste, transporters of hazardous wastes, and owners and operators of treatment, storage, and disposal facilities.

The equally serious problem of abandoned and inactive hazardous waste sites was addressed in the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), which is commonly known as "Superfund." The CERCLA legislation established remedies and allocated responsibilities for correcting problems by providing for federal funding for response and site remediation where responsible parties cannot be identified or are unwilling or unable to accomplish the necessary cleanup. The EPA may then sue identified responsible parties for the recovery of the funds expended in the cleanup and remediation.

Over these years, Congress has enacted and reauthorized many additional environmental laws. Among the better known are:

NEPA National Environmental Policy Act
CAA Clean Air Act
FWPCA Federal Water Pollution Control Act
FIFRA Federal Insecticide, Fungicide & Rodenticide Act
SDWA Safe Drinking Water Act
TSCA Toxic Substance Control Act
CWA Clean Water Act Amendments to FWPCA
UORA Used Oil Recycling Act
SARA Superfund Amendments & Reauthorization Act
EPCRA Emergency Planning & Community Right-to-Know Act
MWTA Medical Waste Tracking Act
OPA Oil Pollution Act
CAAA Clean Air Act Amendments

While Congress was enacting new environmental laws at a rapid pace, OSHA was promulgating additional regulations for the management of hazardous materials and hazardous wastes to improve employee health and safety. The primary regulations are logged in the OSHA 1910 Standards in the following subparts:

G. Occupational Health and Environmental Control
H. Hazardous Materials
Z. Toxic and Hazardous Substances

The most notable of all these OSHA standards are the Hazard Communication (HAZCOM) Standard and the Hazardous Waste Operations and Emergency Response (HAZWOPER) Standard.

Because the transportation of hazardous materials, especially in large volumes, has resulted in so many tragic effects from accidents, the DOT has continued to promulgate standards on the shipping requirements for transporting hazardous materials and hazardous wastes. Additionally, specific DOT licensing and medical requirements must be met by operators of vehicles transporting hazardous materials.

The regulations under EPA, DOT, and OSHA have evolved into thousands of pages. This myriad of requirements must be reviewed and the applicable regulations implemented if a company hopes to achieve compliance.

There is a key that can be utilized very effectively to begin unlocking the mystery of hazardous materials and hazardous waste regulations. That key is the OSHA HAZCOM Standard. It should be considered the starting point for all hazardous materials, hazardous wastes, and pollution prevention programs.

OSHA designed the HAZCOM Standard to establish uniform requirements for the evaluation of chemical hazards by the chemical manufacturer as well as the means to communicate those hazards to employers and employees.

As the Material Safety Data Sheets (MSDSs) are collected, inventoried, and reviewed for the information contained in them, the basic foundation for a comprehensive hazardous materials management program is developed.

Thus, the value of the implementation of a solid HAZCOM program provides returns well beyond the health and safety of the affected employees by laying the groundwork for the development of environmental and transportation regulatory compliance programs as well as waste minimization achievements from pollution prevention plans.

Contained in each of the chapters of this text are recommendations, which, if implemented, will further develop a company's safety and environmental management performances.

Introduction to Hazard Communication

The Hazard Communication Standard covers almost all employers in the United States. The Standard specifically requires employers with employees who might be exposed to a chemical hazard to develop a written HAZCOM Program. This program shall include a comprehensive list of all potentially hazardous chemicals used or stored at the workplace. In addition, employers must provide employees with detailed information about potential hazards. The collection, review, and proper posting of Material Safety Data Sheets (MSDSs) and the development and use of a warning label system for containers of hazardous chemicals used in-house are required for further advancement of employees' safety.

Approximately 32 million workers are employed in plants that are potentially exposed to chemical hazards in the workplace. According to OSHA there are about 650,000 chemical products that currently exist, with hundreds of new chemicals appearing in the workplace every year. To ensure chemical safety in the workplace information must be made available about the identities and hazards of chemicals being used by these workers. There are other federal agencies that also have protocols and requirements for classification and labeling of chemicals at different stages of their life cycle. Just as the government is required to warn you of highway traffic problems on the highways, under HAZCOM, your employer must address these hazards in the workplace. Internationally, there are a number of countries that have developed similar laws that require information about chemicals to be prepared and transmitted to other parties. A number of inconsistencies between the different laws are substantial enough that different labels and safety data sheets must be used for the same product when it is marketed in other nations. This information can be located later on in this chapter under control banding.

It is standard procedure for OSHA officials to inspect a company's HAZCOM program whenever they visit a worksite for any reason. Many companies have been cited for HAZCOM Standard violations. According to data developed by the Bureau of Labor Statistics, the Hazardous Communication Standard continues to be the most frequently cited of all of OSHA's standards. OSHA data reveals that approximately 90 percent of those violations could be eliminated if the companies would follow the basic compliance requirements as discussed in this chapter.

Throughout this publication we will refer to a hypothetical corporation, USA Inc., that is intended to be representative of any company in the United States. It is the intent of USA Inc. to comply with the requirements of the HAZCOM Standard

in its continuing effort to provide a healthy and safe workplace for its employees. The USA Inc. program is designed to accomplish this by providing employee information and training on (1) the hazardous chemicals known to be in the workplace, (2) the methods that will be employed to protect workers, (3) the precautionary methods employees must follow to protect themselves from hazardous chemicals, (4) the detection of a release of hazardous chemicals, and (5) emergency procedures to follow should there be a release of hazardous chemicals and/or employee exposure to them. The following is an overview of the HAZCOM Standard. (See Reference E for a copy of the standard.)

Written Hazard Communication Program

Copies of the written Hazard Communication Program and the MSDS notebook are available at _____. Additional copies of the written HAZCOM Program and the attached MSDS file will be located at _____.

The HAZCOM Manager will be responsible for overseeing the total program as well as the following specific duties:

- Update MSDS file with inventory updates
- Coordinate program implementation
- Schedule training
- Maintain records for programs
- Address all comments concerning the program

When the HAZCOM manager is not in the office, the following persons will be available for questions and requests concerning the program.

The program is reviewed annually and is updated as needed. All present or new employees will be given a copy of the program and copies of MSDSs or other pertinent information that is available to employees upon request.

Material Safety Data Sheets

It is the policy of USA Inc. to list all of the hazardous chemicals used in its warehouses and work areas. An accurate up-to-date MSDS shall be obtained from the manufacturer, distributor, or importer and reviewed and updated, if necessary, for each hazardous chemical in USA Inc. MSDSs shall be obtained from these sources prior to use of the specific hazardous chemical.

It is the policy of USA Inc. to evaluate all chemicals and chemical-containing products to determine if they are hazardous. Scientific evidence published by the following sources will be used in the determination of the hazards: 29 CFR Part 1910, Subpart Z, Toxic and Hazardous Substances, Occupational Safety and Health Administration (OSHA); *Threshold Limit Values for Chemical Substances and Physical Agents*

in the Work Environment, American Conference of Governmental Industrial Hygienists (ACGIH); National Toxicology Program (NTP), *Annual Report on Carcinogens*; and the International Agency for Research on Cancer (IARC), *Monographs*.

USA Inc. will ensure that distributors provide an appropriate Material Safety Data Sheet with their initial shipment and with the first shipment after a Material Safety Data Sheet is updated. This system will be integrated with the system used by the Distribution and Supply Departments and the information will be sent by mail or computer. Updates will be provided after USA Inc. becomes aware of new significant health hazard information or new ways to protect against stated hazards. Additionally, USA Inc. will use information gathered from other sources outside the company and from knowledge developed within the company to evaluate its chemicals for hazards.

NEW AND UPDATED MSDSs

When new or updated MSDSs are received, a copy will be forwarded to the HAZCOM manager for review of completeness. This review will be based on the requirements in CFR 29 1910.1200(g)(2)(i-xii). An outline of these requirements is provided in Table 1.1.

If the HAZCOM manager determines it to be complete, the MSDS will be marked, reviewed, and distributed to the predetermined locations. If it is determined that the information provided is incomplete, the HAZCOM manager shall notify the company and request a complete MSDS or the needed supplemental information be sent immediately. (Table 1.2 contains a sample letter.)

Table 1.1. Material Safety Data Sheet Checklist

Ensure that each MSDS contains the following information:

1. Product or chemical identity used on the label.
2. Manufacturer's name and address.
3. Chemical and common names of each hazardous ingredient.
4. Name, address, and phone number for hazard and emergency information.
5. Preparation or revision date.
6. The hazardous chemical's physical and chemical characteristics, such as vapor pressure and flashpoint.
7. Physical hazards, including the potential for fire, explosion, and reactivity.
8. Known health hazards.
9. OSHA permissible exposure levels (PEL), ACGIH threshold limit value (TLV), or other exposure limits.
10. Emergency and first aid procedures.
11. Whether OSHA, NTP, or IARC list the ingredients as a carcinogen.
12. Precautions for safe handling and use.
13. Control measure such as engineering controls, work practices, hygienic practices, or personal protective equipment required.
14. Primary routes of entry.
15. Procedures for spills, leaks, and clean up.

Table 1.2. Sample Letter Requesting an MSDS (on official agency letterhead)

Dear _____:

The Occupational Safety and Health Administration (OSHA) Hazard Communication Standard (29 CFR § 1910.1200), as well as other applicable federal laws and regulations, including Federal Standard 313B and the Federal Acquisition Regulations, require managers to obtain Material Safety Data Sheets (MSDSs) for all hazardous substances used in our facility, and to make these MSDSs available to employees potentially exposed to these hazardous substances.

Therefore, we are requesting a copy of the MSDS for your product _____. We are also requesting any additional information, supplemental MSDSs, or any other relevant data that your company or supplier has concerning the safety and health aspects of this product.

Note: The MSDS should also include the necessary information for SARA Title III reporting requirements.

Please consider this letter as a standing request to your company for any information concerning the safety and health aspects of using this product that may become known in the future.

The MSDS and any other relevant information should be sent to us within 10 days. Delays in receiving the MSDS information could prevent use of your product in the future. Send the requested information to:

(Company Address)

Thank you for your timely response to this request. If you have any questions concerning this matter, please contact (name) at (telephone number).

Sincerely,

_____

First-time use of hazardous chemicals shall not commence until an MSDS has been received, approved, and distributed to the proper locations. Approved updates of MSDS forms received from the distributors shall replace outdated MSDSs at all locations within two weeks of receipt.

MSDSs shall be maintained in the same form as they are received from the distributor. But, they are to be filed according to the name used by USA Inc. and will be indexed with an MSDS file number / inventory number.

LOCATION/AVAILABILITY

Material safety data sheets shall be kept in the following locations:

Main Location:
Secondary Location:
Central Location:

The relevant information on the MSDS will be shared with employees during the Hazard Communication Training Program. The MSDSs will be available to all employees and OSHA during normal facility operating hours at the above locations. CFR 29 1910.1200(h)(2)(iv).

QUALITY ASSURANCE

The HAZCOM manager will make a monthly inspection of each MSDS location to ensure that every MSDS is present and up to date. The inspection shall be based on an MSDS log maintained at _____. This log will include MSDS date of receipt, date of review, date of revision (if needed), and date of distribution. Initials shall be required after each date.

Hazard Determination

The HAZCOM manager will review each MSDS to determine if the chemical/product must be included on the hazardous chemical/product list. If any sections of the MSDSs have a health hazard that requires protective equipment or special safety procedures the chemical/product will be included on the hazardous chemical list. Likewise, information included in the MSDSs that indicate fire reactivity or other special hazards will require that the chemical product be placed on the hazardous chemicals list.

Hazardous Chemicals List

The following is a list of all hazardous chemicals/products known to be in the workplace; the location(s) and intended use(s) of the chemicals are also provided (Table 1.3). (In this section you must provide a list of all hazardous chemicals/products in the order they are found in the MSDS file.)

Note: List all known or suspected hazardous chemicals. If you do not have copies of all MSDSs, you must contact your suppliers for the necessary copies.

HOW TO IDENTIFY HAZARDOUS CHEMICALS

The chemical manufacturer or importer has the responsibility for determining and stating the hazards associated with the chemicals they sell. As a user of chemicals, you

Table 1.3. Sample Hazardous Chemicals Inventory List

Hazardous Chemical/Product	*Location(s)*
Acid Cleaner—Delimer #114	Storage Room #2
Air Freshener—#50/19	Storage Room #1
Chlorine Bleach	Warehouse
Lubricating oil	Maintenance Shop

rely on the evaluation received from them through the labels placed on their containers and Material Safety Data Sheets. To prepare a list of the chemicals in your facility that are covered by the rule, it is recommended that an initial walk-around survey be conducted by writing down the names of chemicals that have a label indicating a potential hazard (e.g., "flammable" or "causes skin irritation"). Don't limit yourself to chemicals in containers, however. Be aware of substances generated in work operations, such as vapors, fumes, or dusts, as these may be covered too. Chemicals considered to be hazardous are those that are:

- Regulated by OSHA in 29 CFR Part 1910, Subpart Z, Toxic and Hazardous Substances;
- Included in the American Conference of Governmental Industrial Hygienists (ACGIH) latest edition of Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment
- Found to be suspected or confirmed carcinogens by the National Toxicology Program in the latest edition of the Annual Report on Carcinogens, or by the International Agency for Research on Cancer (IARC) in the latest edition of their IARC monographs.

After the initial list has been generated from the walk-around survey, it is highly recommended that the list be provided to line management for verification that all chemicals, chemical-containing products, and process-generating substances are included in the listing. The most effective verification will include the review by first-line supervisors and their workers.

Once you have a complete list, you will want to review it to determine if any of the items are exempt. In paragraph (b)(6) of the rule, OSHA has listed a number of items that are excluded. For example, rubbing alcohol maintained in a first-aid station would be exempt under paragraph (b)(6)(vi) because it is intended for personal use by employees. To be prudent, some employers include all chemicals even if they are exempt. In general, if there is any question regarding a particular chemical, it is best to include that chemical in the HAZCOM Program.

HOW TO LIST CHEMICALS IN THE WORKPLACE

All hazardous chemicals known to be present in your workplace should be listed using an identity that appears on the appropriate MSDS and label for the chemical. The list may also include common or trade names, Chemical Abstract Service (CAS) Registry numbers, MSDS reference numbers, etc. (Reference D provides examples of an individual chemical inventory sheet and a chemical information audit sheet.) The list can be compiled for the entire workplace, or for individual work areas in various sections of the facility. The list is to be an inventory of everything for which a Material Safety Data Sheet must be obtained. It will be part of the written program, and must be made available to employees upon request.

Notification of Other Employers

When contractors or other employers (could be employees from the same company but unfamiliar with the operations) bring a work crew onto the job site, they will be supplied with a copy of the HAZCOM Program and with copies of the MSDS for hazardous chemicals that could be encountered while they perform their on-site work. It shall be their responsibility to train their employees, provide personal protective equipment, and handle employee emergencies. Any releases or spills of hazardous chemicals shall, within minutes, be brought to the immediate attention of the HAZCOM manager. When USA Inc. employees are working on other job sites with other companies, the HAZCOM manager will obtain the following information from the outside employers:

- Information about hazardous materials that may be brought onto the job site.
- Explanation of the labeling system the contractor may be using.
- Information about precautionary measures employees need to take to protect themselves during normal operating conditions and in emergencies.
- Location of MSDSs for substances brought to the job site.

This information will be communicated to all USA Inc. workers before the job begins. When there is this contact between the employees of contractors from off-site who are going to perform work on your site and the employees on your site performing their jobs, there is a potential for one party to not understand the consequences of the chemicals being used by both groups. For this reason, the exchange of information regarding the hazards of chemicals being used by both parties is very important to the safety of all involved.

Table 1.4. Types of Potentially Hazardous Chemicals That May Be Present in the Workplace

Acids	Cleaning agents	Flammables	Insecticides	Paints	Solvents
Adhesives	Coal tar pitch	Foaming resins	Herbicides	Pesticides	Strippers
Aerosols	Coatings	Fungicides	Janitor supplies	Plastics	Surfactants
Asbestos	Degreasing agents	Gasoline	Kerosene	Process chemicals	Thinners
Battery fluids	Detergents	Glues	Lacquers	Resins	Varnishes
Benzene	Dusts	Greases	Lead	Sealers	Water treatments
Catalyst	Etching agents	Industrial oils	Lye	Shellacs	Wood preservatives
Caustics	Fiberglass	Inks	Oxalic acid	Solders	Xylene

Use of Labels

Whenever possible, hazardous chemicals will be kept in their original containers. Should an original container ever become defective, the chemicals will be transferred to a similar type of approved container. The label will be transferred to the replacement container and be securely attached. If the label is nontransferable, a replacement label with all significant information will be prepared and securely and prominently adhered to the new container. This chemical container will be used for its intended use and then emptied as soon as possible. The product name listed on the label of each container will coincide with the product name listed on the MSDS sheet and hazardous chemical listing in the written program.

Signs or placards will be placed on all larger containers in which hazardous chemicals are used, such as storage tanks for chemicals, solvent tanks for cleaning parts, vehicles used in transportation of materials, and the like.

Note: A symbol labeling system will be used so that chemical or product hazards can be easily communicated at the workplace for employees who are illiterate or have difficulty reading.

Is Control Banding Potentially the Answer to Our Problems?

Since the HAZCOM Standard was introduced more than 20 years ago, workplace hazardous material exposures have declined. However, increasing technology means increasing materials. According to former ASSE President S. Kendrick, millions of American workers are exposed to hazardous chemical products in more than three million American workplaces. Aside from the obvious controls such as implementing appropriate engineering controls and other management skills to address issues such as fires, spills, explosions, and transportation disasters, what else can we do?

One approach, called "control banding," will provide for improved worker safety when handling or using multiple chemicals at the work site. Control banding is being used in the United Kingdom and other European countries and, like the HAZCOM Standard, control banding often relies on MSDS exposure limits, hazard assessments and toxicological review. Both communication systems require knowledge of physical characteristics, chemical properties, health hazards (identified as "R-phrases" in control banding), appropriate control measures and personal protective equipment and special control or toxicological review. Control banding, however, groups materials together into broad "bands" based on their physical and chemical characteristics, quantities used, the environment in which the material is used and risk information; whereas, HAZCOM only addresses chemicals as single entities. The control banding approach focuses resources on exposure controls and describes how a risk needs to be managed. According to NIOSH, the qualitative risk assessment and management tool is intended to help small businesses by providing an easy-to-understand, practical approach to controlling hazardous exposures in the workplace.

In small businesses, the employees need to know the identities and hazards of chemicals that they will be exposed to in the workplace. In most cases, the hazardous materials found in small enterprises are usually cleaning chemicals used in most households. These small businesses should keep a list of the chemicals they use and have the proper procedures for container labeling and records for MSDSs materials and make this information readily available to employees.

HAZARD COMMUNICATION / CONTROL BANDING

The methods of Hazard Communication and control banding for protecting employees depend on much of the same data information. The two systems in different ways rely on MSDSs, exposure limits, hazard assessment and toxicological reviews by the professionals. The two approaches require the assessment and analysis by professionals in the discipline and the knowledge of the following:

- Physical characteristics of the material (e.g., boiling point);
- Health hazards (e.g., R-Phrases);
- Chemical properties (e.g., reactivity);
- Appropriate controls and protective actions (ventilation, containment and personal protective equipment);
- Special controls or toxicological reviews for specific materials.

The HAZCOM Standard has the following requirements:

- Workplace inventory of hazardous materials
- Written program covering the use, handling and storage of materials
- Identification in the form of labels or process sheets for containers
- Employee information concerning hazards and exposures in the form of an MSDS for all materials
- Selection and use of PPE materials
- Adherence to employer-prescribed precautions of use and process instructions

The primary difference between the HAZCOM Standard and Control Banding is the methodology utilized to ensure a safe workplace and to reduce exposures to a safe level. Rather than looking at chemicals as single entities, the Control Banding approach groups the materials together into broad "bands" based on their physical and chemical characteristics. After completing the assessment, controls are developed based on the bands. The greater the potential for an injury, the greater the degree of control that is needed in order to manage the situation and make the risk "acceptable."

Using control banding allows you to focus on the process, task, material characteristics, control (ventilation), and quantity used. The material is then evaluated and the outcome is one of four decisions:

1. Employ good industrial hygiene practices
2. Use local exhaust ventilation

3. Enclose the process
4. Seek the advice of a specialist

Pavan Baichoo of the United Nations International Labor Organization (ILO) developed the five Control Banding stages for each process. The Tool Kit requires that R-phrases, the state of material, permissible exposure limits, ability to become airborne, quantities used and operating temperatures be documented.

The five control banding stages are:

1. Hazard classification
2. Scale of use
3. Ability to become airborne
4. Control approach
5. Selecting the task-specific control guidance sheets

There is also an on-line approach to Control Banding that is used in the United Kingdom and being tested elsewhere called "Control of Substances Hazardous to Health" or "COSHH-Essentials," which was developed by the United Kingdom's Health and Safety Executive and Health and Safety Commission (HSE). This program used the same information mentioned above, and once that information is entered into the system, a set of "Control Sheets" is presented for printing that summarizes the analysis, exposure and controls. Another approach from the international arena is the procedure for the transportation of dangerous chemicals. These chemicals are classified with the United Nations (UN) codes that are used for identifying safe storage rules permitted types of containers and the actions to be taken in an emergency.

Another follow-up study on control banding was carried out by the International Labor Organization (ILO) Toolkit and was conducted in the United States. The study found small safety margins for the hazard bands that included high-potency chemicals.

According to Dr. Jon Hanson, Director of Safety for the Wyoming Medical Center and the American Society for Safety Engineers, OSHA and MSHA should begin the process of updating the Hazard Communication Standard to incorporate elements of Control Banding and the expected changes of the Globally Harmonized System (Classification and Labeling of Chemicals MSDS). Incorporating each of those is believed to be the best solution since using either the HAZCOM Standard or the Control Banding System still fails to address issues of common information, standardization of phrases, signal words and process monitoring methods that are needed in order to be effective.

The key to success for the HAZCOM Standard is the completion of the Globally Harmonized System's work on the standard sixteen-part MSDS, common risk phrase (R-phrases), common safety phrases (S-phrases), common signal words, and common methodology of assessment and classification of chemical hazards. These elements will be especially needed where a product is used globally and the information is in an unfamiliar format, or where there are country-specific systems.

In conclusion, both the HAZCOM Standard and the Control Banding need common information, standardized phrases, signal words and process monitoring methods

to be effective. Without a common base, neither program, whether alone or integrated, can succeed in the United States. The model will assist OSHA and MSHA to continue to provide standards that help employers to reduce worker injuries and illnesses from the exposure of hazardous materials.

Employee Information and Training

All employees will be provided with information and training on hazardous chemicals in their workplace:

- At the time of their initial employment;
- Whenever a new hazardous chemical is brought into the workplace; and
- Whenever an existing hazardous chemical is modified sufficiently to require a change in hazard levels and/or safeguarding requirements.

The employees will be provided with the following information:

- The requirements of the Hazard Communication Standard;
- Location and availability of the written Hazard Communication Program and MSDS file; and
- Job tasks in their work area where hazardous chemicals are present, used, or stored.

Employee training will include:

- Methods and observations that may be used to detect the presence of a hazardous chemical in the work area (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);
- The physical and health hazards of the chemicals in the work areas;
- The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employee exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used, and the details of the Hazard Communication Program developed by the employer, including an explanation of the labeling system appropriate, information from the Material Safety Data Sheet; and
- How employees can obtain and use the appropriate hazard information.

Nonroutine Task Training

The HAZCOM Manager will identify training for the nonroutine tasks involving hazardous chemicals in its facility: CFR 1910.1200(e)(1)(ii). Some examples of nonroutine tasks are:

- Confined space entry—entering a storage tank that contains gasoline.
- Lockout/Tagout—cleaning a degreaser that utilizes 1-1-1 Trichloroethylene and contains sludge
- Hearing conservation
- Respiratory protection
- Fire and disaster plan

Some hazards are presented from chemical substances when nonroutine tasks are being performed that are not present during the routine performance of the job or task.

Training courses will be developed for each of these nonroutine tasks:

- Confined space entry
- Lockout/tagout
- Hearing conservation
- Respiratory protection
- Disaster drills

NEW HAZARD TRAINING

When new hazards are introduced into the workplace, training will be given to personnel at the highest level at which they have been trained. CFR 1910.1200 (h)

RETRAINING

Employees shall be given refresher training on an annual basis. It shall consist of training module included in the written program, and addition of any new materials or processes.

SPECIAL TRAINING REQUIREMENTS

The material presented in the HAZCOM Program will be presented verbally to workers who have difficulty reading written material. If a worker wants information on a specific chemical/product MSDS, he or she is to contact the designated HAZCOM person for further assistance.

Hazardous Chemical Release, Spill, or Exposure

Employees will immediately (within minutes) notify their direct supervisor of any release, spill, or human exposure to a hazardous chemical/product. If it is a significant release into the atmosphere, a spill on nonowned property, or into a surface or ground water supply, notify the local emergency service agency and/or fire department (telephone 911) and/or

the state Office(s) of Emergency Service. (The preceding requirement is not an OSHA HAZCOM Standard requirement, but is a Community Right-To-Know requirement.)

If a person is exposed to a hazardous chemical, emergency treatment as specified by the MSDS or label will be immediately applied. Whenever the question of need for further medical treatment arises, the individual(s) will be transported to _____ (name of doctor or emergency treatment center). A copy of the MSDS and/or label will be provided to the treating doctor or emergency treatment center as soon as possible. It would be best if the MSDS were transported with the exposed victim.

The supervisor of an area in which a hazardous chemical release, spill, or exposure occurs will, immediately after taking initial emergency action, notify the HAZCOM manager of the event.

Trade Secrets

The following format is offered to assist in the development of policies and procedures regarding trade secrets in your particular enterprise.

1. Regulatory Requirement 29 CFR 1910.1200(i)—See Reference A.
2. Policy Statement—It is the policy of USA Inc. to provide trade secret information on its products to those individuals requesting such information under the existing regulations.
3. Program Objectives—It is the policy of USA Inc. to reserve the right to withhold specific information on certain chemicals it uses or sells that may contain trade secret formulas. Use of such program would follow existing regulations.
4. Program Content—Information may be withheld by USA Inc. as a trade secret. If so, the Material Safety Data Sheet will contain information concerning the properties and effects of the hazardous chemical. The specific chemical identity will be made available to health professionals, employees, and designated representatives in accordance with the applicable regulations.
5. Quality Assurance—At the time a new chemical and its MSDS forms are reviewed by the HAZCOM manager and it is found to contain a trade secret, or if USA Inc. begins to produce a product that is hazardous and contains a trade secret, the HAZCOM Manager shall notify the company manager. It will be the responsibility of USA Inc. to determine company action on the subject of the trade secrets.

Documentation

The following areas of recordkeeping and documentation need policies and procedures developed to aid both management and labor.

1. Regulatory Requirement 29 CFR 1910.20—Access to employee exposure and medical records will be provided to employees on a written request basis.
2. Policy Statement—USA Inc. shall make the forms and documents listed in this written program available to employees on a written request basis.

3. Program Objective—This component of the program is included to identify, list, and define the various forms and reports referred to in this program.
4. Program Content—The forms and documents listed in this section are integral components of the ongoing effective performance of this program. They are meant to allow efficient monitoring of the program as a means of quality assurance. The following forms and documents are listed by program component:

    - Hazard Communication Standard 1910.1200
    - Hazard Communication Program Lesson Plan
    - MSDS Lesson Plan
    - Employee Evaluation
    - Sample Chemical Inventory Sheet
    - Sample MSDS Request Letter
    - Acronyms/Common Terms for MSDSs
    - MSDS Review/Completeness Checklist
    - Hazardous Chemical Product Listing

Employee Requirements

Employees are required to follow all standard operating procedures during the handling of hazardous chemicals, including the use of protective equipment. Failure to do so shall provide sufficient reason for reprimand, suspension, or termination of employment. When revising your training plans, consider including some information related to off-the-job hazard communications for the employees. A key element that the employees will realize is that there are many similarities to job-related hazard responsibilities. As an example, both on and off the job, your workers need to know what constitutes a hazardous material and how to detect the presence of one. Because of OSHA's Hazard Communication Standard (29 CFR 1910.1200), most employees should be familiar with how to safely handle the hazardous materials they see on the job. However, we know that many of the materials used on the job are also in their homes. One of the problems is that most victims of chemical accidents are injured at home, not at work. These incidents usually result from ignorance or carelessness in using flammable or combustible materials. In essence hazardous materials are everywhere, so chemical accidents can happen anywhere.

Management's Requirements

Management must train employees to know how and when to escape from the facility in the event of a fire or other emergency. Listed below are some key elements that need to be considered when thinking about evacuation plans and exit routes.

- Keep all exit routes free of explosives or highly flammable furnishings, material and decorations.
- Exit routes should be arranged so that employees will not have to travel toward a high-hazard area—unless the path of travel is effectively shielded from the hazardous conditions.

- Check that all exit routes remain unobstructed by materials, equipment, locked doors or dead-end corridors.
- Provide lighting for exit routes that is adequate for employees' normal vision.
- Post signs along the exit route that indicate the direction of travel.
- Install "EXIT" signs in plainly legible letters in all appropriate locations.
- Maintain exit routes during construction, repairs or alterations. Provide an emergency alarm system (audible/visual) to alert employees of a fire or other hazards.

Management can achieve most of their responsibilities through personnel management, limiting worker exposure, monitoring, training and continuing education, along with prudent purchasing. Management must exhibit a strong commitment to safety and lead by example. There are a number of ways management can show commitment to safety. Managers and supervisors should set a good safety example, attend safety and health meetings, perform walk-through inspections, investigate accidents (also, near-miss accidents), review safety performance at all levels and be open-minded and objective. Management must make sure the supervisors have a responsibility to safeguard, educate, and train employees under their supervision.

Summary

All materials used by an enterprise must be identified, knowing what their hazards consist of and placing controls on these materials to ensure that they do not harm workers or the environment while in the workplace. Hazardous material spill plans must be developed and implemented. Management needs to be well aware of the extent and magnitude of the problem and to provide an action plan to deal with cleaning up hazardous waste sites. This chapter provides the necessary elements for a comprehensive Hazard Communication Program, as specified by the HAZCOM Standard. The sample checklist, letter, and lists provided in this chapter are functional examples. They can be used by U.S. companies as they are presented or with minor adjustments.

Information in this chapter is designed to be applicable in a broad sense to all U.S. organizations. However, each organization's situation is unique. 29 CFR §1910.1200 is provided as Reference E at the end of the chapter. It is highly recommended that this standard be read in its entirety to provide a complete examination of its requirements.

Reference A

HAZARD COMMUNICATION
PROGRAM LESSON PLAN

*This Hazard Communication Program Lesson Plan will be used by the assigned HAZCOM Instructor _____ to ensure all sections are covered during training.

*Recently, there has been a movement to modify the MSDS forms and/or change the Hazard Communication Standard within OSHA.

Introduction

The Hazard Communication Program, a federal OSHA program, is designed for you, the employee. Its purpose is to provide greater protection to you in the workplace. It places responsibility on you, the employee, and on us, the employer.

The Plan

The objectives of the program are to provide employees information and training on:

1. The hazardous chemicals known to be in the workplace;
2. The methods that will be employed to protect workers;
3. The precautionary methods employees must follow to protect themselves from hazardous chemicals;
4. The detection of a release of hazardous chemicals; and
5. Emergency procedures to follow should there be a release of hazardous chemicals and/or employee exposure to them.

Materials Needed

The following materials are needed to teach this lesson effectively:

1. Sufficient copies of your organization's written Hazard Communication Program for each employee.
2. Sample copies of Material Safety Data Sheets and/or pesticide labels for employees to study.
3. Samples of hazardous chemical labels.
4. Supply of MSDS Study Guides.

Teaching-Learning Activities

1. Distribute your organization's written Hazard Communications Program to each employee.
2. Discuss each major section of the program with the employees.

Written Hazard Communication Program

- Tell them where additional copies are available. (Point out that this is the only "free" copy they will receive. They are to keep it. Discuss the cost of additional copies. [Optional Statement])
- If significant changes are made in the program these changes will be given to them in written form.

- If they have questions about the program, they are to ask them now, or ask their supervisor in the future. If they have questions or suggestions for improvement in the future they should bring them to the attention of their supervisor.

Material Safety Data Sheets

- Explain that these are often called MSDSs
- Explain where they are located and that all workers are urged to refer to them whenever they have a question. Additional questions and any need for clarification should be directed to their supervisor.
- MSDS will be discussed in much greater detail later in this chapter.

Notification of Other Employees

If other employers bring employees onto our property, it will be their responsibility to train their employees. We will provide them with our Hazard Communication Program and access to our MSDS file.

Use of Labels

- Hazardous chemicals are to be kept in their original containers.
- If a container becomes damaged, notify your supervisor immediately.
- The supervisor will direct the transfer and labeling of the material to a replacement container.
- Never use materials from an unlabeled container.
- Portable containers do not have to be labeled if they are only used by one person during an 8- to 10-hour shift.

Employee Information and Training

- Review each item under this heading in the Hazard Communication Program.
- Emphasize that they are *never* to use a hazardous chemical unless they are first trained in its safe use.
- Employees are to first contact their supervisor if they have any questions or concerns regarding hazardous chemicals. If the supervisor cannot or will not satisfactorily answer their questions, they are to contact _____ (name of manager, safety director, or HAZCOM manager).
- If you smell, feel, see, or detect any material that might be a hazardous chemical, report it immediately to your supervisor. He or she will take the action needed to correct the problem or evacuate the area. If the danger is serious, immediately initiate the appropriate emergency alert procedure to other workers, then evacuate the area and call 911 to report the emergency.

- Appropriate work practices, emergency procedures, and personal protective equipment have been developed and will be supplied for each hazardous material in your workplace. It is imperative that each employee follow these practices and procedures, including the wearing of all recommended personal protective equipment.
- Each employee will be supplied with the appropriate personal protective equipment required for working with hazardous chemicals and will be trained in the proper use and maintenance of it. Each employee will be responsible for their care and proper use. Your organization will need to conduct special training on respirator fit and care as well as for other specialized equipment. Such training is outside the scope of this lesson. Your organization may also wish to supply special clothing and footwear; in fact, this is required by OSHA in certain cases where hazardous work requires the use of protective equipment and clothing.

Hazard Chemical Release, Spill, or Exposure

- For any minor release, spill, or exposure, immediately notify supervision. They will direct the action to be taken.
- For any major release, spill, or exposure, follow the COMPANY EMERGENCY procedure, evacuate the area, and call 911.
- If you or a co-worker are exposed to a hazardous chemical, follow the emergency procedures outlined on the MSDS for that chemical and notify the supervisor immediately. He or she will determine what further medical treatment is necessary.
- If a supervisor is not readily available, do not hesitate to call 911 for the appropriate emergency vehicle. For medical treatment, the injured person is to be transported to _____ (Emergency Medical Center).
- An MSDS or pesticide label should be sent with the injured person so the doctors will have the necessary information for prompt and proper treatment.

NOTE: Before proceeding, be sure to ask if there are any questions in regard to the Hazard Communication Program.

Reference B

MSDS LESSON PLAN
(TO BE UTILIZED IN MSDS TRAINING)

The Material Safety Data Sheet Lesson Plan

We have determined which hazardous chemical or hazardous pesticide each of you will be working with. Some of you will be working with or around as many as _____ or as few as _____ hazardous products. Each of you will be completing an MSDS Study Guide for some of the hazardous products you may encounter. I, we will be here to help you complete each of the MSDS Study Guides.

We will begin with one hazardous chemical that all of you are familiar with: gasoline. An MSDS has various sections. These may vary by chemical and manufacturer, but are required to include:

I	Material Identification
II	Ingredients
III	Physical Data
IV	Fire and Explosion Data
V	Reactivity Data
VI	Toxicity Data
VII	Hazard Data
VIII	Health Hazard Information
IX	Spill, Leak, Release, Disposal Data
X	First Aid Information
XI	Precautionary Statements
XII	Personal Protective Equipment
XIII	Other Information

Let's look at the gasoline MSDS and complete the Study Guide. We will want to answer the following questions:

Section I How is the material identified?
- Gasoline, lead-free
- Volatile automotive fuel

Section II What is it made of?
- Hydrocarbons—crude oil

Section III What are its physical properties?
- Insoluble, will float on water, clear, liquid characteristic odor

Section IV Will it burn, explode?
- Yes, at temperatures as low as –45°F
- Use dry chemical or carbon dioxide extinguishers
- Dangerous fire, explodes, flashbacks

Section V What is its reactivity data?
- Stable when in a closed container at room temperature or below
- Mixed with air at high temperatures it will explode

Section VI What is its toxicity data?
- The gasoline MSDS does not have this section but under Health Hazard Information and the Hazard Data Sections we find that gasoline is toxic—poisonous
- Throat, lung, stomach, skin and eyes can all be damaged
- Excessive amounts can lead to death
- You may or may not wish to discuss Time Weighted Average (TWA). (For gasoline, 300 p/pm for 8 hours is considered safe, 500 p/pm for the eyes or 900 p/pm for the lungs is considered excessive and dangerous.)

Section VII	What is its hazard data? • Fires, explosions, skin rashes, eye damage, lung damage, possible death
Section VIII	Does it present any health hazards? • Inhalation—burning to mouth, throat, and respiratory tract • Skin—rashes, blistering • Eyes—burning, temporary blindness • Ingestion—drunkenness, drowsiness, blurred vision, vomiting
Section IX	How should a spill, leak, release, or disposal be handled? • Remove heat, sources of ignition • Provide ventilation • Contain spill, keep out of water supplies • Clean up and contain waste for treatment or disposal
Section X	What are the first aid procedures? • Flush eyes for 15 minutes • Wash skin with soap and water • Remove to fresh air • Do *not* induce vomiting
Section XI	What are the precautionary statements for safe use? • Do not smoke • Do not use indoors • Shut off motors • Avoid splashes, inhalation • Do not overfill, spill • Store in proper containers
Section XII	What personal protective equipment should be utilized? • Wear goggles or face shield • Clean clothing • Rubber gloves and boots
Section XIII	What other information is available for safe use? • Only authorized employees shall pump gasoline

Note: Care must be taken when evaluating to determine the safeguards and personal protective equipment to be worn when using a hazardous chemical. Different tasks and applications using the same hazardous material will not necessarily require the same safeguards or personal protective equipment.

This procedure should be followed with each group of hazardous chemicals with which an employee works or to which they are exposed. Encourage questions and discussion on each section. When an employee has completed an MSDS to his or her and your satisfaction both the trainer and the employee should sign and date the study guide. This study guide should then be kept in the employee's file as evidence of training.

Finally, employees should be reminded that it is their responsibility to follow all recommended procedures and practices whenever they are working with or around hazardous chemicals or pesticides. It is management's responsibility to provide the environment, equipment and supplies, information training, and supervision to ensure that the employee has a safe workplace.

Table 1.5. Material Safety Data Sheet (MSDS Study Guide)

SECTION	I	MATERIAL IDENTIFICATION
SECTION	II	INGREDIENTS
SECTION	III	PHYSICAL DATA
SECTION	IV	FIRE AND EXPLOSION DATA
SECTION	V	REACTIVITY DATA
SECTION	VI	TOXICITY DATA
SECTION	VII	HAZARD DATA
SECTION	VIII	HEALTH HAZARD INFORMATION
SECTION	IX	SPILL, LEAK, RELEASE, DISPOSAL DATA
SECTION	X	FIRST AID INFORMATION
SECTION	XI	PRECAUTIONARY STATEMENTS
SECTION	XII	PERSONAL PROTECTIVE EQUIPMENT
SECTION	XIII	OTHER INFORMATION

I have been instructed on I have instructed _____
(NAME OF EMPLOYEE)

_____ on the MSDS
(NAME OF PRODUCT)

and understand what must be done and believe he or she is adequately trained to work with it.

(EMPLOYEE'S NAME) (TRAINER'S NAME)
DATE DATE

Reference C

EMPLOYEE EVALUATION
HAZARD COMMUNICATION PROGRAM

Instructor Notes

1. The purpose of the Hazard Communication Program is to:
   Inform employees of the hazardous chemicals or substances in their workplace.
2. The specific objectives of the Hazard Communication Program are to learn:
   - The hazardous chemicals known to be in the workplace.
   - The methods that will be employed to protect workers.
   - The precautionary methods employees must follow to protect themselves from hazardous chemicals.
   - The detection of a release of hazardous chemicals.
   - Emergency procedures to follow should there be a release of hazardous chemicals and/or exposure to employees.
3. Additional copies of the Hazard Communication Program are available from:
   (*See written plan*)

Table 1.6. Material Safety Data Sheet (Training Purposes Only)

PRODUCT NAME: JOHN DOE UNLEADED GASOLINE
PRODUCT CODE NO: 00600 Issue Date 8/10/91

MANUFACTURER:

John Doe's Refining & Marketing Division
Morgan Oil Company of California
10000 W. 9th Avenue
Morgantown, California 80017

Contact for further information:
MSDS Coordinator (213) 977-7589

Transportation Emergencies
Call CHEMTREC
(800) 424-9300 Cont. U.S.
(202) 483-7616 (Collect from
Alaska & Hawaii
Health Emergencies
Call Joe Doe's Poison
Information Center (24 Hours)
(304) 001-0001

PRODUCT IDENTIFICATION

Product Name: XXX Unleaded Gasoline
Synonyms: XXX Unleaded Gasoline
Generic Name: Unleaded Gasoline
Chemical Family: Petroleum Hydrocarbon Mixture
DOT Proper Shipping Name: Gasoline
ID Number: UN1203

SECTION I—INGREDIENTS	TLV UNITS AGENCY	TYPE
Gasoline	300.00 PPM	ACGIH Full Term TWA
Benzene	10.00 PPM	OSHA Full Term TWA

Gasoline is a complex combination of hydrocarbons, including a small quantity of benzene. The identities of ingredients that are trade secrets are excluded from this list.

SECTION II—EMERGENCY FIRST AID PROCEDURES***EMERGENCY***

Have physicians call Joe Doe's Poison
Information Center (24 Hours) (304) 001-0001.

EYE CONTACT:
For direct contact, flush the affected eye(s) with clean water. If irritation or redness develops, seek medical attention.
SKIN CONTACT:
Wipe material from skin and remove contaminated clothing. Cleanse affected area(s) thoroughly by washing with soap and water. If irritation or redness develops and persists, seek medical attention.
INHALATION (Breathing):
If symptoms of exposure develop (see Section III), move away from source of exposure and into fresh air. If symptoms persist, seek medical attention. If victim is not breathing or if breathing difficulties develop, artificial respiration or oxygen should be administered by qualified personnel. Seek immediate medical attention.
SECTION II—EMERGENCY AND FIRST AID PROCEDURES ***EMERGENCY***

Have physician call Joe Does Poison
Information Center (24 Hours) (304) 001-0001

Table 1.6. (*continued*)

PRODUCT NAME: JOHN DOE UNLEADED GASOLINE
PRODUCT CODE NO: 00600 Issue Date 8/10/91

INGESTION (Swallowing):

ASPIRATION HAZARD: Do not induce vomiting because gasoline can enter lungs and cause severe lung damage. If victim is conscious and alert, give 2 to 3 cups of milk or water to drink. Seek medical attention. To physician: Emesis or layage is not recommended for ingestions of minute quantities or tastes of most hydrocarbons. Medical opinion is divided for larger ingestions. Emesis or layage has been recommended for those petroleum products that have a high oral toxicity. Gastric layage with a cuffed endotracheal tube is recommended by some physicians to prevent aspiration.

SECTION III—POTENTIAL ADVERSE HEALTH EFFECTS

EYE CONTACT:

This material may cause eye irritation. Direct contact may cause burning, tearing, and redness.

SKIN CONTACT:

This material may cause skin irritation. Prolonged or repeated contact may cause redness and burning, drying, and cracking, and dermatitis.

INHALATION (Breathing):

Exposure to mists or prolonged or repeated exposure to fumes or vapors may cause initial nervous system stimulation followed by nervous system depression. Symptoms include: flushing, blurred vision, dizziness, nausea, headache, drowsiness, loss of coordination, and fatigue. A severe acute exposure may cause loss of consciousness, convulsions, respiratory collapse, and death.

INGESTION (Swallowing):

Accidental ingestion of this material may cause irritation of the digestive tract. Ingestion of excessive quantities may cause signs of nervous system depression (e.g., drowsiness, dizziness, loss of coordination, and fatigue). This material is an aspiration hazard, gasoline can enter lungs during swallowing or vomiting and cause lung inflammation and damage.

COMMENTS:

Gasoline inhalation has been shown to cause tumors in laboratory animals after long-term exposure. Gasoline contains a small amount of benzene. Benzene is associated with leukemia, other blood disorders and chromosome damage in humans, and adverse reproductive effects in laboratory animals. While there is insufficient evidence to show that gasoline poses any hazard related to its low benzene content, prudent handling is advised.

SECTION IV—SPECIAL PROTECTION INFORMATION

VENTILATION:

If current ventilation practices are not adequate in maintaining airborne concentrations below the established exposure limits (See Section I), additional explosion-proof ventilation or exhaust systems may be required.

SECTION IV—SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:

The use of respiratory protection is advised when vapor or gas concentrations exceed the established exposure limits (See Section I). Depending on the airborne concentration, use a respirator or gas mask with appropriate cartridges and canisters (NIOSH approved, if available) or supplied air equipment.

PROTECTIVE GLOVES:

The use of gloves impermeable to the specific material handled is advised to prevent skin contact, possible irritation and absorption.

EYE PROTECTION:

Approved eye protection to safeguard against potential eye contact, irritation or injury is recommended.

OTHER PROTECTIVE EQUIPMENT:

It is suggested that a source of clean water be available in work area for flushing eyes and skin. Barrier creams that are specific for oil-based materials are recommended when gloves are impractical

SECTION V—REACTIVITY DATA

STABILITY:

Stable

CONDITIONS TO AVOID (Stability):

Avoid contact of liquid, fumes, or vapors with any source of heat, sparks, or flames.

INCOMPATIBILITY (Materials to avoid):

Strong oxidizing agents such as chlorine, permanganates and dichromates may cause fire or explosion.

HAZARDOUS DECOMPOSITION PRODUCTS:

Combustion may yield significant amounts of carbon monoxide and small amounts of oxides of sulfur and nitrogen, benzene and other organic compounds.

HAZARDOUS POLYMERIZATION:

Will not occur.

SECTION VI—SPILL OR LEAK PROCEDURES ***HIGHWAY OR RAILWAY SPILLS***

Call CHEMTREC (800)424-9300 Cont. U.S.
(Collect) (202) 483-7616 from Alaska & Hawaii

PRECAUTIONS IN CASE OF RELEASE OR SPILL:

Stay upwind and away from spill unless wearing a self-contained breathing apparatus (SCBA). Isolate hazard area and restrict entry. Stop and/or contain discharge if it can be done safely. Flammable; keep all sources of ignition and hot metal surfaces away from spill. Use non- sparking tools for cleanup. Keep out of drains, sewers or waterways. Spilled materials may be absorbed into an appropriate absorbent. Contact fire authorities and appropriate state/local agencies. If spill of any amount is made into or upon U.S. Navigable Waters, the contiguous zone, or adjoining shorelines, notify Coast Guard National Response Center(Phone Number 899-424-8802).

Table 1.6. (*continued*)

PRODUCT NAME: JOHN DOE UNLEADED GASOLINE
PRODUCT CODE NO: 00600 Issue Date 8/10/91

SECTION VI—SPILL OR LEAK PROCEDURES ***HIGHWAY OR RAILWAY SPILLS***

WASTE DISPOSAL METHOD:

Dispose of product in accordance with local, county, state, and federal regulations.

SECTION VII—STORAGE AND SPECIAL PRECAUTIONS

HANDLING AND STORAGE PRECAUTIONS:

Store only in approved containers. Keep containers tightly closed, out of direct sunlight, and away from all sources of ignition. Keep away from incompatible materials (See Section V). Outdoor or detached storage is preferred. Indoor storage should be in a standard flammable liquid storage room. Provide adequate ventilation and post area "No Smoking or Open Flame." Bond and ground all equipment when transferring from one vessel to another. Keep work area free of hot metal surfaces and other sources of ignition. Avoid inhalation of vapors and personal contact with the product. Wash thoroughly after handling. Launder saturated clothing before wearing.

SECTION VIII—FIRE AND EXPLOSION HAZARD DATA

HAZARD RANKING

NFPA Health Hazard: 20 = Least DOT FLAMMABILITY FLASHPOINT
Hazard Flammability: 31 = Slight CLASSIFICATION
Class Reactivity: 02 = Moderate
Other:3 = High Flammable Liquid-45 TCC F
4 = Extreme

EXTINGUISHING MEDIA:

The use of dry chemical, foam or CO_2 is recommended. Water may be ineffective.

FIRE AND EXPLOSION HAZARDS:

This material is extremely flammable and may be ignited by heat, sparks or flames. Flashbacks along vapor trail may occur.

FIRE FIGHTING PROCEDURES:

The use of a self-contained breathing apparatus (SCBA) is recommended for fire fighters. Water spray may be useful in minimizing vapors and cooling containers exposed to heat and flame. Avoid spreading burning liquid with water used for cooling purposes. Move undamaged containers from fire area if you can do so without risk.

SECTION IX—PHYSICAL DATA

APPROX. BOILING RANGE	VAPOR DENSITY	VAPORATION RATE	%VOLATILE
85°–430°f	HEAVIER THAN AIR	SLOWER THAN EITHER	100%
%SOLUBILITY IN WATER	SPECIFIC GRAVITY	APPEARANCE	ODOR
NEGLIGIBLE	0.75	CLEAR LIQUID	GASOLINE ODOR

SECTION X—PRECAUTIONARY LABEL

DANGER! Extremely Flammable. Vapors may explode. Harmful or fatal if swallowed. Vapor harmful. Possible cancer hazard based on tests with laboratory animals. No

smoking. Keep away from heat, sparks, or flame, including pilot lights, electric motors and other sources of ignition. Vapors may be ignited by spark or flame source many feet away. Do not overfill tank. Use only with adequate ventilation. Avoid prolonged breathing of vapors. Keep face away from nozzle and container opening. Keep away from eyes, skin and clothing. Wash thoroughly if eye or skin contact occurs. Never siphon by mouth. For use as motor fuel only. Do not use for any other purpose. Do not cut, puncture or weld on or near this container. After container has been emptied, it will contain explosive vapors. Keep out of reach of children. Failure to use caution may cause serious injury or illness.

SECTION XI—DOCUMENTARY INFORMATION

ISSUE DATE: 8/10/91 PREV. DATE: 0/0/0 PRODUCT CODE NO. 00600

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES

The information in this document is believed to be correct as of the date issued.

HOWEVER, NO WARRANTY OF MERCHANTABILITY, FITNESS OR ANY PARTICULAR PURPOSE, OR ANY OTHER WARRANTY IS EXPRESSED OR IS TO BE IMPLIED REGARDING THE ACCURACY OR COMPLETENESS OF THIS INFORMATION, THE RESULTS TO BE OBTAINED FROM THE USE OF THIS INFORMATION OR THE PRODUCT, THE SAFETY OF THIS PRODUCT, OR THE HAZARDS RELATED TO ITS USE.

This information and product are furnished on the condition that the person receiving them shall make his/her own determination as to the suitability of the product for his particular purpose and on the condition that he/she assume the risk of his/her use thereof.

4. Material Safety Data Sheets are available for review at the following location(s): (*See written plan*)
5. If there is a *major* release, spill, or exposure to a hazardous chemical, I am to: (*See written plan*)
6. If a co-worker and/or I are seriously injured, I should call (*see written plan*) and have the injured person transported to the (*see written plan*).
7. A *MSDS* or *Label* should be sent with the injured employee when he or she is sent for medical treatment.

I have received information and training on the Hazard Communication Program and understand my responsibilities to work safely with hazardous chemicals and pesticides.

DATE
NAME OF EMPLOYEE

Table 1.7. Chemical Information Audit

Product or Trade Name

CAS #	*Chemical Constituents*	*% in Mixture*
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

PHYSICAL DESCRIPTION:

Pure ___ Solid ___ Gas ___

Mixture ___ Liquid ___

EPA HAZARD CATEGORY:

___ Immediate (acute) Health Hazard

___ Delayed (chronic) Health Hazard

___ Fire Hazard

___ Sudden Release of Pressure Hazard

___ Reactive Hazard

INVENTORY:

___ Average Amount on Site

___ Maximum Amount on Site

___ Number of Days on Site

STORAGE:

Type	No. of Containers	X	Size	=	Total
_____	_____	___	____		_____
_____	_____	___	____		_____

STATE OF CHEMICAL:

Pressure:

___ Ambient

___ Greater Than Ambient

___ Less Than Ambient

Temperature:

___ Ambient

___ Greater Than Ambient

___ Less Than Ambient

___ Cryogenic

Location of Chemical:

Comments: _____

Inspected by: _____

Date: _____

Reference D

SAMPLE CHEMICAL INVENTORY SHEET AND SAMPLE CHEMICAL INFORMATION AUDIT

Generic Name

Trade Name
Supplier

Address and Phone No.

Label Statements

MSDS Cross Reference No.

MSDS received with shipment? Yes ___ No ___
(If no, attach a copy of letter sent to manufacturer requesting MSDS.)

Updated MSDS received? Yes ___ No ___
(If yes, date that new MSDS was supplied to MSDS file.)

(If yes, does updated MSDS contain new health or physical hazard information?)

(If yes, set date for new training schedule for workers to explain new health and physical hazard.)

Training needed? Yes ___ No ___

Date training held

Use Information:

Where Used

Quantities

Where Stored

Date of Preparation

Annual Review date

Reference E

HAZARD COMMUNICATION STANDARD
29 CFR §1910.1200

1910.1200 Hazard communication.

(a) *Purpose*. (1) The purpose of this section is to ensure that the hazards of all chemicals produced or imported are evaluated, and that information concerning their hazards is transmitted to employers and employees. This transmittal of information is to be accomplished by means of comprehensive hazard communication programs, which are to include container labeling and other forms of warning, material safety data sheets, and employee training.

(2) This occupational safety and health standard is intended to comprehensively address the issue of evaluating the potential hazards of chemicals and appropriate protective measures to employees, and to preempt any legal requirements of the state, or political subdivision of a state, pertaining to the subject. Evaluating the potential hazards of chemicals, and communicating information concerning hazards and appropriate protective measures to employees, may include, for example, but is not limited to, provisions for: developing and maintaining a written hazard communication program for the workplace, including lists of hazardous chemicals present; labeling of containers of chemicals in the workplace, as well as of containers of chemicals being shipped to other workplaces; preparation and distribution of material safety data sheets to employees and downstream employers; and development and implementation of employee training programs regarding hazards of chemicals and protective measures. Under section 18 of the Act, no state or political subdivision of a state may adopt or enforce, through any court or agency, any requirement relating to the issue addressed by this federal standard, except pursuant to a federally approved state plan.

(b) *Scope and application*. (1) This section requires chemical manufacturers or importers to assess the hazards of chemicals that they produce or import, and all employers to provide information to their employees about the hazardous chemicals to which they are exposed, by means of a hazard communication program, labels and other forms of warning, material safety data sheets, and information and training. In addition, this section requires distribution to transmit the required information to employers.

(2) This section applies to any chemical that is known to be present in the workplace in such a manner that employees may be exposed under normal conditions of use or in a foreseeable emergency.

(3) This section applies to laboratories only as follows:

(i) Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced;

(ii) Employers shall maintain any material safety data sheets that are received

with incoming shipments of hazardous chemicals and ensure that they are readily accessible to laboratory employees; and,

(iii) Employers shall ensure that laboratory employees are appraised of the hazards of the chemicals in their workplaces in accordance with paragraph (h) of this section.

(4) In work operations where employees only handle chemicals in sealed containers that are not opened under normal conditions of use such as are found in marine cargo handling, warehousing, or retail sales, this section applies to these operations only as follows:

(i) Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced;

(ii) Employers shall maintain copies of any Material Safety Data Sheets that are received with incoming shipments of the sealed containers of hazardous chemicals received without a Material Safety Data Sheet if any employee requests the material safety data sheet, and shall ensure that the Material Safety Data Sheets are readily accessible during each work shift to employees when they are in their work area(s); and,

(iii) Employers shall ensure that employees are provided with information and training in accordance with paragraph(h) of this section except for the location and availability of the written hazard communication program under paragraph (h)(1)(iii), to the extent necessary to protect them in the event of a spill or leak of a hazardous chemical from a sealed container.

(5) This section does not require labeling of the following chemicals:

(i) Any pesticide as such term is defined in the Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. 136 et seq), when subject to the labeling requirements of that Act by the Environmental Protection Agency;

(ii) Any food, food additive, color additive, drug, cosmetic, or medical or veterinary device, including materials intended for use as ingredients in such products (e.g., flavors, and fragrances), as such terms are defined in the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 301 et seq.) and regulations issued under that Act, when they are subject to the labeling requirements under that Act by the Food and Drug Administration;

(iii) Any distilled spirits (beverage alcohols), wine, or malt beverage intended for nonindustrial use, as such terms are defined in the Federal Alcohol Administration Act (27 U.S.C. 201 et seq) and regulations issued under that Act, when subject to the labeling requirements of that Act and labeling regulations issues under that Act by the Bureau of Alcohol, Tobacco, and Firearms; and

(iv) Any consumer product or hazardous substance as those terms are defined in the Consumer Product Safety Act (15 U.S.C. 2051 et seq) and Federal Hazardous Substances Act (15 U.S.C. 1261 et seq), respectively, when subject to a consumer product safety standard or labeling requirement of those Acts, or regulations issued under those Acts by the Consumer Products Safety Commission.

(6) This section does not apply to:

(i) Any hazardous waste as such term is defined by the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, as amended (42 U.S.C. 6901 et seq), when subject to regulations issued under that Act by the Environmental Protection Agency;

(ii) Tobacco or tobacco products;

(iii) Wood or wood products;

(iv) Articles;

(v) Food, drugs, cosmetics, or alcohol beverages in a retail establishment that are packaged for sale to consumers;

(vi) Foods, drugs, or cosmetics, intended for personal consumption by employees while in the workplace;

(vii) Any consumer product or hazardous substance, as those terms are defined in the Consumer Product Safety Act (15 U.S.C. 1262 et seq) respectively, where the employer can demonstrate it is used in the workplace in the same manner as normal consumer use, and that use results in a duration and frequency of exposure experienced by consumers; and

(viii) Any drug, as that term is defined in the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 301 et seq.), when it is in solid, final form for direct administration to the patient (i.e., tablets or pills).

(c) *Definitions*.

"Article" means a manufactured item: (i) that is formed to a specific shape or design during manufacture; (ii) that has end use function(s) dependent in whole or in part upon its shape or design during end use; and (iii) that does not release, or otherwise result in exposure to, a hazardous chemical, under normal conditions of use.

"Assistant Secretary" means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

"Chemical" means any element, chemical compound, or mixture of elements and/or compounds.

"Chemical manufacturer" means any employer with a workplace where chemical(s) are produced for use or distribution.

"Chemical name" means the scientific designation of a chemical in accordance with the nomenclature system developed by the International Union of Pure and Applied Chemistry (IUPAC) or the Chemical Abstracts Service (CAS) rules of nomenclature, or a name which will clearly identify the chemical for the purpose of conducting a hazard evaluation.

"Combustible liquid" means any liquid having a flashpoint at or above 100° F (37.8° C), but below 200° F (93.3° C), except any mixture having components with flashpoints of 200° F (93.3° C), or higher, the total volume of which make up 99 percent or more of the total volume of the mixture.

"Common name" means any designation or identification such as code name, code number, trade name, brand name, or generic name used to identify a chemical other than by its chemical name.

"Compressed gas" means:

(i) A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70° F (21.1° C); or

(ii) a gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70° F (21.1° C); or

(iii) A liquid having a vapor pressure exceeding 40 psi at 100° F (37.8° C) as determined by ASTM D-323-72.

"Container" means any bag, barrel, bottle, box, can, cylinder, drum, reaction, vessel, storage tank, or the like that contains a hazardous chemical. For purposes of this section, pipes or piping systems, engines, fuel tanks, or other operating systems in a vehicle are not considered to be containers.

"Designated representative" means any individual or organization to whom an employee gives written authorization to exercise such employee's rights under this section. A recognized or certified collective bargaining agent shall be treated automatically as a designated representative without regard to written employee authorization.

"Director" means the Director, National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, or designee.

"Distributor" means a business, other than a chemical manufacturer or importer, which supplies hazardous chemicals to other distributors or to employers.

"Employee" means a worker who may be exposed to hazardous chemicals under normal operating conditions or in foreseeable emergencies. Workers such as office workers or bank tellers who encounter hazardous chemicals only in nonroutine, isolated instances are not covered.

"Employer" means a person engaged in a business where chemicals are either used, distributed, or are produced for use or distribution, including a contractor or subcontractor.

"Explosive" means a chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

"Exposure" or "Exposed" means that an employee is subjected to a hazardous chemical in the course of employment through any route of entry (inhalation, ingestion, skin contact or absorption, etc.), and includes potential (e.g., accidental or possible) exposure.

"Flammable" means a chemical that falls into one of the following categories:

(i) "Aerosol, flammable" means an aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame projection exceeding 18 inches at full valve opening, or a flash-back (a flame extending back to the valve) at any degree of valve opening;

(ii) "Gas, flammable" means:

(A) A gas that, at ambient temperature and pressure, forms a flammable mixture with the air at a concentration of 13 percent by volume or less; or

(B) A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12 percent by volume, regardless of the lower limit;

(iii) "Liquid flammable" means any liquid having a flashpoint below 100° F (37.8° C), except any mixture having components with flashpoints of 100° F (37.8° C) or higher, the total of which make up 99 percent or more of the total volume of the mixture;

(iv) "Solid, flammable" means a solid, other than a blasting agent or explosive as defined in 1910.109 (a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

"Flashpoint" means the minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite when tested as follows:

(i) Tagliabue Closed Tester (See American National Standard Method of Test for Flash Point by Tag Closed Tester, Z11.24-1979 (ASTM D 56-79)) for liquids with a viscosity of less than 45 Saybolt University Seconds (SUS) at 100° F (37.8° C), or that do not contain suspended solids and so not have a tendency to form a surface film under test; or

(ii) Pensky-Marten Closed Tester (see American National Standard Method of Test for Flash Point by Pensky-Martens Closed Tester, Z11.7-1979 (ASTM D 93-79)) for liquids with a viscosity equal or greater than 45 SUS at 100° F (37.8° C), or that contain suspended solids, or that have a tendency to form a surface film under test; or

(iii) Setaflash Closed Tester (see American National Standard Method of Test for Flash Point by Setaflash Closed Tester (ASTMD 3278-78))

Organic peroxides, which undergo autoaccelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified above.

"Foreseeable emergency" means any potential occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment that could result in an uncontrolled release of a hazardous chemical into the workplace.

"Hazardous chemical" means any chemical that is a physical hazard or a health hazard.

"Hazard warning" means any words, pictures, symbols, or combination thereof appearing on a label or other appropriate form of warning that convey the hazard(s) of the chemical(s) in the container(s).

"Health hazard" means a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed em-

ployees. The term "health hazard" includes chemicals that are carcinogens, toxic or highly toxic agents, reproductive toxins, irritant, corrosives, sensitizers, hepatoxins, nephrotoxins, neurotoxins, agents that act on the hematopoietic system, and agents that damage the lungs, skin, eyes, or mucous membranes. Appendix A provides further definitions and explanations of the scope of health hazards covered by this section, and Appendix B describes the criteria to be used to determine whether or not a chemical is to be considered hazardous for purposes of this standard.

"Identity" means any chemical or common name that is indicated on the Material Safety Data Sheet (MSDS) for the chemical. The identity used shall permit cross-references to be made among the required list of hazardous chemicals, the label and the MSDS.

"Immediate use" means that the hazardous chemical will be under the control of and used only by the person who transfers it from a labeled container and only within the work shift in which it is transferred.

"Importer" means the first business with employees within Customs Territory of the United States that receives hazardous chemicals produced in other countries for the purpose of supplying them to distributors or employers within the United States.

"Label" means any written, printed, or graphic material, displayed on or affixed to containers of hazardous chemicals.

"Material Safety Data Sheet (MSDS)" means written or printed material concerning a hazardous chemical that is prepared in accordance with paragraph (g) of this section.

"Mixture" means any combination of two or more chemicals if the combination is not, in whole or in part, the result of a chemical reaction.

"Organic peroxide" means an organic compound of two or more chemicals the bivalent –O-O-structure and that may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.

"Oxidizer" means a chemical other than a blasting agent or explosive as defined in §1910.109(a) that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

"Physical hazard" means a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable reactive, or water-reactive.

"Produce" means to manufacture, process, formulate, or repackage.

"Pyrophoric" means a chemical that will ignite spontaneously in air at a temperature of 130° F (54.4° C) or below.

"Responsible party" means someone who can provide additional information on the hazardous chemical and appropriate emergency procedures, if necessary.

"Specific chemical identity" means the chemical name. Chemical Abstracts

Service (CAS) Registry Number, or any other information that reveals the precise chemical designation of the substance.

"Trade secret" means any confidential formula, pattern, process, device, information, or computation of information that is used in an employer's business, and that gives the employer an opportunity to obtain an advantage over competitors who do not know or use it. Appendix D sets out the criteria to be used in evaluating trade secrets.

"Unstable (reactive)" means a chemical, which in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure, or temperature.

"Use" means to package, handle, react, or transfer.

"Water-reactive" means a chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

"Work area" means a room or defined space in a workplace where hazardous chemicals are produced or used, and where employees are present.

"Workplace" means an establishment, job site, or project, at one geographical location containing one or more work areas.

(d) *Hazard determination*. (1) Chemical manufacturers and importers shall evaluate chemicals produced in their workplaces or imported by them to determine if they are hazardous. Employers are not required to evaluate chemicals unless they choose not to rely on the evaluation performed by the chemical manufacturer or importer for the chemical to satisfy this requirement.

(2) Chemical manufacturers, importers, or employers evaluating chemicals shall identify and consider the available scientific evidence concerning such hazards. For health hazards, evidence that is statistically significant and that is based on at least one positive study conducted in accordance with established scientific principles is considered to be sufficient to establish a hazardous effect if the results of the study meet the definitions of health hazards in this section. Appendix A shall be consulted for the scope of health hazards covered, and Appendix B shall be consulted for the criteria to be followed with respect to the completeness of the evaluation, and the data to be reported.

(3) The chemical manufacturer, importer, or employer evaluating chemicals shall treat the following sources as establishing that the chemicals listed in them are hazardous:

(i) 29 CFR Part 1910, subpart Z. Toxic and Hazardous Substances, Occupational Safety and Health Administration (OSHA); or,

(ii) *Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment.* American Conference of Governmental Industrial Hygienists (ACGIH) (latest edition).

The chemical manufacturer, importer, or employer is still responsible for evaluating the hazards associated with the chem-

icals in these source lists in accordance with requirements of this standard.

(4) Chemical manufacturers, importers, and employers evaluating chemicals shall treat the following sources as establishing that a chemical is a carcinogen or potential carcinogen for hazard communication purposes:

(i) National Toxicology Program (NTP), *Annual Report on Carcinogens* (latest edition);

(ii) International Agency for Research on Cancer (IARC) *Monographs* (latest edition); or

(iii) 29 CFR Part 1910, Subpart Z, Toxic and Hazardous Substances, Occupational Safety and Health Administration.

NOTE: The *Registry of Toxic Effects of Chemical Substances* published by the National Institute for Occupational Safety and Health indicates whether a chemical has been found by NTP or IARC to be a potential carcinogen.

(5) The chemical manufacturer, importer, or employer shall determine the hazards of mixtures of chemicals as follows:

(i) If a mixture has been tested as a whole to determine its hazards, the results of such testing shall be used to determine whether the mixture is hazardous;

(ii) If a mixture has not been tested as a whole to determine whether the mixture is a health hazard, the mixture shall be assumed to present the same health hazards as do the components that comprise one percent (by weight or volume) or greater of the mixture, except that the mixture shall be assumed to present a carcinogenic hazard if it contains a component in concentrations of 0.1 percent or greater, which is considered to be a carcinogen under paragraph (d)(4) of this section;

(iii) If a mixture has not been tested as a whole to determine whether the mixture is a physical hazard, the chemical manufacturer, importer, or employer may use whatever scientifically valid data is available to evaluate the physical hazard potential of the mixture; and

(iv) If the chemical manufacturer, importer, or employer has evidence to indicate that a component present in the mixture in concentrations of less than one percent or in the case of carcinogens, less than 0.1 percent could be released in concentrations, which would exceed an established OSHA permissible exposure limit or ACGIH Threshold Limit Value, or could present a health hazard to employees in those concentrations, the mixture shall be assumed to present the same hazard.

(6) Chemical manufacturers, importers, or employers evaluating chemicals shall describe in writing the procedures they use to determine the hazards of the chemicals they evaluate. The written procedures are to be made available, upon request, to employees, their designated representatives, the Assistant Secretary and the Director. The written hazard communication program required under paragraph (e) of this section.

(e) *Written Hazard Communication Program*. (1) Employers shall develop, implement, and maintain at the workplace, a written Hazard Communication Program

for their workplaces, which at least describes how the criteria specified in paragraphs (f), (g) and (h) of this section for labels and other forms of warning, Material Safety Data Sheets, and employee information and training will be met, and that also includes the following:

(i) A list of the hazardous chemicals known to be present using an identity that is referenced on the appropriate material safety data sheet (the list may be compiled for the workplace as a whole or for individual work areas); and

(ii) The methods the employer will use to inform employees of the hazards of nonroutine tasks (for example, the cleaning of reactor vessels), and the hazards associated with chemicals contained in unlabeled pipes in their work areas.

(2) *Multiemployer workplaces.* Employers who produce, use, or store hazardous chemicals at a workplace in such a way that employees of other employer(s) may be exposed (for example, employees of a construction contractor working on-site) shall additionally ensure that the hazard communication programs developed and implemented under this paragraph (e) include the following:

(i) The methods the employer will use to provide the other employer(s) with a copy of the Material Safety Data Sheet, or to make it available at a central location in the workplace, for each hazardous chemical the other employer(s)' employees may be exposed to while working;

(ii) The methods the employer will use to inform the other employer(s) of any precautionary measures that need to be taken to protect employees during the workplace's normal operating conditions and in foreseeable emergencies; and

(iii) The methods the employer will use to inform the other employer(s) of the labeling system used in the workplace.

(3) The employer may rely on an existing Hazard Communication Program to comply with these requirements, provided that it meets the criteria established in this paragraph, (e).

(4) The employer shall make the written Hazard Communication Program available, upon request, to employees, their designated representatives, the Assistant Secretary and the Director, in accordance with the following information:

(i) Identity of the hazardous chemical(s);

(ii) Appropriate hazard warnings; and

(iii) Name and address of the chemical manufacturer, importer, or other responsible party.

(2) For solid metal (such as a steel beam or a metal casting) that is not exempt as an article due to its downstream use, the required label may be transmitted to the customer at the time of the initial shipment, and need not be included with subsequent shipments to the same employer unless the information on the label changes. The label may be transmitted with the initial shipment itself, or with the Material Safety Data Sheet that is to be provided prior to or at the time of the first shipment. This exception to requiring labels on every container of hazardous chemicals is only for the solid metal itself and does not apply to hazardous chemicals used in conjunction

with, or known to be present with, the metal and to which employees handling the metal may be exposed (for example, cutting fluids or lubricants).

(3) Chemical manufacturers, importers, or distributors shall ensure that each container of hazardous chemicals leaving the workplace is labeled, tagged, or marked in accordance with this section in a manner which does not conflict with the requirements of the Hazardous Materials Transportation Act (49 U.S.C. 1801 et. seq.) and regulations issued under that Act by the Department of Transportation.

(4) If the hazardous chemical is regulated by OSHA in a substance-specific health standard, the chemical manufacturer, importer, distributor, or employer shall ensure that the labels or other forms of warning used are in accordance with the requirements of that standard.

(5) Except as provided in paragraphs (f)(6) and (f)(7) the employer shall ensure that each container of hazardous chemicals in the workplace is labeled, tagged, or marked with the following information:

(i) Identity of the hazardous chemical(s) contained therein; and

(ii) Appropriate hazard warnings.

(6) The employer may use signs, placards, process sheets, batch tickets, operating procedures, or other such written materials in lieu of affixing labels to individual stationary process containers, as long as the alternative method identifies the containers to which it is applicable and conveys the information required by paragraph (f)(5) of this section to be on a label. The written materials shall be readily accessible to the employees in their work area throughout each work shift.

(7) The employer is not required to label portable containers into which hazardous chemicals are transferred from labeled containers, and that are intended only for the immediate use of the employee who performs the transfer.

(8) The employer shall not remove or deface existing labels on incoming containers of hazardous chemicals, unless the container is immediately marked with the required information.

(9) The employer shall ensure that labels or other forms of warning are legible, in English, and prominently displayed on the container, or readily available in the work area throughout each work shift. Employers having employees who speak other languages may add the information in their language to the material presented, as long as the information is presented in English as well.

(10) The chemical manufacturer, importer, distributor, or employer need not affix new labels to comply with this section if existing labels already convey the required information.

(g) *Material Safety Data Sheets.* (1) Chemical manufacturers and importers shall obtain or develop a Material Safety Data Sheet for each hazardous chemical they produce or import. Employers shall have a Material Safety Data Sheet for each hazardous chemical which they use.

(2) Each Material Safety Data Sheet shall be in English and shall contain at least the following information:

(i) The identity used on the label, except as provided for in paragraph (i) of this section on trade secrets:

(A) If the hazardous chemical is a single substance, its chemical and common name(s);

(B) If the hazardous chemical is a mixture that has been tested as a whole to determine its hazards, the chemical and common name(s) of the ingredients that contribute to these known hazards, and the common name(s) of the mixture itself; or,

(C) If the hazardous chemical is a mixture that has not been tested as a whole:

(1) The chemical and common name(s) of all ingredients that have been determined to be health hazards, and that comprise one percent or greater of the composition, except that chemicals identified as carcinogens under paragraph (d)(4) of this section shall be listed if the concentrations are 0.1 percent or greater; and

(2) The chemical and common name(s) of all ingredients that have been determined to be health hazards, and that comprise less than 1 percent (0.1 percent for carcinogens) of the mixture, if there is evidence that the ingredient(s) could be released from the mixture in concentrations that would exceed an established OSHA permissible exposure limit or ACGIH Threshold Limit Value, or could present a health hazard to employees; and

(i) The chemical and common name(s) of all ingredients that have been determined to present a physical hazard when present in the mixture;

(ii) Physical and chemical characteristics of the hazardous chemical (such as vapor pressure, flash point);

(iii) The physical hazards of the hazardous chemical, including the potential for fire, explosion, and reactivity;

(iv) The health hazards of the hazardous chemical, including signs and symptoms of exposure, and any medical conditions that are generally recognized as being aggravated by exposure to the chemical;

(v) The primary route(s) of entry;

(vi) The OSHA permissible exposure limit, ACGIH Threshold Limit Value, and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the Material Safety Data Sheet, where available;

(vii) Whether the hazardous chemical is listed in the National Toxicology Program (NTP) *Annual Report on Carcinogens* (latest edition) or has been found to be a potential carcinogen in the International Agency for Research on Cancer (IARC) *Monographs* (latest editions), or by OSHA;

(viii) Any generally applicable precautions for safe handling and use that are known to the chemical manufacturer, importer, or employer preparing the Material Safety Data Sheet, including appropriate hygienic practices, protective measures during repair and maintenance

of contaminated equipment, and procedures for clean-up of spills and leaks;

(ix) Any generally applicable control measures, which are known to the chemical manufacturer, importer or employer preparing the Material Safety Data Sheet, such as appropriate engineering controls, work practices, or personal protective equipment;

(x) Emergency and first aid procedures;

(xi) The date of preparation of the Material Safety Data Sheet or the last change to it; and

(xii) The name, address, and telephone number of the chemical manufacturer, importer, employer or other responsible party preparing or distributing the Material Safety Data Sheet, who can provide additional information on the hazardous chemical and appropriate emergency procedures, if necessary.

(3) If no relevant information is found for any given category on the Material Safety Data Sheet, the chemical manufacturer, importer, or employer preparing the Material Safety Data Sheet shall mark it to indicate that no applicable information was found.

(4) Where complex mixtures have similar hazards and contents (i.e., the chemical ingredients are essentially the same, but the specific composition varies from mixture to mixture), the chemical manufacturer, importer, or employer may prepare one Material Safety Data Sheet to apply to all of these similar mixtures.

(5) The chemical manufacturer, importer, or employer preparing the Material Safety Data Sheet shall ensure that the information recorded accurately reflects the scientific evidence used in making the hazard determination. If the chemical manufacturer, importer or employer preparing the Material Safety Data Sheet becomes newly aware of any significant information regarding the hazards of a chemical, or ways to protect against the hazards, this new information shall be added to the Material Safety Data Sheet within three months. If the chemical is not currently being produced or imported the chemical manufacturer or importer shall add the information to the Material Safety Data Sheet before the chemical is introduced into the workplace again.

(6) Chemical manufacturers or importers shall ensure that distributors and employers are provided an appropriate Material Safety Data Sheet with their initial shipment, and with the first shipment after a Material Safety Data Sheet is updated. The chemical manufacturer or importer shall either provide Material Safety Data Sheets with the shipped containers or send them to the employer prior to or at the time of the shipment. If the Material Safety Data Sheet is not provided with a shipment that has been labeled as a hazardous chemical, the employer shall obtain one from the chemical manufacturer, importers or distributor as soon as possible.

(7) Distributors shall ensure that Material Safety Data Sheets, and updated information, are provided to other distributors and employers. Retail distributors that sell hazardous chemicals to commercial customers shall provide a Material Safety Data Sheet to such employers upon request, and shall post a sign or

otherwise inform them that a Material Safety Data Sheet is available. Chemical manufacturers, importers, and distributors need not provide Material Safety Data Sheets to retail distributors that have informed them that the retail distributors do not sell the product to commercial customers or open the sealed container to use it in their own workplaces.

(8) The employer shall maintain copies of the required Material Safety Data Sheets for each hazardous chemical in the workplace, and shall ensure that they are readily accessible during each work shift to employees when they are in their work area(s).

(9) Where employees must travel between work-places during a work-shift, i.e., their work is carried out at more than one geographical location, the Material Safety Data Sheets may be kept at a central location at the primary workplace facility. In this situation, the employer shall ensure that employees can immediately obtain the required information in an emergency.

(10) Material Safety Data Sheets shall also be made readily available, upon request, to designated representatives and to the Assistant Secretary, in accordance with the requirements of 29 CFR 1910.20 (e). The Director shall also be given access to Material Safety Data Sheets in the same manner.

(h) *Employee information and training.* Employers shall provide employees with information and training on hazardous chemicals in their work area at the time of their initial assignment, and whenever a new hazard is introduced into their work area.

(1) *Information.* Employees shall be informed of:

(i) The requirements of this section;

(ii) Any operations in their work areas where hazardous chemicals are present; and

(iii) The location and availability of the written Hazard Communication Program, including the required list(s) of hazardous chemicals and material safety data sheets required by this section.

(2) *Training.* Employee training shall include at least:

(i) Methods and observations that may be used to detect the presence or release of a hazardous chemical in the work area (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);

(ii) The physical and health hazards of the chemicals in the work area;

(iii) The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used; and,

(iv) The details of the Hazard Communication Program developed by the em-

ployer, including an explanation of the labeling system and the Material Safety Data Sheet, and how employees can obtain and use the appropriate hazard information.

(i) *Trade secrets.* (1) The chemical manufacturer, importer, or employer may withhold the specific chemical identity, including the chemical name and other specific identification of a hazardous chemical, from the Material Safety Data Sheet, provided that:

(i) The claim that the information withheld is a trade secret can be supported;

(ii) Information contained in the Material Safety Data Sheet concerning the properties and effects of the hazardous chemical is disclosed;

(iii) The Material Safety Data Sheet indicates that the specific chemical identity is being withheld as a trade secret; and,

(iv) The specific chemical identity is made available to health professionals, employees, and designated representatives in accordance with the applicable provisions of this paragraph.

(2) Where a treating physician or nurse determines that a medical emergency exists and the specific chemical identity of a hazardous chemical is necessary for emergency or first-aid treatment, the chemical manufacturer, importer, or employer shall immediately disclose the specific chemical identity of a trade secret chemical to that treating physician or nurse, regardless of the existence of a written statement of need of a confidentiality agreement. The chemical manufacturer, importer, or employer may require a written statement of need and confidentiality agreement, in accordance with the provisions of paragraphs (i)(3) and (4) of this section, as soon as circumstances permit.

(3) In nonemergency situations, a chemical manufacturer, importer, or employer shall, upon request, disclose a specific chemical identity, otherwise permitted to be withheld under paragraph (i)(1) of this section, to a health professional (i.e., physician, industrial hygienist, toxicologist, epidemiologist, or occupational health nurse) providing medical or other occupational health services to exposed employee(s) or designated representatives, if:

(i) The request is in writing;

(ii) The request describes with reasonable detail one or more of the following occupational health needs for the information:

(A) To assess the hazards of the chemicals to which employees will be exposed;

(B) To conduct or assess sampling of the workplace atmosphere to determine employee exposure levels;

(C) To conduct pre-assignment or periodic medical surveillance of exposed employees;

(D) To provide medical treatment to exposed employees;

(E) To select or assess appropriate personal protective equipment for exposed employees;

(F) To design or assess engineering controls or other protective measures for exposed employees; and

(G) To conduct studies to determine the health effects of exposure.

(iii) The request explains in detail why the disclosure of the specific chemical identity is essential and that, in lieu thereof, the health professional, employee, or designated representative, would not satisfy the purposes described in paragraph (i)(3)(ii) of this section:

(A) The properties and effects of the chemical;

(B) Measures for controlling workers' exposure to the chemical;

(C) Methods of monitoring and analyzing worker exposure to the chemical; and

(D) Methods of diagnosing and treating harmful exposures to the chemical;

(iv) The request includes a description of the procedures to be used to maintain the confidentiality of the disclosed information; and

(v) The health professional, and the employer or contractor of the services of the health professional (i.e., downstream employer, labor organization, or individual employee), employee, or designated representative, agree in a written confidentiality agreement that the health professional, employee, or designated representative, will not use the trade secret information for any purpose other than the health need(s) asserted and agree not to release the information under any circumstances other than to OSHA, as provided in paragraph (i)(6) of this section, except as authorized by the terms of the agreement or by the chemical manufacturer, importer, or employer.

(4) The confidentiality agreement authorized by paragraph (i)(3)(iv) of this section:

(i) May restrict the use of the information to the health purposes indicated in the written statement of need;

(ii) May provide for appropriate legal remedies in the event of a breach of the agreement, including stipulation of a reasonable pre-estimate of likely damages; and

(iii) May not include requirements for the posting of a penalty bond.

(5) Nothing in this standard is meant to preclude the parties from pursuing non-contractual remedies to the extent permitted by law.

(6) If the health professional, employee, or designated representative receiving the trade secret information decides that there is a need to disclose it to OSHA, the chemical manufacturer, importer, or employer who provided the information shall be informed by the health professional, employee, or designated representative prior to, or at the same time as, such disclosure.

(7) If the chemical manufacturer, importer, or employer denies a written request for disclosure of a specific chemical identity, the denial must:

(i) Be provided to the health professional, employee, or designated representative, within thirty days of the request;

(ii) Be in writing;

(iii) Include evidence to support the claim that the specific chemical identity is a trade secret;

(iv) State the specific reasons why the request is being denied; and

(v) Explain in detail how alternative information may satisfy the specific medical or occupational health need without revealing the specific chemical identity.

(8) The health professional, employee, or designated representative whose request for information is denied under paragraph (i)(3) of this section may refer the request and the written denial of the request to OSHA for consideration.

(9) When a health professional, employee, or designated representative refers the denial to OSHA under paragraph (i)(8) of this section, OSHA shall consider the evidence to determine if:

(i) The chemical manufacturer, importer, or employer has supported the claim that the specific chemical identity is a trade secret;

(ii) The health professional, employee, or designated representative has supported the claim that there is a medical or occupational health need for the information; and

(iii) The health professional, employee, or designated representative has demonstrated adequate means to protect the confidentiality.

(10)(i) If OSHA determines that the specific chemical identity requested under paragraph (i)(3) of this section is not a *bona fide* trade secret, or that it is a trade secret, but the requesting health professional, employee, or designated representative has a legitimate medical or occupational health need for the information, has executed a written confidentiality agreement, and has shown adequate means to protect the confidentiality of the information, the chemical manufacturer, importer, or employer will be subject to citation by OSHA.

(ii) If a chemical manufacturer, importer or employer demonstrates to OSHA that the execution of a confidentiality agreement would not provide sufficient protection against the potential harm from the unauthorized disclosure of a trade secret specific chemical identity, the Assistant Secretary may issue such orders or impose such additional limitations or conditions upon the disclosure of the requested information as may be appropriate to ensure that the occupational health services are provided without an undue risk of harm to the chemical manufacturer, importer, or employer.

(11) If a citation for a failure to release specific chemical identity information is contested by the chemical manufacturer, importer, or employer, the matter will be adjudicated before the Occupational Safety and Health Review Commission in accordance with the Act's enforcement scheme and the applicable Commission rules of procedure. In accordance with the Commission rules, when a chemical manufacturer, importer, or employer continues to withhold the information during the contest, the Administrative Law Judge may review the citation and supporting documentation *in camera* or

issue appropriate orders to protect the confidentiality of such matters.

(12) Notwithstanding the existence of a trade secret claim, a chemical manufacturer, importer, or employer shall, upon request, disclose to the Assistant Secretary any information that this section requires the chemical manufacturer, importer, or employer to make available. Where there is a trade secret claim, such claim shall be made no later than at the time the information is provided to the Assistant Secretary so that suitable determinations of trade secret status can be made and the necessary protections can be implemented.

(13) Nothing in this paragraph shall be construed as requiring the disclosure under any circumstances of process or percentage of mixture information which is a trade secret.

(j) *Effective dates*. (1) Chemical manufacturers, importers, and distributors shall ensure that material safety data sheets are provided with the next shipment of hazardous chemicals to employers after September 23, 1987.

(2) Employers in the nonmanufacturing sector shall be in compliance with all provisions of this section by May 23, 1988. (Note: Employers in the manufacturing sector, (SIC Codes 20 through 39) are already required to be in compliance with this section.)

APPENDIX A TO §1910.1200—HEALTH HAZARD DEFINITIONS (MANDATORY)

Although safety hazards related to the physical characteristics of a chemical can be objectively defined in terms of testing requirements (e.g., flammability), health hazard definitions are less precise and more subjective. Health hazards may cause measurable changes in the body—such as decreased pulmonary function. These changes are generally indicated by the occurrence of signs and symptoms in the exposed employees—such as shortness of breath; a nonmeasurable, subjective feeling. Employees exposed to such hazards must be apprised of both the change in body function and the signs and symptoms that may occur to signal that change.

The determination of occupational health hazards is complicated by the fact that many of the effects or signs and symptoms occur commonly in nonoccupationally exposed populations, so that effects of exposure are difficult to separate from normally occurring illnesses. Occasionally, a substance causes an effect that is rarely seen in the population at large, such as angiosarcomas caused by vinyl chloride exposure, thus making it easier to ascertain that the occupational exposure was the primary causative factor. More often, however, the effects are common, such as lung cancer. The situation is further complicated by the fact that most chemicals have not been adequately tested to determine their health hazard potential, and data does not exist to substantiate these effects.

There have been many attempts to categorize effects and to define them in various ways. Generally, the terms "acute" and "chronic" are used to delineate between effects on the basis of severity or duration. "Acute" effects usually occur rapidly as a result of short-term exposures and are of short-term duration. "Chronic" effects generally occur as a re-

sult of long-term exposure, and are of long duration.

The acute effects referred to most frequently are those defined by the American National Standards Institute (ANSI) standard for Precautionary Labeling of Hazardous Industrial Chemicals (Z129 1.1982)—irritation, corrosivity, sensitization, and lethal dose. Although these are important health effects, they do not adequately cover the considerable range of acute effects that may occur as a result of occupational exposure, such as, for example, narcosis.

Similarly, the term chronic effect is often used to cover only carcinogenicity, teratogenicity, and mutagenicity. These effects are obviously a concern in the workplace, but again, do not adequately cover the area of chronic effects, excluding, for example, blood dyscrasias (such as anemia), chronic bronchitis and liver atrophy.

The goal of defining precisely, in measurable terms, every possible health effect that may occur in the workplace as a result of chemical exposures cannot realistically be accomplished. This does not negate the need for employees to be informed of such effects and protected from them. Appendix B, which is also mandatory, outlines the principles and procedures of hazardous assessment.

For purposes of this section, any chemicals that meet any of the following definitions, as determined by the criteria set forth in Appendix B, are health hazards:

1. *Carcinogen:* A chemical is considered to be a carcinogen if:

(a) It has been evaluated by the International Agency for Research on Cancer (IARC), and found to be a carcinogen or potential carcinogen;

(b) It is listed as a carcinogen or potential carcinogen in the *Annual Report on Carcinogens*, published by the National Toxicology Program (NTP) (latest edition); or,

(c) It is regulated by OSHA as a carcinogen.

2. *Corrosive:* A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact. For example, a chemical is considered to be corrosive if, when tested on the intact skin of albino rabbits by the method described by the U.S. Department of Transportation in Appendix A to 49 CFR Part 173, it destroys or changes irreversibly the structure of the tissue at the site of contact following an exposure period of four hours. This term shall not refer to action on inanimate surfaces.

3. *Highly toxic:* A chemical falling within any of the following categories:

(a) A chemical that has a median lethal dose (LD_{50}) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each;

(b) A chemical that has a median lethal dose (LD_{50}) of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits

weighing between two and three kilograms each; or

(c) A chemical that has a median lethal concentration (LC_{50}) in air of 200 parts per million by volume or less of gas or vapor, or 2 milligrams per liter or less of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

4. *Irritant:* A chemical, which is not corrosive, but that causes a reversible inflammatory effect on living tissue by chemical action at the site of contact. A chemical is a skin irritant if, when tested on the intact skin of albino rabbits by the methods of 16 CFR 1500.41 for four hours exposure or by other appropriate techniques, it results in an empirical score of five or more. A chemical is an eye irritant if so determined under the procedure listed in 16 CFR 1500.42 or other appropriate techniques.

5. *Sensitizer:* A chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.

6. *Toxic:* A chemical falling within any of the following categories:

(a) A chemical that has a median lethal dose (LD_{50}) of more than 50 milligrams per kilogram but not more than 500 milligrams per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

(b) A chemical that has a median lethal dose (LD_{50}) of more than 50 milligrams per kilogram but not more than 1000 milligrams per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.

(c) A chemical that has a median lethal concentration(LC_{50}) in air of more than 200 parts per million but not more than 2000 parts per million by volume of gas or vapor or more than two milligrams per liter but not more than 20 milligrams per liter of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

7. *Target organ effects:* The following is a target organ categorization of effects that may occur, including examples of signs and symptoms and chemicals that have been found to cause such effects. These examples are presented to illustrate the range and diversity of effects and hazards found in the workplace, and the broad scope employers must consider in this area, but are not intended to be all-inclusive.

a. Hepatoxins: Chemicals that produce liver damage
Signs & Symptoms: Jaundice; liver enlargement
Chemicals: Carbon tetrachloride; nitrosamines

b. Nephrotoxins: Chemicals that produce kidney damage
Signs & Symptoms: Edema; proteinuria
Chemicals: Halogenated hydrocarbons; Uranium

c. Neurotoxins: Chemicals that produce their primary toxic effects on the nervous system

Signs & Symptoms: Narcosis; behavioral changes; decrease in motor functions
Chemicals: Mercury; carbon disulfide

d. Agents that act on the blood or hematopoietic system: Decrease hemoglobin function; deprive the body tissues of oxygen
Signs & Symptoms: Cyanosis; loss of consciousness
Chemicals: Carbon monoxide; cyanides

e. Agents that damage the lung: Chemicals that irritate or damage the pulmonary tissue
Signs & Symptoms: Cough; Tightness in chest; shortness of breath
Chemicals: Silica; asbestos

f. Reproductive toxins: Chemicals that affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis)
Signs & symptoms: Birth defects; sterility
Chemicals: Lead; DBCP

g. Cutaneous hazards: Chemicals that affect the dermal layer of the body
Signs & Symptoms: Defatting of the skin; rashes; irritation
Chemicals: Ketones; Chlorinated compounds

h. Eye hazards: Chemicals that affect the eye or visual capacity
Signs & Symptoms: Conjunctivitis; corneal damage
Chemicals: Organic solvents; acids

APPENDIX B TO §1910.1200—HAZARD DETERMINATION (MANDATORY)

The quality of a Hazard Communication Program is largely dependent upon the adequacy and accuracy of the hazard determination. The hazard determination requirement of this standard is performance oriented. Chemical manufacturers, importers, and employers evaluating chemicals are not required to follow any specific methods for determining hazards, but they must be able to demonstrate that they have adequately ascertained the hazards of the chemicals produced or imported in accordance with the criteria set forth in this Appendix.

Hazard evaluation is a process that relies heavily on the professional judgment of the evaluator, particularly in the area of chronic hazards. The performance orientation of the hazard determination does not diminish the duty of the chemical manufacturer, importer, or employer to conduct a thorough evaluation examining all relevant data and producing a scientifically defensible evaluation. For purposes of this standard, the following criteria shall be used in making hazard determinations that meet the requirements of this standard.

1. *Carcinogenicity:* As described in paragraph (d)(4) and Appendix A of this section, a determination by the National Toxicology Program, the International Agency for Research on Cancer, or OSHA that a chemical is a carcinogen or potential carcinogen will be considered conclusive evidence for purposes of this section.

2. *Human data:* Where available, epidemiological studies and case reports of adverse health effects shall be considered in the evaluation.

3. *Animal data:* Human evidence of health effects in exposed populations is

generally not available for the majority of chemicals produced or used in the workplace. Therefore, the available results of toxicological testing in animal populations shall be used to predict the health effects that may be experienced by exposed workers. In particular, the definitions of certain acute hazards refer to specific animal testing results (see Appendix A).

4. *Adequacy and reporting of data:* The results of any studies that are designed and conducted according to established scientific principles, and that report statistically significant conclusions regarding the health effects of a chemical, shall be a sufficient basis for a hazard determination and reported on any material safety data sheet. The chemical manufacturer, importer, or employer may also report the results of other scientifically valid studies, which tend to refute the findings of hazard.

APPENDIX C TO §1910.1200—INFORMATION SOURCES (ADVISORY)

The following is a list of available data sources, which the chemical manufacturer, importer, distributor, or employer may wish to consult to evaluate the hazards of chemicals they produce or import:

• Any information in their own company files, such as toxicity testing results or illness experience of company employees.

• Any information obtained from the supplier if the chemical, such as material safety data sheets or product safety bulletins.

• Any pertinent information obtained from the following source list (latest editions should be used):

Condensed Chemical Dictionary Van Nostrand Reinhold Co., 135 West 50th Street, New York, NY 10020.

The Merck Index: An Encyclopedia of Chemicals and Drugs Merck and Company, Inc. 126 E. Lincoln Ave., Rahway, NJ 07065

IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man: Geneva: World Health Organization, International Agency for Research on Cancer, 1972—Present (Multivolume work). Summaries are available in supplement volumes, 49 Sheridan Street, Albany, NY 12210.

Industrial Hygiene and Toxicology, by F.A. Patty, John Wiley & Sons., Inc., New York, NY 10518 (multivolume work).

Clinical Toxicology of Commercial Products, Gleason, Gosselin, and Hodge.

Casarett and Doull's Toxicology: The Basic Science of Poisons Doull, Klaassen, and Amdur, Macmillian Publishing Co., Inc., New York, NY.

*Industrial Toxicology,*by Alice Hamilton and Harriet L. Hardy Publishing Sciences Group, Inc., Acton, MA.

Toxicology of the Eye, by W. Morton Grant, Charles C. Thomas, 310-327 East Lawrence Ave., Springfield, IL.

Recognition of Health Hazards in Industry William A Burgess, John Wiley & Sons, 605 Third Avenue, New York, NY 10158.

Chemical Hazards of the Workplace Nick H. Proctor and James P. Hughes, JP Lip-

incott Company, 6 Winchester Terrace, New York, NY 10022.

Handbook of Chemistry and Physics, Chemical Rubber Company, 18901 Cranwood Parkway, Cleveland, OH 44128.

Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment and Biological Exposure Indices with Intended Changes American Conference of Governmental Industrial Hygienists (ACGIH), 6500 Glenway Avenue., B. D-5, Cincinnati, OH 45211. Information on the physical hazards of chemicals may be found in publications of the National Fire Protection Association, Boston, MA.

NOTE: The following documents may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Occupational Health Guidelines NIOSH/OSHA (NIOSH Pub. No. 81-123)

NIOSH Pocket Guide to Chemical Hazards NIOSH Pub. No. 85-114.

Registry of Toxic Effects of Chemical Substances NIOSH Pub. No. 80-102

Miscellaneous Documents Published by the National Institute for Occupational Safety and Health:

Criteria documents.
Special Hazard Reviews.
Occupational Hazard Assessments.
Current Intelligence Bulletins.

OSHA'S General Industry Standards (29 CFR Part 1910)

NTP Annual Report on Carcinogens and Summary of the Annual Report on Carcinogens. National Technical information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161; (703) 487-4650.

BIBLIOGRAPHIC DATA BASES

Service provider: Bibliographic Retrieval Services (BRS),1200 Route 7, Lantham, NY 12110
File name:
- CA Search
- Mediars
- NTIS
- Hazardline
- American Chemical Society Journal
- Exerpta Medica
- IRCS Medical Science Journal
- Pre-Med
- Int'l, Pharmaceutical Abstracts
- Paper Chem

Service provider: Lockheed-DIALOG Information Service, Inc., 3460 Hillview Avenue, Palo Alto, CA 94304
File name:
- Biosis Prev Files
- CA Search Files
- CAB Abstracts
- Chemical Exposure
- Chem-name
- Chem-sis Files
- Chem-zero
- Embase Files
- Environmental Bibliographies
- Enviroline
- Federal Research in Progress
- IRL Life Science Collection
- NTIS
- Occupational Safety and Health (NIOSH)
- Paper Chem

Service provider: SDC-Orbit, SDC Information Service, 2500 Colorado Avenue, Santa Monica, CA 90406
File name:
CAS Files
Chemdex, 2.3
NTIS

Service provider: National Library of Medicine, Department of Health and Human Services, Public Health Service, National Institute of Health, Bethesda, MD 20209
File name:
Hazardous Substances Data Bank (HSDB)
Medline Files
Toxline Files
Cancerlit
RTECS
Chemline

Service provider: Pergamon International Corp., 1340 Old Chain Bridge Rd. Mclean, VA 22101
File name:
Laboratory Hazard Bulletin

Service provider: Questel, Inc., 1625 Eye Street, NW., Suite 818, Washington, DC 20006
File name:
CIS/ILO
Cancernet

Service provider: Chemical Information System ICI (ICIS), Bureau of National Affairs, 1133 15th Street, NW, Suite 300, Washington, DC 20005
File name:
Structure and Nomenclature Search System(SANSS)
Acute Toxicology (RTECS)
Clinical Toxicology of Commercial Products
Oil and Hazardous Materials Technical Assistance Data System
CCRIS
Cesars

Service provider: Occupational Health Services, 400 Plaza Drive, Secaucus, NJ 07094
File name:
MSDS
Hazardline

APPENDIX D TO §1910.1200—DEFINITION OF "TRADE SECRET" (MANDATORY)

The following is a reprint of the *Restatement of Torts* section 757, comment *b* (1939):

b. *Definition of a trade secret.* A trade secret may consist of any formula, pattern, device, or compilation of information that is used in one's business, and that gives him/her an opportunity to obtain an advantage over competitors who do not know or use it. It may be a formula for a chemical compound, a process of manufacturing, treating or preserving materials, a pattern for a machine or other device, or a list of customers. It differs from other secret information in a business (see §759 of the *Restatement of Torts*, which is not included in this Appendix) in that it is not simply information as to single or ephemeral events in the conduct of the business, as, for example, the amount or other terms of a secret bid for a contract or the salary of certain employees, or the security investments made or contemplated, or the date fixed for the announcement of a new policy or for bringing out a new model or the like. A trade secret is a process or device for continuous use in the operations of the

business. Generally, it relates to the production of an article. It may, however relate to the sale of goods or to other operations in the business, such as a code for determining discounts, rebates, or other concessions in a price list or catalogue, or a list of specialized customers, or a method of bookkeeping or other office management.

Secrecy. The subject matter of a trade secret must be secret. Matters of public knowledge or of general knowledge in an industry cannot be appropriated as his/her secret. Matters that are completely disclosed by the goods that one markets cannot be his/her secret. Substantially, a trade secret is known only in the particular business in which it is used. It is not requisite that only the proprietor of the business know it. He/she may, without losing his/her protection, communicate it to employees involved in its use. He/she may likewise communicate it to others pledged to secrecy. Others may also know of it independently as, for example, when they have discovered the process or formula by independent invention and are keeping it secret. Nevertheless, a substantial element of secrecy must exist, so that, except by the use of improper means, there would be difficulty in acquiring the information. An exact definition of a trade secret is not possible. Some factors to be considered in determining whether given information is known is one's trade secret are: (1) The extent to which the information is known outside of his/her business; (2) the extent to which it is known by employees and others involved in his/her business; (3) the extent of measures taken by him/her to guard the secrecy of the information; (4) the value of the information to him/her and his/her competitors; (5) the amount of effort or money expended by him/her in developing the information; (6) the ease or difficulty with which the information could be properly acquired or duplicated by others.

Novelty and prior art. A trade secret may be a device or process which is patentable, but it need not be that. It may be a device or process, which is clearly anticipated in the prior art, or one that is merely a mechanical improvement that a good mechanic can make. Novelty and invention are not requisite for a trade secret as they are for patentability. These requirements are essential to patentability because a patent protects against unlicensed use of the patented device or process even by one who discovers it properly through independent research. The patent monopoly is a reward to the inventor. But such is not the case with a trade secret. Its protection is not based on a policy of rewarding or otherwise encouraging the development of secret processes or devices. The protection is merely against breach of faith and reprehensible means of learning another's secret. For this limited protection it is not appropriate to require also the kind of novelty and invention that is a requisite of patentability. The nature of the secret is, however, an important factor in determining the kind of relief that is appropriate against one who is subject to liability under the rule stated in this section. Thus, if the secret consists of a device or process that is a novel invention, one who acquires the secret wrongfully is ordinarily enjoined from further use of it and is required to account for the profits derived from his/her past use. If, on the other hand, the secret consists

of mechanical improvements that a good mechanic can make without resort to the secret, the wrongdoer's facility may be limited to damages, and an injunction against future use of the improvements made with the aid of the secret may be inappropriate.

(52 FR 31877, Aug. 24, 1987, as amended at 52 FR 46080, Dec. 4, 1987; 53 FR 15035, Apr. 27, 1988)

(Approved by the Office of Management and Budget under Control No. 1218-0072)

Reference F

MSDS
ACRONYMS/COMMON TERMS

The following glossary presents brief explanations of acronyms and common terms frequently used by chemical manufacturers in their MSDS forms.

ACGIH American Conference of Governmental Industrial Hygienists is an organization of professional personnel in governmental agencies or educational institutions engaged in occupational safety and health programs. ACGIH establishes recommended occupational exposure limits for chemical substances and physical agents. See **TLV**.

Acid Any chemical that undergoes dissociation in water with the formation of hydrogen ions. Acids have a sour taste and may cause severe skin burns. Acids turn litmus paper red and have pH values of 0 to 6.

Acute Effect Adverse effects on a human or animal that has severe symptoms developing rapidly and coming quickly to a crisis.

Acute Toxicity Acute effects resulting from a single dose of, or exposure to, a substance. Ordinarily used to denote effects in experimental animals.

Adenocarcinoma A tumor with glandular (secreting) elements.

Adenosis Any disease of a gland.

Adhesion A union of two surfaces that are normally separate.

Aerosol A fine aerial suspension of particles sufficiently small in size to confer some degree of stability from sedimentation (e.g., smoke or fog).

Air-Line Respirator A respirator that is connected to a compressed, breathable air source by a hose of small inside diameter. The air is delivered continuously or intermittently in a sufficient volume to meet the wearer's breathing requirements.

Air-Purifying Respirator A respirator that uses chemicals to remove specific gases and vapors from the air or that uses a mechanical filter to remove particulate matter. An air-purifying respirator must only be used when there is sufficient oxy-

gen to sustain life and the air contaminant level is below concentration limits of the device.

Alkali Any chemical substance that forms soluble soaps with fatty acids. Alkalis are also referred to as bases. They may cause severe burns to the skin. Alkalis turn litmus paper blue and have pH values from 8 to 14.

Allergic Reaction An abnormal, physiological response to chemical or physical stimuli.

Amenorrhea Absence of menstruation.

Anesthetic A chemical that causes a total or partial loss of sensation. Overexposure to anesthetics can cause impaired judgment, dizziness, drowsiness, headache, unconsciousness, and even death. Examples include alcohol, paint remover, and degreasers.

ANSI American National Standards Institute is a privately funded, voluntary membership organization that identifies industrial and public needs for national consensus standards and coordinates development of such standards.

Antidote A remedy to relieve, prevent, or counteract the effects of a poison.

API American Petroleum Institute is an organization of the petroleum industry.

Appearance A description of a substance at normal room temperature and normal atmospheric conditions. Appearance includes the color, size, and consistency of a material.

Aquatic Toxicity The adverse effects to marine life that result from being exposed to a toxic substance.

Asphyxiant A vapor or gas that can cause unconsciousness or death by suffocation (lack of oxygen). Most simple asphyxiants are harmful to the body only when they become so concentrated that they reduce oxygen in the air (normally about 21 percent) to dangerous levels (18 percent or lower). Asphyxiation is one of the principle potential hazards of working in confined and enclosed spaces.

ASTM American Society for Testing and Materials is the world's largest source of voluntary consensus standards for materials, products, systems, and services. ASTM is a resource for sampling and testing methods, health and safety aspects of materials, safe performance guidelines, effects of physical and biological agents and chemicals.

Asymptomatic Showing no symptoms.

ATM Atmosphere, a unit or pressure equal to 760 mmHG (mercury) at sea level.

Atmosphere-Supplying Respirator A respirator that provides breathable air from a source independent of the surrounding atmosphere. There are two types: air-line and self-contained breathing apparatus.

Auto-ignition Temperature The temperature to which a closed, or nearly closed, container must be heated in order that the flammable liquid, when introduced into the container, will ignite spontaneously or burn.

BAL British Anti-Lewisite—A name for the drug dimercaprol—a treatment for toxic inhalations.

Base A substance that (1) liberates hydroxide (OH) ions when dissolved in water, (2) receives hydrogen ions from a strong acid to form a weaker acid, and (3) neutralizes an acid. Bases react with acids to form salts and water. Bases have a pH greater than 7 and turn litmus paper blue. See **Alkali.**

BCM Blood-clotting mechanism effects.

Benign Not recurrent or not tending to progress. Not cancerous.

Biodegradable Capable of being broken down into innocuous products by the action of living things.

Biopsy Removal and examination of tissue from the living body.

BLD Blood effects.

Boiling Points—BP The temperature at which a liquid changes to a vapor state at a given pressure. The boiling point usually expressed in degrees Fahrenheit at sea level pressure (760 mmHG, or one atmosphere). For mixtures, the initial boiling point or the boiling range may be given.

Flammable materials with low boiling points generally present special fire hazards. Some approximate boiling points:

_____ Propane	–44 degrees F
Anhydrous Ammonia	–28 degreesF
Butane	31 degrees F
Gasoline	100 degrees F
Allyl Chloride	113 degrees F
Ethylene Glycol	387 degrees F

BOM, or BUMINES Bureau of Mines, U.S. Department of Interior.

Bonding The interconnecting of two objects by means of a clamp and bare wire. Its purpose is to equalize the electrical potential between the objects to prevent a static discharge when transferring a flammable liquid from one container to another. The conductive path is provided by clamps that make contact with the charged object and a low resistance flexible cable, which allows the charge to equalize. See **Grounding**.

Bulk Density Mass of powdered or granulated solid material per unit of volume.

C Centigrade, a unit of temperature.

ca Approximately.

CAA Clean Air Act was enacted to regulate/reduce air pollution. CAA is administered by U.S. Environmental Protection Agency.

Carcinogen A substance or agent capable of causing or producing cancer in mammals, including humans. A chemical is considered to be a carcinogen if:

(a) It has been evaluated by the International Agency for Research on Cancer (IARC) and found to be a carcinogen or potential carcinogen; or

(b) It is listed as a carcinogen or potential carcinogen in the **Annual Report on Carcinogens** published by the National Toxicology Program(NTP)(latest edition); or

(c) It is regulated by OSHA as a carcinogen.

Carcinogenicity The ability to produce cancer.

Carcinoma A malignant tumor. A form of cancer.

CAS Chemical Abstracts Service is an organization under the American Chemical Society. CAS abstracts and indexes chemical literature from all over the world in "Chemical Abstracts." "CAS Numbers" are used to identify specific chemicals or mixtures.

Caustic See **Alkali**.

cc Cubic centimeter is a volume measurement in the metric system that is equal in capacity to one milliliter (ml). One quart is about 946 cubic centimeters.

Ceiling Limit (PEL or TLV) The maximum allowable human exposure limit for an airborne substance, which is not to be exceeded even momentarily. Also see **PEL** and **TLV**.

Central Nervous System The brain and spinal cord. These organs supervise and coordinate the activity of the entire nervous system. Sensory impulses are transmitted into the central nervous system, and motor impulses are transmitted out.

CERCLA Comprehensive Environmental Response, Compensation, and Liability Act of 1980. The Act requires that the Coast Guard National Response Center be notified in the event of a hazardous substance release. The Act also provides for a fund (the Superfund) to be used for the cleanup of abandoned hazardous waste disposal sites.

CFR Code of Federal Regulations. A collection of the regulations that have been promulgated under United States Law.

Chemical An element (e.g., chlorine) or a compound (e.g., sodium bicarbonate) produced by chemical reaction.

Chemical Cartridge Respirator A respirator that uses various chemical substances to purify inhaled air of certain gases and vapors. This type of respirator is effective for concentrations no more than ten times the TLV of the contaminate, if the contaminate has warning properties (odor or irritation) below the TLV.

Chemical Family A group of single elements or compounds with a common general name. Example: acetone, methyl ethyl ketone (MEK), and methyl isobutyl ketone (MIBK) are of the "Ketone" family; acrolein, furfural, and acetaldehyde are of the "aldehyde" family.

Chemical Name The name given to a chemical in the nomenclature system developed by the International Union of Pure and Applied Service (CAS). The scientific designation of a chemical or a name that will clearly identify the chemical for hazard evaluation purposes.

Chemical Pneumonitis Inflammation of the lungs caused by accumulation of fluids due to chemical irritation.

CHEMTREC Chemical Transportation Emergency Center is a national center established by the Chemical Manufacturers Association (CMA) to relay pertinent emergency information concerning specific chemicals on requests from individuals. CHEMTREC has a 24-hour,

toll-free telephone number (800-424-9300) to help respond to chemical transportation emergencies.

Chronic Effect An adverse effect on a human or animal body, with symptoms that develop slowly over a long period of time or that recur frequently. Also see **Acute Effect**.

Chronic Exposure Long-term contact with a substance.

Chronic Toxicity Adverse (chronic) effects resulting from repeated doses of or exposures to a substance over relatively prolonged period of time. Ordinarily used to denote effects in experimental animals.

Clean Air Act See **CAA**.

Clean Water Act Federal law enacted to regulate/reduce water pollution. CWA is administered by EPA.

CMA Chemical Manufacturers Association. See **CHEMTREC**.

CO Carbon monoxide is a colorless, odorless, flammable, and very toxic gas produced by the incomplete combustion of carbon. It is also a byproduct of many chemical processes. A chemical asphyxiant, it reduces the blood's ability to carry oxygen. Hemoglobin absorbs CO two hundred times more readily than it does oxygen.

CO_2 Carbon dioxide is a heavy, colorless gas that is produced by the combustion and decomposition of organic substances and is a byproduct of many chemical processes. CO_2 will not burn and is relatively nontoxic (although high concentrations, especially in confined spaces, can create hazardous oxygen-deficient environments).

COC Cleveland Open Cup is a flash point test method.

Combustible A term used by NFPA, DOT, and others to classify certain liquids that will burn, on the basis of flash points. Both NFPA and DOT generally define "combustible liquids" as having a flash point of 100°F (37.8°C) or higher but below 200°F (93.3°C). Also see **Flammable**. Nonliquid substances such as wood and paper are classified as "ordinary combustibles" by NFPA.

Combustible Liquid Any liquid having a flash-point at or above 100°F (37.8°C), but below 200°F (93.3°C), except any mixture having components with flash-points of 200°F (93.3°C) or higher, the total volume of which makes up 99 percent or more of the total volume of the mixture.

Common Name Any means used to identify a chemical other than its chemical name (e.g., code name, code number, trade name, brand name, or generic name). See **Generic Name**.

Compressed Gas:

(a) A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 pounds per square inch (psi) at 70°F(21.1°C);

(b) A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130°F (54.4°C), regardless of the pressure at 70°F (21.1°C); or

(c) A liquid having a vapor pressure exceeding 40 psi at 100°F (37.8°C) as determined by ASTM D-323-72.

Conc See **Concentration**.

Concentration The relative amount of a substance when combined or mixed with other substances. Examples: 2 ppm hydrogen sulfide in air, or a 50 percent caustic solution.

Conditions to Avoid Conditions encountered during handling or storage that could cause a substance to become unstable.

Confined Space Any area that has limited openings for entry and exit that would make escape difficult in an emergency, has a lack of ventilation, contains known and potential hazards, and is not intended nor designated for continuous human occupancy.

Conjunctivitis Inflammation of the conjunctiva, the delicate membrane that lines the eyelids and covers the eyeballs.

Containers Any bag, barrel, bottle, box, can, cylinder, drum, reaction vessel, storage tank, or the like that contains a hazardous chemical. For purposes of MSDS or HCS, pipes or piping systems are not considered to be containers.

Corrosive A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact. For example, a chemical is considered to be corrosive if, when tested on the intact skin of albino rabbits by the method described by the DOT in Appendix A to 49 CFR Part 173, it destroys or changes irreversibly the structure of the tissue at the site of contact following an exposure period of 4 hours. This term shall not refer to action on inanimate surfaces.

CPSC Consumer Products Safety Commission has responsibility for regulating hazardous materials when they appear in consumer goods. For CPSC purposes, hazards are defined in the Hazardous Substances Act and the Poison Prevention Packaging Act of 1970.

Curettage Cleansing of a diseased surface.

Cutaneous Toxicity See **Dermal Toxicity**.

CWA Clean Water Act was enacted to regulate/reduce water pollution. It is administered by EPA.

Cyst A sac containing liquid. Most cysts are harmless.

Cytology The scientific study of cells.

Decomposition Breakdown of a material or substance (by heat, chemical reaction, electrolysis, decay, or other processes) into parts or elements or simpler compounds.

Density The mass (weight) per unit volume of a substance. For example, lead is much more dense than aluminum.

Depressant A substance that reduces a bodily functional activity or an instinctive desire, such as appetite.

Dermal Relating to the skin.

Dermal Toxicity Adverse effects resulting from skin exposure to a substance. Ordinarily used to denote effects in experimental animals.

DHHS U.S. Department of Health and Human Services (replaced U.S. Department of Health Education and Welfare). NIOSH and the Public Health Service (PHS) are part of DHHS.

Dike A barrier constructed to control or confine hazardous substances and prevent them from entering sewers, ditches, streams, or other flowing waters.

Dilution Ventilation Air flow designed to dilute contaminants to acceptable levels.

DOL U.S. Department of Labor. OSHA and MSHA are part of DOL.

DOT U.S. Department of Transportation regulates transportation of chemicals and other substances.

Dry Chemical A powdered fire-extinguishing agent usually composed of sodium bicarbonate, potassium bicarbonate, etc.

Dysmenorrhea Painful menstruation.

Dysplasia A sense of difficulty in breathing; shortness of breath.

Ectopic Pregnancy The fertilized ovum becomes implanted outside of the uterus.

Edema An abnormal accumulation of clear, watery fluid in the tissues.

Endocrine Glands Glands that regulate body activity by secreting hormones.

Endometrium The mucous membrane lining the uterus.

Environmental Toxicity Information obtained as a result of conducting environmental testing designed to study the effects on aquatic and plant life.

EPA Environmental Protection Agency.

Epidemiology Science concerned with the study of disease in a general population. Determination of the incidence (rate of occurrence) and distribution of a particular disease (as by age, sex, or occupation), which may provide information about the cause of the disease.

Epithelium The covering of internal and external surfaces of the body.

Estrogen Principal female sex hormone.

Evaporation Rate The rate that a material will vaporize (evaporate) when compared to the known rate of vaporization of a standard material. The evaporation rate can be useful in evaluating the health and fire hazards of a material. The designated standard material is usually normal butyl acetate (NBUAC or n-BuAc), with a vaporization rate designated as 1.0. Vaporization rates of other solvents or materials are then classified as:

- FAST evaporating if greater than 3.0. Examples: Methyl ethyl Ketone = 3.8, Acetone = 5.6, Hexane = 8.3.
- MEDIUM evaporating if 0.8 to 3.0. Examples: 190 proof (95 percent) Ethyl Alcohol = 1.4, VM&P Naphtha = 1.4, MIBK = 1.6.
- SLOW evaporating if less than 0.8. Examples: Xylene = 0.6, Isobutyl Alcohol = 0.6, Normal Butyl Alcohol = 0.4, Water = 0.3, Mineral Spirits = 0.1.

Explosive A chemical that causes a sudden, almost instantaneous, release of pres-

sure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

Exposure or Exposed State of being open and vulnerable to a hazardous chemical by inhalation, ingestion, skin contact, absorption, or any other course; includes potential (accidental or possible) exposure.

Extinguishing Media The firefighting substance to be used to control a material in the event of a fire. It is usually identified by its generic name, such as fog, foam, water, etc.

Eye Protection Recommended safety glasses, chemical splash goggles, face shields, etc. to be utilized when handling a hazardous material.

F Fahrenheit is a scale for measuring temperature. On the Fahrenheit scale, water boils at 212°F and freezes at 32°F.

f/cc Fibers per cubic centimeter of air.

FDA Food and Drug Administration.

Fetal Pertaining to the fetus.

Fetus The developing young in the uterus from the seventh week of gestation until birth.

Fibrosis An abnormal thickening of fibrous connective tissue, usually in the lungs.

FIFRA Federal Insecticide, Fungicide, and Rodenticide Act requires that certain useful poisons, such as chemical pesticides, sold to the public contain labels that carry health hazard warnings to protect users. It is administered by EPA.

First Aid Emergency measures to be taken when a person is suffering from overexposure to a hazardous material, before regular medical help can be obtained.

Flammable A chemical that includes one of the following categories:

> (a) "Aerosol, flammable." An aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame projection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening;
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> (b) "Gas, flammable."(1) A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 percent by volume or less: or (2) A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12 percent by volume, regardless of the lower limit;
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> (c) "Liquid, flammable." Any liquid having a flashpoint below 100°F (37.8°C), except any mixture having components with flashpoints of 100°F (37.8°C) or higher, the total of which make up 99 percent or more of the total volume of mixture.
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> (d) "Solid flammable." A solid, other than a blasting agent or explosive as defined in 1910.109(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so

vigorously and persistently as to create a serious hazard. A solid is a flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

Flashback Occurs when flame from a torch burns back into the tip, the torch, or the hose. It is often accompanied by a hissing or squealing sound with a smoky or sharp-pointed flame.

Flashpoint The minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite when tested by the following methods:

(a) Tagliabue Closed Tester (See American National Standard Method of Test for Flash Point by Tag Closed Tester, Z11.24 1979 [ASTM D56-79]).

(b) Pensky-Martens Closed Tester (See American National Standard Method of Test for Flash Point by Pensky-Martens Closed Tester, Z11.7-1979 [ASTM D93-79]).

(c) Setaflash Closed Tester (See American National Standard Method of Test for Flash Point by Setaflash Closed tester [ASTM D 3278-78]).

Foreseeable Emergency Any potential occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment, which could result in an uncontrolled release of a hazardous chemical into the workplace.

Formula The scientific expression of the chemical composition of a material (e.g., water is H_2O, sulfuric acid is H_2SO_4, sulfur dioxide is SO_2).

Fume A solid condensation particle of extremely small diameter, commonly generated from molten metal as metal fume.

g Gram is a metric unit of weight. One ounce U.S. (avoirdupois) is about 28.4 grams.

General Exhaust A system for exhausting air containing contaminants from a general work area. Also see **Local Exhaust**.

Generic Name A designation or identification used to identify a chemical by other than its chemical name (e.g., code name, code number, trade name, and brand name).

Genetic Pertaining to or carried by genes. Hereditary.

Gestation The development of the fetus in the uterus from conception to birth; pregnancy.

g/kg Grams per kilogram is an expression of dose used in oral and dermal toxicology testing to denote grams of a substance dosed per kilogram of animal body weight. Also see **kg** (kilogram).

Grounding The procedure used to carry an electrical charge to ground through a conductive path. A typical ground may be connected directly to a conductive water pipe or to a grounding bus and ground rod. See **Bonding**.

Gynecology The study of the reproductive organs in women.

Hand Protection Specific type of gloves or other hand protection required to prevent harmful exposure to hazardous materials.

Hazardous Chemical Any chemical whose presence or use is a physical hazard or a health hazard.

Hazardous Warning Words, pictures, symbols, or combination thereof presented on a label or other appropriate form to inform of the presence of various materials.

HCS Hazard Communication Standard is an OSHA regulation issued under CFR Part 1910.1200.

Health Hazard A chemical for which there is significant evidence, based on at least one study conducted in accordance with established scientific principles, that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals that are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatoxins, nephrotoxins, neurotoxins, agents that act on the hematopoietic system, and agents that damage the lungs, skin, eyes, or mucous membranes.

Hemoglobin An iron-containing conjugated protein or respiratory pigment occurring in the red blood cells of vertebrates.

Hematoma A blood clot under the surface of the skin.

Hematopoietic System The blood-forming mechanism of the human body.

Hematuria The presence of blood in the urine.

Hepatoxin A substance that causes injury to the liver.

Highly Toxic A chemical in any of the following categories:

(a) A chemical with a median lethal dose (LD_{50}) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

(b) A chemical with a median lethal dose (LD_{50}) of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between 2 and 3 kilograms each.

(c) A chemical that has a median lethal concentration (LC_{50}) in air of 200 parts per million by volume or less of gas or vapor, or 2 milligrams per liter or less of mist, fume, or dust, when administered by continuous inhalation for 1 hour (or less if death occurs within 1 hour) to albino rats weighing between 200 and 300 grams each.

Hormones Act as chemical messengers to body organs.

Hyperplasia Increase in volume of a tissue or organ caused by the growth of new cells.

IARC International Agency for Research on Cancer.

Ignitable Capable of being set afire.

Impervious A material that does not allow another substance to pass through or penetrate it.

Incompatible Materials that could cause dangerous reactions by direct contact with one another.

Ingestion Taking in by the mouth.

Inhal See **Inhalation**.

Inhalation Breathing in of a substance in the form of a gas, vapor, fume, mist, or dust.

Inhibitor A chemical added to another substance to prevent an unwanted chemical change.

Insol See **Insoluble**.

Insoluble Incapable of being dissolved in a liquid.

Intrauterine Within the uterus.

Irritant A chemical, which is not corrosive, that causes a reversible, inflammatory effect on living tissue by chemical action at the site of contact. A chemical is a skin irritant if, when tested on the intact skin of albino rabbits by the methods of 16 CFR 1500.41 for 4 hours exposure or by other appropriate techniques, it results in an empirical score of 5 or more. A chemical is an eye irritant if so determined under the procedure listed in 16 CFR 1500.42 or other appropriate techniques.

Irritating As defined by DOT, a property of a liquid or solid substance, which, upon contact with fire or when exposed to air, gives off dangerous or intensely irritating fumes (not including poisonous materials). See **Poison, Class A** and **Poison, Class B**.

kg Kilogram is a metric unit of weight about 2.2 U.S. pounds. Also see **g/kg** and **mg**.

L Liter is a metric unit of capacity. A U.S. quart is about 9/10 of a liter.

Label Notice attached to a container, bearing information concerning its contents.

Lacrimation Secretion and discharge of tears.

Lactation The secretion of milk by the breasts.

LC Lethal concentration is the concentration of a gas or vapor capable of killing a specified species over a specified time.

LC_{50} The concentration of a material in air that will kill 50 percent of a group of test animals with a single exposure (usually 1 to 4 hours). The LC_{50} is expressed as parts of material per million parts of air, by volume (ppm) for gases and vapors, or as micrograms of material per liter of air (g/l) pr milligrams of material per cubic meter of air (mg/m^3) for dusts and mists, as well as for gases and vapors.

LD Lethal dose is the quantity of a substance being tested that will kill.

LDL Lethal dose low, lowest administered dose of a material capable of killing a specified test species.

LD_{50} A single dose of a material expected to kill 50 percent of a group of test animals. The LD_{50} dose is usually expressed as milligrams or grams of material per kilogram of animal body weight (mg/kg or g/kg). The material may be administered by mouth or applied to the skin.

LEL, or LFL Lower explosive limit, or lower flammable limit, of a vapor or gas: the lowest concentration (lowest percentage of the substance in air) that will produce a flash of fire when an ignition source (heat, arc, or flame) is present. At concentrations lower than the LEL, the mixture is too "lean" to burn. Also see **UEL**.

Lesion Any damage to a tissue.

LFM Linear feet per minute, a unit of air velocity.

Local Exhaust A system for capturing and exhausting contaminants from the air at the point where the contaminants are produced (welding, grinding, sanding, other processes or operations). Also see **General Exhaust**.

M See **Meter**.

m^3 Cubic meter is a metric measure of volume, approximately 35.3 cubic feet or 1.3 cubic yards.

Malaise A feeling of general discomfort, distress, or uneasiness, an out-of-sorts feeling.

Malignant Tending to become progressively worse and to result in death.

Mammary Pertaining to the breast.

Mechanical Exhaust A powered device, such as a motor-driven fan or air stream venturi tube, for exhausting contaminants from a workplace, vessel, or enclosure.

Mechanical Filter Respirator A respirator used to protect against airborne particulate matter like dusts, mists, metal fume, and smoke. Mechanical filter respirators do not provide protection against gases, vapors, or oxygen deficient atmospheres.

Melting Point The temperature at which a solid substance changes to a liquid state.

Menorrhagia Excessive menstruation.

Menstruation Periodic discharge of blood from the vagina of a nonpregnant uterus.

Metabolism Physical and chemical processes taking place among the ions, atoms, and molecules of the body.

Metastasis The transfer of disease from one organ or part to another not directly connected with it.

Meter A unit of length; equivalent to 39.37 inches.

mg Milligram is a metric unit of weight that is one-thousandth of a gram.

mg/kg Milligrams of substance per kilogram of body weight is an expression of toxicological dose.

mg/m^3 Milligrams per cubic meter is a unit for expressing concentrations of dusts, gases, or mists in air.

Micron (Micrometer) A unit of length equal to one-millionth of a meter; approximately 0.000039 of an inch.

Mist Suspended liquid droplets generated by condensation from the gaseous to the liquid state, or by breaking up a liquid into a dispersed state, such as splashing, foaming, or atomizing. Mist is formed when a finely divided liquid is suspended in air.

Mixture Any combination of two or more chemicals if the combination is not, in whole or part, the result of a chemical reaction.

ml Milliliter is a metric unit of capacity, equal in volume to 1 cubic centimeter (cc) or approximately one-sixteenth of a cubic inch. One-thousandth of a liter.

MLD Mild

mmHg Millimeters (mm) of mercury(Hg) is a unit of measure for low atomic weights of the atoms that make up the molecule.

Molecular Weight Weight (mass) of a molecule based on the sum of the atomic weights of the atoms that make up the molecule.

mppcf Million particles per cubic foot is a unit for expressing concentration of particles of a substance suspended in air. Exposure limits for mineral dusts (silica, graphite, Portland cement, nuisance dusts, and others), formerly expressed as mppcf, are now more commonly expressed in mg/m^3.

MSDS Material Safety Data Sheet.

MSHA Mine Safety and Health Administration, U.S. Department of Labor.

Mutagen A substance or agent capable of altering the genetic material in a living cell.

MW See **Molecular Weight**.

N_2 Nitrogen is a colorless, odorless, and tasteless gas that will not burn and will not support combustion. The earth's atmosphere (air) is about 78 percent nitrogen. At higher concentrations, nitrogen can displace oxygen and become a lethal asphyxiant. See **Asphyxiant**.

Narcosis A state of stupor, unconsciousness, or arrested activity produced by the influence of narcotics or other chemicals.

Nausea Tendency to vomit, feeling of sickness at the stomach.

NCI National Cancer Institute is that part of the National Institutes of Health that studies cancer causes and prevention as well as diagnosis, treatment, and rehabilitation of cancer patients.

NEO See **Neoplasia**,

Neonatal The first 4 weeks after birth.

Neoplasia A condition characterized by the presence of new growths (tumors).

Nephrotoxin A substance that causes injury to the kidneys.

Neurotoxin A material that affects the nerve cells and may produce emotional or behavioral abnormalities.

Neutralize To eliminate potential hazards by inactivating strong acids, caustics, and oxidizers. For example, acids can be neutralized by adding an appropriate amount of caustic substance to the spill.

NFPA National Fire Protection Association is an international membership organization that promotes/improves fire protection and prevention and establishes safeguards against loss of life and property by fire. Best known on the industrial scene for the National Fire Codes—16 volumes of codes, standards, recommended practices and manuals developed (and periodically updated) by NFPA technical committees. Among these is NFPA 704M, the code for showing hazards of materials as they might be encountered under fire or related emergency conditions, using the familiar diamond-shaped label or placard with appropriate numbers or symbols.

ng Nanogram, one-billionth of a gram.

NIOSH National Institute for Occupational Safety and Health, U.S. Public Health Service, U.S. Department of Health and Human Services (DHHS), among other activities, tests and certifies respiratory protective devices and air sampling detector tubes, recommends occupational exposure limits for various substances, and assists OSHA and MSHA in occupational safety and health investigations and research.

Nonflammable Not easily ignited, or if ignited, not burning rapidly.

NonSparking Tools Tools made from beryllium-copper or aluminum-bronze greatly reduce the possibility of igniting dusts, gases, or flammable vapors. Although these tools may emit some sparks when striking metal, the sparks have a low heat content and are not likely to ignite most flammable liquids.

NO_x Oxides of nitrogen that are undesirable air pollutants. NO emissions are regulated by EPA under the Clean Air Act.

NPIRS National Pesticide Information Retrieval System is an automated database operated by Purdue University containing information on EPA registered pesticides, including reference file MSDSs.

NRC National Response Center is a notification center that must be called when significant oil or chemical spills or other environmental-related accidents occur. The toll-free telephone number is 1-800-424-8802.

NTP National Toxicology Program. The NTP publishes an Annual Report on Carcinogens.

Odor A description of the smell of the substance.

Odor Threshold The lowest concentration of a substance's vapor, in air, that can be smelled.

Olfactory Relating to the sense of smell.

Oral Used in or taken into the body through the mouth.

Oral Toxicity Adverse effects resulting from taking a substance into the body by mouth. Ordinarily used to denote effects in experimental animals.

Organic Peroxide An organic compound that contains the bivalent –O-O structure and may be considered a structural derivative of hydrogen atoms has been replaced by an organic radical.

Organogenesis The formation of organs during development.

OSHA Occupational Safety and Health Administration, U.S. Department of Labor.

Ovary The female sex gland in which the ova are formed.

Overexposure Exposure to a hazardous material beyond the allowable exposure limits.

Oxidation In a literal sense, oxidation is a reaction in which a substance combines with oxygen provided by an oxidizer or oxidizing agent. See **Oxidizing Agent**.

Oxidizer A chemical other than a blasting agent or explosive that initiates or promotes combustion in other materials, causing fire either by itself or through the release of oxygen or other gases.

Oxidizing Agent A chemical or substance that brings about an oxidation reaction. The agent may (1) provide the oxygen to the substance being oxidized (in which case the agent has to be oxygen or contain oxygen), or (2) it may receive electrons being transferred from the substance undergoing oxidation (chlorine is a good oxidizing agent for electron-transfer purposes, even though it contains no oxygen).

Pathologic Pertaining to or caused by disease.

Pathology Scientific study of alterations produced by disease.

PEL Permissible Exposure Limit is an occupational exposure limit established by OSHA's regulatory authority. It may be a time-weighted average (TWA) limit or a maximum concentration exposure limit.

Percent Volatile Percent volatile by volume is the percentage of a liquid or solid (by volume) that will evaporate at an ambient temperature of 70°F (unless some other temperature is specified). Examples: butane, gasoline, and paint thinner (mineral spirits) are 100 percent volatile: their individual evaporation rates vary, but in time, each will evaporate completely.

pH The symbol relating the hydrogen ion (H+) concentration to that of a given standard solution. A pH of 7 is neutral. Numbers increasing from 7 to 14 indicate greater alkalinity. Numbers decreasing from 7 to 0 indicate greater acidity.

Physical Hazard Means a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water-reactive.

Placenta A structure that grows on the wall of the uterus during pregnancy, through which the fetus is nourished.

PMCC Pensky-Martens Closed Cup. See **Flashpoint**.

Pneumoconiosis A condition of the lung in which there is permanent deposition of particulate matter and the tissue

reaction to its presence. It may range from relatively harmless forms of iron oxide deposition to destructive forms of silicosis.

Poison, Class A A DOT term for extremely dangerous poisons, poisonous gases, or liquids that, in very small amounts, either as gas or as vapor of the liquid mixed with air, are dangerous to life. Examples: phosgene, cyanogen, hydrocyanic acid, nitrogen peroxide.

Poison, Class B A DOT term for liquid, solid, paste, or semisolid substances—other than Class A poisons or irritating materials—that are known (or presumed on the basis of animal tests) to be so toxic to humans that they are a hazard to health during transportation.

Polymerization A chemical reaction in which one or more small molecules combine to form larger molecules. A hazardous polymerization is such a reaction that takes place at a rate that releases large amounts of energy. If hazardous polymerization can occur with a given material, the MSDS usually will list conditions that could start the reaction and—since the material usually contains a polymerization inhibitor—the length of time during which the inhibitor will be effective.

ppb Parts per billion is the concentration of a gas or vapor in air—parts (by volume) of the gas or vapor in a billion parts of air. Usually used to express extremely low concentrations of unusually toxic gases or vapors; also the concentration of a particular substance in a liquid or solid.

Prenatal Preceding birth.

psi Pounds per square inch (for MSDS purposes) is the pressure a material exerts on the walls of a confining vessel or enclosure. For technical accuracy, pressure must be expressed as psig (pounds per square inch gauge) or psia (pounds per square inch absolute: that is, gauge pressure plus sea level atmospheric pressure, or psig plus approximately 14.7 pounds per square inch). Also see **mmHg**.

Pul See **Pulmonary**.

Pulmonary Relating to, or associated with, the lungs.

Pulmonary Edema Fluid in the lungs.

Pyrophoric A chemical that will ignite spontaneously in air at a temperature of 13°F (54.4°C) or below.

RCRA Resource Conservation and Recovery Act is environmental legislation aimed at controlling the generation, treating, storage, transportation, and disposal of hazardous wastes. It is administered by the EPA.

Reaction A chemical transformation or change. The interaction of two or more substances to form new substances.

Reactive See **Unstable**.

Reactivity Chemical reaction with the release of energy. Undesirable effects—such as pressure buildup, temperature increase, formation of noxious, toxic or corrosive byproducts—may occur because of the reactivity of a substance to heating, burning, direct contact with other materials, or other conditions in use or in storage.

Reducing Agent In a reduction reaction (which always occurs simultaneously with an oxidation reaction) the reducing agent is the chemical or substance that (1) combines with oxygen or (2) loses electrons to the reaction. See **Oxidation**.

REL The NIOSH REL (Recommended Exposure Limit) is the highest allowable airborne concentration that is not expected to injure the workers. It may be expressed as a ceiling limit or as a time-weighted average (TWA).

Reproductive Toxin Substances that affect either male or female reproductive systems and may impair the ability to have children.

Respiratory Protection Devices that will protect the wearer's respiratory system from overexposure by inhalation to airborne contaminants. Respiratory protection is used when a worker must work in an area where he or she might be exposed to concentration in excess of the allowable exposure limit.

Respiratory System The breathing system that includes the lungs and the air passages (trachea or "windpipe," larynx, mouth, and nose) to the air outside the body, plus the associated nervous and circulatory supply.

Routes of Entry The means by which material may gain access to the body, for example, inhalation, ingestion, and skin contact.

Sarcoma A tumor that is often malignant.

Self-Contained Breathing Apparatus A respiratory protection device that consists of a supply of a means of breathable air, oxygen, or oxygen-generating material, carried by the wearer.

Sensitizer A chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.

SETA Setaflash Closed Tester. See **Flashpoint**.

Silicosis A disease of the lungs (fibrosis) caused by the inhalation of silica dust.

Skn Skin.

"Skin" A notation (sometimes used with PEL or TLV exposure data) that indicates that the stated substance may be absorbed by the skin, mucous membranes, and eyes—either airborne or by direct contact—and that this additional exposure must be considered part of the total exposure to avoid exceeding the PEL or TLV for that substance.

Skin Absorption Ability of some hazardous chemicals to pass directly through the skin and enter the bloodstream.

Skin Sensitizer See **Sensitizer**.

Skin Toxicity See **Dermal Toxicity**.

Solubility in Water A term expressing the percentage of a material (by weight) that will dissolve in water at ambient temperature. Solubility information can be useful in determining spill cleanup methods and re-extinguishing agents and methods for a material.

Solvent A substance, usually a liquid, in which other substances are dissolved. The most common solvent is water.

SOx Oxides of sulfur.

Species On the MSDSs, species refers to the test animals—usually rats, mice, or rabbits—used to obtain the toxicity test data reported.

Specific Chemical Identity The chemical name, Chemical Abstracts Service (CAS) Registry Number, or any precise chemical designation of a substance.

Specific Gravity The weight of a material compared to the weight of an equal volume of water is an expression of the density (or heaviness) of a material. Insoluble materials with specific gravity of less than 1.0 will float in (or on) water. Insoluble materials with specific gravity greater than 1.0 will sink in water. Most (but not all) flammable liquids have specific gravity of less than 1.0 and, if not soluble, will float on water—an important consideration for fire suppression.

Spill or Leak Procedures The methods, equipment, and precautions that should be used to control or clean up a leak or spill.

Splash-Proof Goggles Eye protection made of a noncorrosive material that fits snugly against the face and has indirect ventilation ports.

Spontaneously Combustible A material that ignites as a result of retained heat from processing, or that will oxidize to generate heat and ignite, or that absorbs moisture to generate heat and ignite.

Squamous Scaly or platelike.

Stability The ability of a material to remain unchanged. For MSDS purposes, a material is stable if it remains in the same form under expected and reasonable conditions of storage or use. Conditions that may cause instability (dangerous change) are stated: for example, temperatures above 150°F: shock from dropping.

STEL Short-Term Exposure Limit (ACGIH terminology). See **TLV**.

Stenosis Narrowing of a body passage or opening.

Steroid A complex molecule among which are the male or female hormones.

Subcutaneous Beneath the layers of the skin.

Supplied-Air Respirators Air line respirators of self-contained breathing apparatus.

Synonym Another name or names by which a material is known. Methyl alcohol, for example, is known as methanol or wood alcohol.

Sys System or systemic.

Systemic Toxicity Adverse effects caused by a substance that affects the body in a general rather than local manner.

Target Organ Effects The following is a target organ categorization of effects that may occur, including examples of signs and symptoms and chemicals that have been found to cause such effects. These examples are presented to illustrate the

range and diversity of effects and hazards found in the workplace, and the broad scope employers must consider in this area, but they are not intended to be all-inclusive.

(a) Hepatoxins: Chemicals that produce liver damage.
Signs and Symptoms: Jaundice; liver enlargement.
Chemicals: Carbon Tetrachloride: nitrosamines.

(b) Nephrotoxins: Chemicals that produce kidney damage.
Signs and Symptoms: Edema: proteinuria.
Chemicals: Halogenated hydrocarbons; uranium.

(c) Neurotoxins: Chemicals that produce their primary toxic effects on the nervous system.
Signs and Symptoms: Narcosis; behavioral changes; decrease in motor functions.
Chemicals: Mercury, carbon disulfide.

(d) Agents that act on blood hematopietic system: Decrease hemoglobin function; deprive the body tissues of oxygen.
Signs and Symptoms: Cyanosis; loss of consciousness.
Chemicals: Carbon monoxide; cyanides.

(e) Agents that damage the lungs: Chemicals that irritate or damage the pulmonary tissue.
Signs and Symptoms: Cough, tightness in chest, shortness of breath.
Chemicals: Silica; asbestos.

(f) Reproductive toxins: Chemicals that adversely affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).
Signs and Symptoms: Birth defects; sterility.
Chemicals: Lead; DBCP.

(g) Cutaneous hazards: Chemicals that affect the dermal layer of the body.
Signs and Symptoms: Defatting of the skin; rashes; irritation.
Chemicals: Ketones; chlorinates compounds.

(h) Eye hazards: Chemicals that affect the eye or visual capacity.
Signs and Symptoms: Conjunctivitis; corneal damage.
Chemicals: Organic solvents; acids.

Target Organ Toxin A toxic substance that attacks a specific organ of the body. For example, overexposure to carbon tetrachloride can cause liver damage.

TCC Tag (Tagliabue) Closed Cup. See **Flashpoint**.

TCL Toxic concentration low, the lowest concentration of a gas or vapor capable of producing a defined toxic effect in a specified test species over a specified time.

TDL Toxic dose low, lowest administered dose of a material capable of producing a defined toxic effect in a specified test species.

Temp Temperature.

Ter See Teratogen.

Teratogen A substance or agent, exposure to which by a pregnant female can result in malformations in the fetus.

Tfx Toxic effect(s).

TLV Threshold Limit Value is a term used by ACGIH to express the airborne concentrations of material to which nearly all persons can be exposed day after day without adverse effects. ACGIH expresses TLVs in three ways:

1. TLV-TWA: The allowable Time-Weighted Average concentrations for a normal 8-hour work day or 80 hour work week.

2. TLV-STEL: The Short-Term Exposure Limit, or maximum concentration for a continuous 15-minute exposure period (maximum of four such periods per day, with at least 60 minutes between exposure periods, and provided the daily TLV-TWA is not exceeded).

3. TLV-C: The ceiling exposure limit—the concentration that should not be exceeded even instantaneously.

TOC Tag Open Cup. See **Flashpoint**.

Torr A unit of pressure, equal to 1/760 atmosphere.

Toxic A chemical falling within any of the following categories:

(a) A chemical that has a median lethal dose (LD_{50}) of more than 50 milligrams per kilogram but not more than 500 milligrams per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

(b) A chemical that has a median lethal dose (LD_{50}) of more than 200 milligrams per kilogram but not more than 1,000 milligrams per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.

(c) A chemical that has a median lethal concentration (LC_{50}) in air of more than 200 parts per million but not more than 2,000 parts per million by volume of gas or vapor, or more than two milligrams per liter but not more than 20 milligrams per liter of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within 1 hour) to albino rats weighing between 200 and 300 grams each.

Toxicity The sum of adverse effects resulting from exposure to a material, generally, by the mouth, skin, or respiratory tract.

Toxic Substance Any substance that can cause acute or chronic injury to the human body, or that is suspected of being able to cause diseases or injury under certain conditions.

Trade Name The trademark name or commercial trade name for a material or product.

Transplacental An agent that causes physical defects in the developing embryo.

TSCA Toxic Substances Control Act (federal environmental legislation administered by EPA) regulates the manufacture,

handling, and use of materials classified as "toxic substances."

TWA Time-Weighted Average exposure is the air-borne concentration of a material to which a person is exposed, averaged over the total exposure time—generally the total work day (8 to 12 hours). Also see **TLV**.

UEL, or UFL Upper explosive limit or upper flammable limit of a vapor or gas; the highest concentration (highest percentage of the substance in air) that will produce a flash of fire when an ignition source (heat, arc, or flame) is present. At higher concentrations, the mixture is too "rich" to burn. Also see **LEL**.

Ug Microgram, one-millionth of a gram.

Unstable Tending toward decomposition or other unwanted chemical change during normal handling or storage.

Unstable Reactive A chemical that, in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or become self-reactive under conditions of shocks, pressures, or temperatures.

USDA U.S. Department of Agriculture.

Vapor The gaseous form of a solid or liquid substance as it evaporates.

Vapor Density The weight of a vapor or gas compared to the weight of an equal volume of air is an expression of the density of the vapor or gas. Materials lighter than air have vapor densities less than 1.0 (examples: acetylene, methane, hydrogen). Materials heavier than air (examples: propane, hydrogen sulfide, ethane, butane, chlorine, sulfur dioxide) have vapor densities greater than 1.0. All vapors and gases will mix with air, but the lighter materials will tend to rise and dissipate (unless confined). Heavier vapors and gases are likely to concentrate in low places—along or under floors, in sumps, sewers, and manholes, in trenches and ditches—where they may create fire or health hazards.

Vapor Pressure The pressure exerted by a saturated vapor above its own liquid in a closed container. When quality control tests are performed on products, the test temperature is usually 100°F, and the vapor pressure is expressed as pounds per square inch (psig or psia), but vapor pressures reported as MSDSs are in millimeters of mercury (mmHg) at 68°F (20°), unless stated otherwise. Three facts are important to remember:

(1) Vapor pressure of a substance at 100°F will always be higher than the vapor pressure of the substance at 68°F (20°C),

(2) Vapor pressures reported on MSDSs in mmHg are usually very low pressures; 760 mmHg is equivalent to 14.7 pounds per square inch, and

(3) The lower the boiling point of the substance, the higher its vapor pressure.

Ventilation See **General Exhaust**, **Local Exhaust**, and **Mechanical Exhaust**.

Vermiculite An expanded mica (hydrated magnesium-aluminum-iron silicate) used as absorbent for spill control and cleanup.

Viscosity The tendency of a liquid to resist internal flow without regard to its density.

Volatility A measure of how quickly a substance forms a vapor at ordinary temperatures.

Water Disposal Methods Proper disposal methods for contaminated material, recovered liquids or solids, and their containers.

Water-reactive A chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

Work area A room or defined space in a work-place where hazardous chemicals are produced or used, and where employees are present.

Workplace An establishment at one geographical location containing one or more work areas.

Zinc Fume Fever A condition brought on by inhalation of zinc oxide fume characterized by flu-like symptoms with a metallic taste in the mouth, coughing, weakness, fatigue, muscular pain, and nausea, followed by fever and chills. The onset of symptoms occurs four to twelve hours after exposure.

Questions

1. Explain why management needs to be aware of the issues of hazardous wastes including the extent and magnitude of the problem in order to deal with the cleanup of existing hazardous waste sites.

2. List and explain three or four reasons why all employees should be provided with information and training on hazardous chemicals in the workplace.

3. Develop a format to assist in the development of policies and procedures regarding trade secrets in a particular enterprise.

4. Develop, as part of an integrated hazardous substance program, some standard operating safety procedures on how to accomplish specific tasks to match prevailing conditions.

5. Explain how CERCLA, better known as the "Superfund Act," deals with the problems related to the uncontrolled release of hazardous substances into the environment.

6. Explain why it is a standard procedure for OSHA officials to inspect a company's hazard communication program, whenever they visit a worksite for any reason.

7. Why is it necessary to have accurate up-to-date Material Safety Data Sheets (MSDSs) from the manufacturer, distributor, or importer and reviewed and updated if necessary, for each hazardous chemical in the enterprise?

8. Expound on why the HAZCOM Manager should review each MSDS to determine whether the chemical/product must be included on the hazardous chemical/product list. Site some examples.

9. Discuss the issue involved when outside contractors bring a work crew onto the job site and supply them with a copy of the Hazardous Communication Program.

10. Who shall be responsible for training outside contractor employees and their emergency response teams?

Case Studies

HAZARDOUS COMMUNICATION AND HAZARDOUS MATERIALS

Date of Accident: January 13, 2004
Time of Accident: 7:35 a.m.
Location of Accident: Rural Route 985
Supervisor: Tom Shultz
Losses Incurred: Equipment Damage and Injury

Summary Description of Event

At 5:00 a.m. on Tuesday, January 13, 2004, the secretary-dispatcher of Amcoil Gas Company, Mary Weaver, arrived at her office and began dispatching the daily fuel deliveries. It was 22°F and snowing. Forecasters were predicting blizzard conditions at rush-hour traffic and were warning motorists to take extra precautions if they had to be on the roads.

Mary contacted gas tanker driver Rich Cain first because he had the largest delivery that day. Rich had nine gas stations to deliver to within his eight-hour shift. Normal deliveries consisted of six stations per day. Mary continued to dispatch the remaining truck deliveries. Upon completion, she began taking orders for the following day.

At 7:35 a.m. the phone rang and she answered it only to learn there had been an incident on Rural Route 985. Rich Cain's tractor trailer jack-knifed as he was going into a turn. The truck slid on the snow-covered roads and flipped on its side, hitting a telephone pole. Upon impact, the tanker began spilling a significant quantity of gasoline. Rich was able to get out of the truck cab. He suffered a fractured elbow and index finger.

Post-response Assessment

Seconds after Mary received the phone call, she summoned plant supervisor Tom Schultz and the company's staff HAZMAT crew by activating the warning siren and flashing lights. Every employee had been trained in emergency response relating to the specific siren or whistle that is heard.

During the time when the sirens were blaring, Mary contacted the local police, ambulance, and fire departments through the company's automated dialing system. The fire department already had MSDS sheets on the tanker contents, which they had received prior to their annual emergency response briefing with Amcoil Company. Within 15 minutes of the accident, Tom Schultz and the company's HAZMAT crew arrived at the scene. Truck driver Rich Cain had already had residents from five houses evacuated to the post office building one block down the road and had already contacted the telephone company.

In this case, when the hazardous material accident occurred, the task force response crew was prepared. They had the gasoline spillage contained within 45 minutes. None of the residents were injured nor did their properties sustain any damage as a result of the gasoline spill.

PARAPET COLLAPSE INCIDENT

Date of Accident: July 28, 2002
Time of Accident: 6:06 a.m.
Location of Accident: New York City, NY
Losses Incurred: Total Building Loss
Journal: *Fire Engineering*, November 2002

Summary Description of Event

The fire began in a 100' by 75', brick and wood joist construction one-story building which contained six retail stores. The first call received at the dispatch office was at 6:06 a.m. concerning a fire at the store. The first units arrived shortly after the initial call. Deputy fire chief Thomas Dunne arrived on the scene at 6:22 a.m. and immediately called for a second alarm situation. There were signs that the fire had been in progress for longer time then originally thought.

A team was dispatched with 2-1/2 inch handlines to extinguish visible flames in the stores and vent holes in the roof. This team discovered fire in the cockloft of this facility (where two sections of roof join together). Upon this discovery, the deputy chief ordered to upgrade the situation to a three-alarm fire, using the additional personnel for relief and further overhauling. A short time after dispatching for additional units, it became apparent that the fire in the cockloft was extremely difficult to

control and an aggressive interior attack was making very little headway. This prompted the deputy fire chief to call for a four-alarm fire and began to withdraw all units out of the building in order to prepare for an outside attack strategy.

A collapse zone was established for firefighter safety, along with four tower ladders and two portable deck gun nozzles for a heavy exterior attack. The surrounding tenement buildings were relatively safe because there were 20-foot-wide alleyways that separated them from the fire. Additional lines were run to these locations to assist in the fighting of fire and also as a precautionary measure to protect the tenement buildings. These buildings were eventually evacuated due to the high levels of carbon monoxide and moderate to heavy smoke. The fire was contained and under control at 1003 hours (am). The structure was a total loss but the surrounding buildings were not damaged due to the preventive measure taken throughout the course of this fire.

Post-response Assessment

An approximately 50-foot section of the parapet collapsed onto the sidewalk. The cubic weight of brick and masonry together is about 100 pounds per cubic foot. Taking this into consideration, this collapse involved about 30,000 pounds of brick and other material falling from a height of 10 feet onto the sidewalk. This event was instantaneous. There were no warning signs of any kind. The collapse zone that was established was adequate and no injuries were incurred as a result of this event.

The construction of this building has a lot to do with the collapse. This parapet was built only on the front of the building and its entire weight was concentrated on only a small section of the structure (essentially on the front of the store). The parapet was not reinforced by additional beams or joists which would have distributed the load more evenly throughout the structure. This weight and design instability of the parapet, combined with the intense heat and flames, caused the structure to fail and resulted in the collapse of the parapet.

GROUP DISCUSSION

Discuss and expound on the level of performance for each of the hazardous materials and/or fire problems in the two case studies.

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CHAPTER 2

Accident Investigation

Contents of Chapter

Introduction
The Need for Accident Investigation
Accident Investigation Plan
Methods of Acquiring Accident Facts
Correcting Missing Skills
Investigator Tendencies and Characteristics
Reporting the Right Accident Facts
Higher Supervision's Role in Accident Investigation
Summary
Reference A—Procedures to Complete All Accident Investigation Forms
Reference B—Guidelines for Processing Workers' Compensation Claims
Reference C—Analysis and Reporting
Questions
Case Study
Resources

Introduction

To be successful in an activity as diverse and complex as accident investigation requires considerable planning and preparation. The question we have to ask ourselves is this: What causes accidents? This question should be the primary focus of every accident prevention program. Substandard acts and substandard conditions are two main causes of accidents. Substandard acts are what the employee did to cause the accident or what the supervisor failed to do in supervising the employee in the proper performance of duties. Substandard conditions are anything related to the physical environment of the workplace that has contributed to the cause of the accident. In most cases, a combination of substandard acts and substandard conditions

are responsible for causing accidents Again, failures in the management system contribute to the cause of many serious as well as non-serious accidents.

An accident represents some failure on the part of management to exercise control over conditions and actions in the workplace. However, once an accident occurs, management has the obligation to ensure that a similar accident will not occur. To achieve this obligation, management must organize an effective accident investigation. The accident investigation should determine the elements of the event and the part that management and the employee played to produce this outcome.

To be effective, any accident investigation should involve a plan that is executed by management and trained individuals. This accident plan is designed to satisfy corporate policies, including legal issues. The accident plan will always produce an investigation that will determine the cause of the accident and what preventive measures must be taken.

The Need for Accident Investigation

Nobody wants an accident to happen, but countless numbers of close calls and potential-accident situations occur every day in a realistic industrial complex. Supervisors should be right there to learn as much as possible about the problem that precipitated the accident. The idea of accident investigation is to take action and prevent similar situations from occurring again. The safety supervisor is assigned to conduct the accident investigation. This procedure should be in place at all times relative to investigating all accidents. This usually is a corporate policy that establishes the policy and procedures for investigating accidents.

Accident Investigation Plan

The primary purpose of an accident investigation is to preclude or greatly reduce the chances of a recurrence and ultimately to prevent future accidents. The accident investigation plan is the key to conducting a comprehensive accident investigation and should be prepared by corporate management in conjunction with the legal department. This plan represents the commitment on the part of top management to conduct an impartial investigation and to decide the appropriate action to be taken to prevent recurrence. Once prepared, the accident investigation plan is implemented at the initial report of the accident event. This plan will provide guidance for the investigation and will ensure that all investigations are uniformly conducted. The plan should provide direction for each investigative step and reduce the need to delay a step when questions arise. Another reason for accident investigation is to gather the data and facts important for accident reconstruction. There are a number of methods to analyze an accident; one often used is the fault-tree analysis. There are computer models that are used to reconstruct the behavior of people in fire accidents, especially with the evacuation when exiting the premises.

To ensure an effective investigation, the accident investigation plan should consist of the following components:

1. **Report of the accident or incident.** Once a report is received, it is paramount that the appropriate medical services be dispatched, the emergency plan implemented, and the accident scene secured to prevent others from being injured.
2. **Notifications.** The policy will dictate who will be notified to initiate the investigative policy. This policy will dictate who will conduct the investigation for the following events:

   - Fatality
   - Injury—Serious
   - Injury—Minor
   - Injury—Subjective
   - Value—Excessive dollar and property loss
   - Value—Minor
   - Motor vehicle involvement
   - Environmental damage or spill
   - Injuries to contract workers
   - Injuries to individuals outside of the organization
   - Injuries to employees under the supervision of another department or division
   - Injuries that may have occurred as a result of a crime due to intentional or negligent conduct
   - Injuries or damage when the employee involved has used or is under the influence of a dangerous drug, a prescription drug, or alcohol
   - Product liability matter (i.e., failure of equipment purchased for employee use)

   The notification policy should include the safety manager for investigative input; the human resource manager for the filing of workers' compensation forms and engaging the involvement of the company physician; the legal department for notifications to outside regulatory agencies (i.e., OSHA, MSHA, EPA, DOT, and state agencies); and, when required, top management.

   Workers' compensation laws are designed to ensure that employees who are injured or disabled on the job are provided with fixed monetary awards, eliminating the need for litigation. These laws also provide benefits for dependents of workers who are killed because of work-related accidents or illnesses. Some laws also protect employers and fellow workers by limiting the amount an injured employee can recover from an employer and by eliminating the liability of co-workers in most accidents. State workers' compensation statutes establish this framework for most employment. Federal statutes are limited to federal employees or those workers employed in some significant aspects of interstate commerce.
3. **Investigative responsibility.** Investigative responsibility is clearly the prerogative of top management. Serious investigations should be directed by a designated manager to ensure that all appropriate issues are addressed. In some cases, a high-level manager will be assigned the investigative task. In other cases, it may be appropriate to assemble an investigative team with a manager responsible for the investigation.

This approach is usually required when the accident is technical in nature and requires the expertise of several people.

At other times, it may be best to have the matter investigated by an outside source. This action may occur when there are no employees who have the experience or credentials to investigate the matter. This situation is common when a motor vehicle accident may require a reconstruction of the events or when a fire requires a fire investigator or a cause-and-origin investigator. Other areas that would consider the use of outside sources would be for the existence of a violation or potential violation of the law.

The use of the first-line supervisor as the accident investigator is common to most industrial accidents, especially when they are considered to be minor in injury or property damage. When the first-line supervisor is designated to conduct an investigation, it is important that the investigation be reviewed by a manager to ascertain the real cause of the accident.

The first-line supervisor has the responsibility to maintain a safe and hazard-free workplace. When an accident occurs, the first-line supervisor has an interest in the outcome of the investigation. If the accident is the result of the supervisor failing to correct a substandard act or condition, the supervisor may be reluctant to completely report all facts that resulted in the accident.

Another reason for not having the first-line supervisor conduct the investigation is when time is a factor. A minor investigation may require an in-depth analysis of a system and could take the supervisor away from other duties that could result in loss of production and quality.

4. **Investigative methods.** The accident investigation plan must provide general guidelines to the investigator concerning the methods to be employed in gathering evidence to support the facts of the case. If the guidelines are not established before an accident, questions will arise that will only delay the investigative process and may result in the destruction of important evidence. Therefore, the accident investigation plan will provide the guidelines for the techniques to be employed. Important areas that require a policy include the following:

   - Interviews—When are they to be conducted, who will be interviewed, and how will the interviews be recorded? Will notes suffice, can they be mechanically recorded, must they be transcribed in the form of a statement, and are there questions that can cause a delay in the investigations?
   - Isolating the scene—Apart from protecting others from a hazardous accident scene, how long can the scene be secured for investigative purposes? The answer depends on the circumstances surrounding the accident. If the scene can be recorded by photographic equipment and the accident was minor, the isolation may be terminated. However, if the accident requires experts, the investigative plan will dictate this time. When there has been an exposure to a hazardous material, for example, an industrial hygienist may want to test the atmosphere to determine the chemicals involved.

The accident investigation plan will provide guidance for experts. The plan will also consider issues beforehand, such as business contracts, the client-attorney rela-

tionship concerning notes and reports, and who will be contacted and what laboratories can be used.

A common question that is raised in most investigations is one of photograph recording. The use of videotape is becoming increasingly popular and has been employed with excellent results in the area of criminal investigations. There is no reason why videotaping cannot be used in the recording of accidents.

There are several advantages of videotaping. The first is that it provides a more realistic and graphic portrayal of the accident scene. It tends to capture the atmosphere of the scene and the events leading up to the accident. It can also be used to record statements of witnesses. Finally, the use of such equipment is relatively easy and is cost effective in terms of recording evidence and reproducing copies.

The accident investigation plan has established the investigative process and will allow for an effective investigation with a minimization of duplication of activities. The plan will only work if managers and supervisors are trained in its components and understand the importance of following every step.

Once an accident has been reported, the most difficult step confronting the supervisor is the interview. Management has the responsibility of training supervisors and managers in the methods of acquiring facts through the interview.

Methods of Acquiring Accident Facts

The number one problem confronting the supervisor who has been designated to conduct an investigation is beginning the interview of a person who has had an accident or a close call and getting that person to tell complete facts about the incident. There are reasons why employees may be reluctant to tell the truth about the accident:

1. Could be embarrassed about what really happened
2. Could be afraid of ridicule or sarcasm
3. Could feel that telling the truth will result in a reprimand or discipline
4. May lose their right to injury compensation if they tell the truth
5. May have been under the influence of drugs or alcohol

Whatever the reason, a supervisor can count on fear of some kind as the main reason for an injured employee being reluctant in an interview.

An accident investigator must learn to reduce an injured employee's fears. If the investigator conducts the interview in a negative way, it can lead to even more fear of ridicule, sarcasm, or half-truths from the injured employee. Once a supervisor has been "tagged" for giving injured employees a hard time, he or she will usually be given distorted information in other accident investigations. The best way a supervisor can receive good accident information is by acquiring the respect and good will of his or her employees.

There are four major interviewing styles that an individual can use in the interviewing situation: interrogator, analytical, supporter, and integrator.

The primary interrogator is relentless in obtaining results and places a high value on task accomplishment. These individuals tend to enjoy getting things done, usually through resourcefulness and determination. They are usually direct in their communication patterns and decisive in situations in which leadership is needed. Interrogators are usually well organized and hard driving. They have high standards for themselves and others. Often the interrogator sees issues in terms of black and white, right or wrong. They make decisions quickly and feel uncomfortable in situations in which they feel time is being wasted or a decision cannot be agreed on rapidly.

A motto for the interrogator under stress would be, "It's not how you play the game, but whether you win or lose." Interrogators place high emphasis on task accomplishment and as a result sometimes demonstrate "tunnel vision." They can be somewhat impatient and have a tendency to run over the feelings of others. Differing opinions can sometimes be a problem for interrogators and bring on defensive overreactions. They stand their ground firmly until defeated or victorious, and usually will express anger and frustration when others contradict them.

Interviewers whose primary style is analytical rely on observation and rational logic at all times. They avoid emotions and tend to be very skeptical. The analytical style strives to avoid disagreement and tension by letting the facts stand for themselves. They avoid going off "half cocked" or being influenced by the needs of the moment. The analytical style can be effective at pointing out the deficiencies in plans, while not being moved by emotional pressures.

When the analytical style is under stress, he or she may rely too much on this style and appear rigid and insecure. They can become overly cautious to the point of indecision. Rather than undergo the tension and frustration of conflict, this style simply mentally and physically steps away from the situation. Stressful encounters are usually kept as impersonal as possible, and in cases of disagreement, the analytical style will sometimes withdraw altogether. Although in some cases this sort of behavior reduces conflict, it also reduces commitment to whatever solution or decision is being reached.

The primary supporter is likely to be perceived as dynamic and stimulating. They are usually warm and sensitive to another person's needs and wants. They are able to pick up discrepancies between what someone says and what they mean. The supporter is perceptive and patient with others. The primary supporter acts on the basis of a gut feeling about things. They are usually good communicators and at times can be helpful in assisting others in communications.

Supporters under stress may become more concerned about interaction between people than the task to be accomplished. They may become detrimental to the point of not functioning properly. Supporters rely less on logic and thought and more on their gut feelings. Therefore, they can become more concerned about how to make an emotional impact, rather than considering whether such an impact has been carefully planned. At worst, the supporter's overly emotional attitude may be seen by others as a substitute for action. At times, supporters would rather give in than hurt someone's feelings.

Primary integrators are known for questioning themselves as well as others. They place high value on understanding all sides of an issue. The integrator stresses both rational facts and emotional feelings in relation to the job to be done. They are usually

open to the views of others and will probe to understand positions on a given topic. Committed to joint problem solving, the integrator will seek creative solutions to a conflict that allows each side to gain something. This type of interviewer sees conflict as natural and helpful.

Integrators under stress will often attempt to maneuver people and facts into compromise too quickly, thereby creating an appearance of their lack of understanding. They can be seen as easily influenced or too political at times of crucial decision-making. They will attempt to integrate issues that should not be integrated and will lack the rational logic to identify the issues before time and energy are wasted. As a leader, the integrator can appear uncertain as to what course of action to take.

Everyone uses a blend of all four interviewing styles. Most people use one style (primary style) and then blend the other three styles when necessary. Problems can develop when an interviewer uses a style too much or not enough. The best interviewer is one who has achieved a balance between all four styles.

HOW TO INCREASE EFFECTIVENESS IN THE INTERROGATIVE STYLE

1. Make your questions specific and to the point.
2. Make disciplined use of time.
3. Place emphasis on supporting results rather than supporting personalities.
4. In conflict situations, take issue with the facts rather than the person.
5. Make your points in a simple and direct manner.
6. Place more emphasis on a business-like relationship.
7. Avoid "why" questions; stick to "what," "when," "who," and so on.

HOW TO INCREASE EFFECTIVENESS IN THE ANALYTICAL STYLE

1. Place emphasis on decisions based on facts.
2. Place emphasis on evidence that is solid, tangible, practical, and realistic.
3. Put more time, if possible, into preparation of various investigations or interview situations.
4. In conflict situations, earn credibility by making an organized, thought out, and systematic presentation of your position.
5. Place emphasis on planning and specific measurable follow through.
6. Place emphasis on durability of plans or solutions.

HOW TO INCREASE EFFECTIVENESS IN THE SUPPORTIVE STYLE

1. Show personal interest in interviewee on individual attempt to find an area of common involvement.
2. If you are involved in a disagreement, encourage discussion of personal opinions and feelings while avoiding a logical debate about facts.

3. Beware of moving to the task too quickly; demonstrate that you are in truth interested in the interviewee as a person.
4. Share your own personal reactions and acknowledge the importance of the interviewee's help.
5. Praise the efforts of the interviewee that contribute to the accomplishment of the task.
6. Place more emphasis on building commitment, instead of focusing entirely on compliance.

HOW TO INCREASE EFFECTIVENESS IN THE INTERROGATIVE STYLE

1. In conflict situations, ask questions about the opinions and ideas of the interviewee.
2. Don't rush conversations; instead develop a climate that builds ideas together. Let the interviewee take as much credit as possible for problem resolution.
3. Avoid competing with the interviewee, even when their behavior seems to encourage it.
4. Value diversity and identify positive characteristics about the interviewee's viewpoint.
5. In a situation that calls for negotiation, pick one or two points that support your opinion, and stick to them rather than jumping from one defense to another.
6. Be willing to tolerate ambiguity, and be persistent in the struggle for new possibilities.

Correcting Missing Skills

PEOPLE LOW IN INTERROGATOR SKILLS NEED TO BE:

A. More action-oriented.
B. More concerned with being finished than being perfect.
C. More concerned about organizing other people (take more leadership).
D. More assertive.
E. More concerned with products, timeliness, and due dates than process and planning.
F. More willing to take a firm stand on issues.
G. More willing to take risks.
H. More task-oriented in conflict situations.

PEOPLE LOW IN ANALYTICAL SKILLS NEED TO BE:

A. More structured.
B. More personal in involving the interviewee.
C. More thoughtful in decision-making (less impulsive).
D. More goal-oriented (get things done and done well).
E. More punctual.
F. More willing to check out the facts.

PEOPLE LOW IN SUPPORTER SKILLS NEED TO BE:

A. More conscious of the interviewee's feelings.
B. More helpful in translating the interviewee's feelings into words that the interviewee can understand, instead of criticizing.
C. More helpful in making the interviewee feel comfortable.
D. More free to follow their own feelings and be spontaneous.
E. More relationship-oriented in conflict situations.

PEOPLE LOW IN INTEGRATOR SKILLS NEED TO BE:

A. More open to new ideas.
B. More willing to say "What would happen if?" instead of "That won't work."
C. More conscious of seeking common ground in conflict situations.
D. More creative and innovative.
E. More able to find new uses of old ideas.
F. More able to see the interviewee's viewpoint.
G. More interested in problem solving.

By using one or a combination of the four interviewing styles, a supervisor can begin interviewing a worker who has had an accident. There are five methods of acquiring information from an injured employee.

1. Remind the employee of the investigation's purpose.
2. Ask him or her to give all the complete versions.
3. Ask questions about unclear subjects.
4. Ensure that the supervisor clearly understands the injured employee's facts.
5. Discuss how this accident might be avoided in the future.

One of the accident investigator's main purposes is to reassure injured employees that their statement will only benefit them. The purpose of the investigation is to learn more about what occurred so it can be prevented before someone else is injured. The more an accident investigator knows the person he or she is interviewing, the more cooperative the employee may be. The interview should be on a friendly basis and not on a threatening basis. The idea is to set employees at ease and let them tell the complete story while maintaining only the truth about the accident.

Once the employee is at ease with the interviewer, it is time to ask the employee to explain:

1. What were you doing?
2. How were you doing it?
3. What happened?

Many people have difficulty explaining an accident when they cannot express themselves. It is a good practice to do the interview where the accident occurred. The

employee can demonstrate and point things out that would be hard to explain otherwise. A supervisor must remember to never let the employee demonstrate an unsafe practice. Never interrupt while people are explaining their version of the accident. Wait until they are finished talking, and then ask questions.

Supervisors want to ask questions to get the information that they seek. Stick to questions that find facts and avoid questions that arouse resistance. Questions an interviewer should not ask are questions that antagonize the employee, such as leading questions that suggest an answer or unnecessary questions.

Once the employee has given his or her explanation, the interviewer should go over it to see ifthe employee understands the accident. Give the employee a chance to correct something that the interviewer might have misunderstood. If the employee contradicts himself or herself, try to arrive at a happy medium. An accident investigator gains nothing by trying to corner an employee.

After the interview the supervisor may want to state precautions or safety procedures to help avoid recurrence of the accident. Employees should be welcomed to come up with their own ideas of how to make the situation a safer procedure. Supervisors should write a report after the interview. If the interviewer forgets something later, he or she can always recheck with the employee.

During an accident there may have been a witness or witnesses that can be interviewed. A witness may be the only direct source of information as to what occurred, able to verify what happened or clarify some of the circumstances involved in an accident. Many witnesses will withhold information. Witnesses may fear what they know and distort the facts to protect a friend. Again, the idea is for accident investigators to convince witnesses to cooperate and to help prevent the accident from reoccurring.

Eyewitnesses are persons in the vicinity of the accident site at the time of the accident. The accident investigator interviews the witnesses with two basic objectives in mind:

1. Establish a suspect area.
2. Gather information from all witnesses.

A good accident investigator realizes that bits of seemingly unimportant information may assume great importance when combined with investigation findings in other areas.

Accident investigators should arrive at the accident site, survey the situation, and decide on certain questions that they feel witnesses could answer. The best way to eliminate expanded stories or embellished facts is to interview the witnesses promptly. Do not interview witnesses in groups. While in groups, witnesses can be influenced by other witnesses.

Initially, encourage witnesses to tell their story in their own way without questions, comments, suggestions, or interruptions. Show the witness the same consideration that you would appreciate if the situation were reversed.

The accident investigator can take notes during the witness's testimony. Explain to the witness that the notes will be used later to see if the interviewer understood what the witness was really trying to say. Keep questions simple, avoiding jargon, slang, or terminology that could confuse a witness.

To better evaluate witnesses, it is advisable for an interviewer to realize there are different types of witnesses.

1. **Injured Witness**—The witness might be under sedation, in a state of shock, or in a condition where no coherent statement could be expected. Limit questions to the essentials.
2. **Illiterate Witness**—Question this individual separately to avoid any possible embarrassment. Make sure what the investigator writes down on paper is what the witness really meant.
3. **Timid Witness**—May require moral support. He or she is usually insecure and considers his or her observations unimportant. Stress the need for help or appeal to their humanitarian feelings.
4. **Prejudiced Witness**—May be encouraged to give a statement by sympathizing with him and listening to his complaints.
5. **Suspicious Witness**—Guards his or her privacy and resents any intrusion by the public. Present investigator credentials, and try to resolve any fears or suspicions by stressing the importance of safety and by convincing him or her that help is needed.
6. **Talkative, Boasting Witness**—Impress upon this witness the need for business-like interviews, the importance of safety, and the fact that you have other witnesses to contact.

An accident investigator must learn to reduce the fears of injured employees and witnesses. By using a combination of the four interviewing styles, the accident investigator can acquire the facts and arrange the information to help reduce or prevent the same accidents from reoccurring in the future.

Investigator Tendencies and Characteristics

INTERROGATOR

Typically, an interrogator

- Is a doer, moves ahead resourcefully
- Places a high value on accomplishment
- Is diligent in obtaining results
- Enjoys getting things done
- Is direct and decisive
- Relieves anxiety by acting
- Is well organized, pragmatic, hard driving
- Sees issues in terms of black and white, right or wrong

Under stress, an interrogator

- Is somewhat impatient
- Overreacts to diverse opinions that represent resistance for action and movement

- Has a tendency to ride roughshod over feelings of others
- May demonstrate "tunnel vision"
- Stands by his or her convictions and defends his or her position

Interrogator Characteristics

Ineffective Application	*Effective Application*
doesn't see long range	pragmatic
acts first, then thinks	assertive, directional
lacks trust in others	results-oriented, achiever
tends to be domineering and arrogant	objective, bases opinions on what he or she actually sees
lacks sensitivity	competitive
	confident

ANALYTICAL

Typically, an analytical interviewer

- Relies on observations and rational principles (logic)
- Avoids emotionalism
- Is skeptical toward novel departures from what's proven out in the past
- Is skeptical of own initial reactions and those of others until tested and analyzed
- Avoids being swept away by needs of the moment or emotional fervor
- Experiences conflict as a hopeless, punishing experience

Analytical Characteristics

Ineffective Application	*Effective Application*
verbose	deliberative
indecisive	prudent
overly cautious	weighs alternatives
overanalyzes	stabilizing
unemotional	objective
nondynamic	rational
controlled and controlling	analytical
overly serious, rigid	

Under stress, the analytical interviewer

- Can be overly cautious, to the point of indecision
- Is likely to appear rigid and insecure
- Is concerned with correctness at the expense of timely exploitation of opportunities
- Appears emotionally "out of touch," withdrawn, task oriented
- Is at times unwilling to depart from established methods and routines
- Avoids disagreement and tends not to take sides

SUPPORTER

Typically, a supporter

- Is dynamic/stimulating
- Is warm/sensitive to others' needs and wants
- Can pick up discrepancies between what someone says and what they really mean
- Is insightful and perceptive about people
- Is patient with others
- Is a good listener
- Likes people
- Acts on a basis of gut feelings about things

Under stress, the supporter

- Is impulsive
- May be thin-skinned or overly reactive
- Is often preoccupied with the emotional impact of a situation
- Avoids conflict situations, sometimes seeks harmony at too high a cost

Supporter Characteristics

Ineffective Application	*Effective Application*
impulsive	spontaneous
manipulative	persuasive
over-personalizes	empathetic
sentimental	grasps traditional values
postponing	introspective
stirs up conflict	draws out feelings of others
subjective	loyal

INTEGRATOR

Typically, an integrator

- Looks for middle ground between extremes
- May vacillate between expressing anger and trying to smooth things over
- Places a high value on understanding all sides of an issue
- Places an equal value on rational facts and emotional feelings
- Probes others to air their views or positions
- Is committed to joint problem solving
- Seeks creative solutions to conflict, which allows each side to gain something

Under stress, an integrator

- Will attempt to maneuver people and facts into compromise
- Is sometimes easily influenced and too political
- Will attempt integration of issues that should not be integrated
- Is uncertain and at times too compromising

Integrator Characteristics

Ineffective Application	*Effective Application*
too flexible	creative
uncertain	persistent
lacks clear direction	good negotiator
time consuming	good problem solver
noncommittal	good conflict manager
impractical	original

Reporting the Right Accident Facts

INFORMATION TO BE ESTABLISHED BY THE INVESTIGATION

The information required for various accident report forms changes according to the company or industry across the United States. However, if all accident report forms are correctly designed, they are developed to acquire the same essential kinds of information. The information is the same everywhere because all accident report forms seek the same purpose, which is to prevent recurrence of the accident. To prevent recurrence, it is necessary that both the accident report form and the investigation generate ideas for preventing recurrence.

The following questions are examples of information that generates ideas for preventing recurrence and that every accident investigator should develop:

1. Who experienced the accident?
2. When did the accident occur?
3. Where did the accident occur?
4. What position was being worked?
5. What job was being done?
6. What occurred?
7. What were the causes of the accident?
8. How can recurrence be prevented?

To get a clear picture of how an accident investigation directly or indirectly prevents accident recurrence, each question will be discussed in the following terms:

1. What is wanted?
2. Why is it wanted?
3. How should the information be recorded?

WHO EXPERIENCED THE ACCIDENT?

The full name and Social Security number of a person must be reported on the accident report form to indicate who experienced the accident. Therefore, investigators must realize they are not investigating the accident of just a number, but that of a person. What they know about the person generally may have considerable bearing on why the accident occurred. The person's name may suggest other kinds of information that should be established—for instance, if the person was involved in a similar accident before, or if he or she has been involved in several accidents recently. Other examples of important information would be if the worker has poor eyesight or is overweight. Identification of other types of information associated with the name may help prevent accident recurrence.

WHY DID THE ACCIDENT OCCUR?

The date and exact time of the accident must be reported on the accident report form. This information is useful because it establishes the accident with reference to potential witnesses of the accident, as well as other factors that may have bearing on the interpretation of the accident.

WHERE DID THE ACCIDENT OCCUR?

The exact location of the accident victim at the moment that the accident occurred must be indicated on the accident report for several reasons. First, the exact location indicates to others where the accident took place, permitting them to go to the scene to investigate. It also develops a statistical analysis to establish repetitiveness of accident

locations. From this information, questions may be raised about the safeness of the location of the worker relative to surrounding hazards. The location of the worker should be described in terms of his or her distance and direction from some prominent reference point. Usually, a short and exact descriptive phrase is all that is necessary.

WHAT POSITION WAS INVOLVED?

The position, occupation, or job title that the person was working in at the time of the accident should always be identified on the accident report form. This information is important to indicate whether the worker was working in his or her position at the time of the accident. It also allows studies to be made of the accidents associated with different positions or occupations. Finally, questions may be raised about the worker's experience in the position.

WHAT JOB WAS BEING DONE?

The job being performed is much different from the position being worked, because the job refers to the specific task the person was engaged in at the time of the accident. The job that the worker was doing at the time of the accident should always be identified and indicated on the accident report. A short descriptive phrase is sufficient to identify the job.

This information raises questions about correct performance of the job procedure, how other workers do the job, and the employee's experience in the job. The purpose of the information is to keep track of accidents associated with repetitive jobs and to identify jobs in need of a job safety analysis.

WHAT OCCURRED?

A description involving five distinct elements of information gives a precise account of the flow of events that led up to and ended in the accident.

1. **To lead into the accident description, what background information is necessary?**
   This element consists of any kind of background information that makes the accident description more meaningful, such as activities, conditions, or circumstances that preceded the actual accident sequence. The background information could also consist of a special problem that influenced how the work was being done. Background information sets the stage for the accident description; however, most reports of accidents don't require this information because most accidents don't involve out-of-the-ordinary happenings that must be known first to fully understand the accident description.
2. **What was the person's position in terms of their surroundings?**

The answer to this question must describe where the person was in relationship to those parts of his or her surroundings that had something to do with the accident.

3. **How was he or she doing what he or she was doing?**
   The answer to this question must describe the essential details of the person's actions immediately before the accident.
4. **What happened to trigger off the accident?**
   Usually, but not always, something unexpected happens to trigger off the main event of the accident. If so, this information should be established and indicated as well.
5. **What finally occurred?**
   The correct answer describes the type of accident that occurred—for example, "struck by," "caught between," and the like. It must be noted that not every accident description requires an account of all these elements. A description of background information is usually not necessary. Sometimes the exact position of the person is irrelevant. Sometimes the worker is not doing the job when the accident occurs. There is not always a "triggering" incident in an accident. But for the elements that do not apply, there should always be a description in their normal order of occurrence.

WHAT WERE THE CAUSES OF THE ACCIDENT?

Such a description may involve raising the following questions to get a complete answer to the causes of the accident.

1. **What did the worker who had the accident do (or fail to do) that contributed to the accident?**
   There are often several things a worker has done to cause the accident. The answer should be a specific, concrete description of what the person did that caused the accident.
2. **What caused or influenced the worker to act as he or she did?**
   This information is valuable in an investigation because it often suggests the kind of corrective action that needs to be applied. This information indicates why the person acted in an unsafe manner. For example, was the worker inexperienced at the job? Was the worker trying to save time? Was the worker unaware of the hazard? Was the worker under emotional stress?
3. **What defects or otherwise unsafe conditions of tools, equipment, machines, work area, etc. contributed to the accident?**
   This information could consist of conditions that may have existed before the start of the job or developed during the course of work. Such conditions may even be the worker's doing.
4. **What are the source causes of any defects or otherwise unsafe conditions that contributed to the accident?**
   The possible repetitive or long-standing causes of a contributing (unsafe) condition may be determined from this question. The information received from this question is useful because it often suggests more lasting, corrective actions.

HOW CAN RECURRENCE BE PREVENTED?

Until an accident investigation has developed the corrective actions to prevent recurrence, it is not complete. Such corrective actions are almost always implied by the direct causes of the incident. As there may be several such causes, there may also be several kinds of corrective actions called for to prevent accidents from happening again.

Corrective actions already taken at the time of the report, corrective actions planned but not yet taken or ordered, and recommended corrective actions should always be distinguished on an accident investigation report.

A well-designed accident report form is not only a report of accident facts, but also a guide for investigators of the accident, telling them what information to establish and leading them to whatever corrective measures are necessary to prevent an accident from happening again.

The accident report form is an example of a well-designed accident report form. Its basic content is derived from the logic of accident prevention previously discussed.

The first report of loss is designed to provide immediate, detailed information for any loss related to corporate activities. The report is to be used for losses involving damages to equipment and materials, vehicle accidents, fire (including windstorm and lightning), theft, injuries to persons other than employees, damages to property belonging to others, and other relevant factors. With the exception of those incidents requiring a Workers' Compensation Report of Injury, all claims or losses regardless of involvement or responsibility are to be reported on the first loss report.

A supervisor's Loss Investigation Report form is designed primarily for personal injury or illness during an accident investigation. The report must be completed within 24 hours after receiving notification that an injury (as described) has occurred.

Higher Supervision's Role in Accident Investigation

It is essential that each question of an accident report form be completely and correctly answered. The safety supervisor, who is the person assigned responsibility for accident prevention at the location, should sign the form only after he or she is satisfied that a detailed account of the cause(s) of the accident has been given, including a clear description of the injury, the extent of disability, and all facts needed to properly evaluate the incident.

Superintendents and equivalent levels of plant management should actively investigate disabling injury accidents as well as other potentially serious injury accidents. They should interview witnesses, appraise the scene of the accident, and, if appropriate, interview those centrally involved.

There is a division of responsibility for accident investigation in many plants. Minor injury or equipment damage accidents are investigated by foremen or other first-

line supervisors. Serious injury or equipment damage accidents are investigated by higher supervision, and are usually assisted by the safety staff and personnel.

Superintendent-level investigations of a major injury or equipment damage accident should include the nominally responsible first- and second-line supervisors as active partners in the investigations. This is a good time for them to learn from the example set by superintendent-level personnel. It is also a good idea to train supervisors how to investigate accidents.

Major injury accidents should be analyzed by investigating committees consisting of one or more neutral superintendents plus the superintendent who is nominally responsible. Such committees, appointed by a plant manager, usually conduct more thorough investigations than does the individual investigator.

The division of responsibility for investigation tends to aggravate any lack of concern for minor injury incidents. This lack of concern is shown mostly by the way higher supervision tolerates superficial investigations of minor injury accidents. The solution to this problem lies with higher-level supervision. All minor injury accident reports should be reviewed by superintendents for many reasons. Such reviews would enable higher supervision to spot accidents that need more thorough investigation because of the potential for more serious injury. The reviews remind lower levels of supervision that their accident reports are scrutinized by higher supervision, and also give superintendents an idea of how well minor injury accidents are investigated in their department.

Higher supervision should do two things to improve the overall quality of accident reports. First, they should order personal guidance given to supervisors who turn in poor-quality reports. Second, they should order poorly written reports redone by those who write them. This would encourage supervisors to quickly learn to submit adequately written reports. These two suggestions result in good-quality accident reporting, better accident investigations, and fewer accidents to investigate in the long run.

Summary

A thorough investigation of the accident is a necessary activity for accident prevention. Because the quality of investigating and reporting accident facts is quite frequently insufficient, it is important to improve the quality of accident investigation and reporting among all levels of supervision.

Accident investigation is a major benefit to the employer and the employees. An efficient accident investigation program will contribute greatly to the reduction of future accidents. Learning about the causes of accidents will lead to new accident prevention techniques. Management and employee cooperation is essential in the search for the root cause of accidents. Employees must feel they are contributing to their own future safety by answering questions asked by the accident investigation team. To accomplish this benefit, accident investigators must be skilled in placing individuals at ease during the questioning session.

Reference A

PROCEDURES TO COMPLETE ALL ACCIDENT INVESTIGATION FORMS

OSHA Recordkeeping Forms

Only three forms are used for OSHA recordkeeping. One form, the OSHA 300, is the "Log of Work-Related Injuries and Illnesses" on which the occurrence and extent of cases are recorded during the year. The 300A "Summary of Occupational Injuries and Illnesses" is used to summarize the log at the end of the year to satisfy employer-posting obligations. The other form, the "Injuries and Illnesses Incident Report" (OSHA 301), provides additional information on each of the cases that have been recorded on the log.

A. The Log and Summary of Occupational Injuries and Illnesses, OSHA 300 and 300A

The log is used for recording and classifying occupational injuries and illnesses, and for noting the extent of each case. The log shows when and to whom the occupational injury or illness occurred, the regular job of the injured or ill person at the time of the injury or illness exposure, the location of the injury or illness, the kind of injury or illness, how much time was lost, whether the case resulted in a fatality, and so on. The log consists of three parts: (1) A descriptive section that identifies the employee and (2) briefly describes the case and (3) a section classifying the case covering the extent of the injuries recorded and the type and extent of illness. Usually, employers use the OSHA 300 form as their record of occupational injuries and illnesses. It is important that the columns of the equivalent form have the same identifying number as the corresponding columns of the OSHA 300 form, because the instructions for completing the survey of occupational injuries and illnesses refer to log columns by number. It is advisable that the employer have private equivalents of the log form reviewed by Bureau of Labor Studies (BLS) to insure compliance with the regulations.

The portion of the OSHA 300A form is used to summarize injuries and illnesses in an establishment for the calendar year. Every nonexempt employer who is required to keep OSHA records must prepare an annual summary for each establishment based on the information contained in the log for each establishment. The summary is prepared by totaling the column entries on the OSHA 300 form (or its equivalent), transferring the information to an OSHA 300A form and signing and dating the certification portion of the form at the bottom of the page.

A copy of the Log (OSHA 300) and Summary of Occupational Injuries and Illnesses (OSHA 300A) can be found in Session 4, as well as detailed instructions for completion of the form.

B. The Injuries and Illnesses Incident Report, OSHA 301

For every injury and illness entered on the log, it is necessary to record additional information on the Incident Report, OSHA 301. The Incident Report describes how the

accident or illness exposure occurred, lists the objects or substances involved, and indicates the nature of the injury or illness and the part(s) of the body affected.

The OSHA 301 form is not the only form that can be used to satisfy this requirement. To eliminate duplicate recording, workers' compensation, insurance, or other reports may be used as Incident Reports if they contain all of the items on the OSHA 301 form. Completed Incident Reports must be present in the establishment within seven working days after the employer has received information that an injury or illness has occurred. These records must be available in the establishment without delay and at reasonable times for examination by representatives of the Department of Labor, the Department of Health and Human Services, and states accorded jurisdiction under the OSHA Act. The records must be maintained for a period of not less than five years following the end of the calendar year to which they relate. If an establishment changes ownership, the new employer must preserve the records for the remainder of the five-year period. However, the new employer is not responsible for updating the records of the former owner.

Such records must contain at least the following facts:

1. The employer's name, mailing address, and location if different from mailing address.
2. The injured or ill employee's name, Social Security number, home address, age, gender, occupation, and department.
3. The accident or exposure to occupational illness, place of accident or exposure, whether or not it was on the employer's premises, what the employee was doing when injured, and how the accident occurred.
4. The description of the occupational injury or illness, including the affected part(s) of the body, the name of the object or substance that directly injured the employee, and the date of injury or diagnosis of illness.
5. Name and address of physician, if hospitalized, name and address of hospital, date of report, and name and position of person preparing the report.

A copy of the OSHA Log and Summary (OSHA 300 and 300A) can be found at the end of the chapter. Before examining, please carefully read the procedures for completing the OSHA 300 and 300A forms.

PROCEDURES TO COMPLETE THE OSHA 300 FORM

Use and Purpose

The purpose of the OSHA 300 form is twofold.

1. Log of Occupational Injury and Illness, which basically covers the occurrence, its extent, and the outcome of each case. This form must be filed within seven working days of receiving information concerning the accident or exposure.
2. The second purpose is the Annual Summary of Work Related Injuries and Illnesses. This is used to summarize all of the OSHA Log cases from the previous year. This form plays an important part in pinpointing problem areas in the workplace.

Both the Log and Annual Summary must be kept on file for five years to satisfy OSHA requirements. The only persons permitted access to these OSHA records are employees, former employees, employee representatives, and authorized federal and state agency representatives. Those representatives who are permitted access include:

- Representatives of the Department of Labor, including OSHA Safety and Health Compliance officers and Bureau of Labor Standards (BLS) representatives.
- Representatives of the Department of Health and Human Services (formerly the Department of Health, Education, and Welfare) while carrying out the Department's research responsibilities.
- Representatives of states accorded jurisdiction for inspections or statistical compilations.

Access to the entire log and summary is to be provided to these authorized persons in a reasonable manner and at a reasonable time. Redress for failure to comply with the access provisions of the regulations can be obtained through a complaint to the Occupational Safety and Health Administration, who may issue a citation for failure to provide access under 29 CFR §1904.7.

Generally, the OSHA 300, 300A, and 301 forms are used for recording and classifying recordable occupational injuries and illnesses as well as noting the extent and outcome of each specific case. The OSHA 300 form identifies such information as:

- When the injury or illness occurred
- To whom it happened
- What the injured or ill person's job was at the time of the accident or exposure
- The location where the event occurred
- The specific type of injury or illness that is involved
- The amount of lost or restricted work time and whether the case resulted in fatality or not

Part 1904.4 of the Code of Federal Regulations (CFR) provides recording criteria for the Log and Summary of Work Related Injuries and Illnesses:

Each employer shall:

1. Maintain in each establishment a log and summary of all recordable occupational injuries and illnesses for that establishment
2. Enter each recordable injury and illness on the log and summarize as early as practicable but no later than seven working days after receiving information that a recordable injury or illness has occurred.

The log consists of three parts: (1) a section that identifies the employee, (2) a section briefly describing the case, and (3) a section classifying the case, covering the type and extent of the injuries and illnesses. The summary is used to summarize injuries and illnesses in an establishment for the previous calendar year. Every nonexempt employer who is required to keep OSHA records must prepare an annual summary for each establishment, based on the information contained in the log for each establishment. This summary is prepared by totaling the column entries on the log (OSHA 300),

transferring data to the summary (OSHA 300A), and signing and dating the certification portion of the form at the bottom of the page.

A copy of the Injuries and Illnesses Incident Report form can be found at the end of the chapter. Before examining the following pages, please read the OSHA recordkeeping facts carefully.

OSHA RECORDKEEPING

FACTS TO REMEMBER: ABOUT THE OSHA 301 INJURIES AND ILLNESSES INCIDENT REPORT

Injuries and Illnesses

1. Each employer must have available at each establishment a completed supplementary record for each recordable occupational injury and illness. For each case recorded on the log and summary (OSHA No. 300) there must be a corresponding supplementary record.
2. A substitute form can be used if it contains all of the information required by OSHA 301.
3. The number that was entered as the "case or file number" in column (A) on the Log and Summary (OSHA No. 300) should be the same number entered as the "case or file number" on the Incident Report or added to a substitute form if used in place of OSHA 301.
4. The incident report must be completed and available for inspection at the establishment where the case occurred within seven working days after receiving information that a recordable case has occurred.
5. Incident Report forms must be retained in the establishment for five years following the end of the year to which they relate.

Reference B

GUIDELINES FOR PROCESSING WORKERS' COMPENSATION CLAIMS

Purpose

The purpose of workers' compensation (WC) is to ensure that those employees of USA Inc. who are injured on the job receive entitled benefits through the timely, efficient completion of claims for workers' compensation. Employees of USA Inc. are covered for job-related injuries by their State Compensation Fund.

(The following procedures and forms is a model that varies for each state.)

When a Job-Related Injury Occurs

1. The employee must report an injury immediately to his or her supervisor.
2. The employee is given the option of filling out a Workers' Compensation (WC) form.

3. If the employee chooses not to fill out a WC form the supervisor must obtain a signed statement from the employee stating that he or she does not want to submit a WC form, and forward it to Human Resources.
4. After obtaining the above, all information should be sent to the Compensation Claims Representative in the human resources department.

Investigation of the Accident

The supervisor assists the injured employee in fully completing the WC form and has the employee sign a "Release of Information Form." As soon as the supervisor becomes aware of the accident, the company should immediately initiate an investigation. The supervisor must question the employee in detail, if possible, and commit to writing the facts as reported. Statements including facts and observations are immediately obtained from all witnesses. If necessary, a detailed sketch is made of the area where the accident occurred, outlining pertinent things such as equipment, doors, steps, and the like. The supervisor retains all materials until the employee returns the WC form from the medical vendor. The supervisor must advise the employee that if a compensable injury results in lost time, a choice between receiving employer-paid sick leave and benefits or workers' compensation disability benefits must be made.

Processing the WC Forms

After completing the various sections, the injured employee (who may be accompanied by the supervisor) immediately takes the WC form to the medical vendor of his or her choice to have it completed, along with the physician's slip to be completed in full detail (if medical attention is required). The medical vendor retains a copy and returns the WC form and the physician's slip to the injured employee, his or her representative, or the supervisor (NOTE: Regardless of whether the WC form is promptly completed that same day, the employee is responsible for returning the completed physician's slip to his or her supervisor immediately and returning the WC form upon completion).

After the WC form is received by the supervisor, the supervisor signs the form in the space indicated, and then removes the carbon copy and gives it to the injured employee or his or her representative. The remaining sections should be completed in full by the designated individual in each department.

Formulas to Use in Reporting Wage Information

Workers' compensation makes all wage calculations and awards disability benefits on a seven-day work week basis. The following model should be used when reporting wage information in the remaining sections:

Daily Rate—for hourly employee:
Hourly rate $\times$ number of hours worked per week

Example:

$5 per hour × 37.50 = $187.50 ÷ 7 = $26.79
Enter daily rate of $26.79

Daily Rate—for salaried employees:
Annual rate ÷ 365

Example:

$15,000 per year ÷ 365 = $41.10
Enter daily rate of $41.10

Calculations for Full-time Employees

Depending on the length of time the injured worker has been employed by USA Inc., the daily rate is multiplied by 60, 180, or 365 days. For example, if the injured worker has been employed for 65 days prior to his or her accident, the daily rate of pay and the 60 days prior to date of injury would be completed.

Calculations for Part-time Employees

If the employee works part time, then calculations will be figured on the number of hours worked per week. Indicate how many hours the employee works per week above the wage calculations.

Completion of Section III

After reviewing all witness statements and other pertinent information, questions should be answered as to whether the incident should be reviewed. The completed form and all supporting materials are forwarded to the appropriate department (usually human resources), within three working days from the date of signature.

Responsibility of the Human Resources Department

Upon receipt of the materials from the supervisor, the human resources (HR) department will conduct an additional investigation. The white copy of the WC form, with supporting material, will be forwarded to the Workers' Compensation Fund within five work days from the date of signature as required by law.

Findings of the Workers' Compensation Commissioner

The findings of the Workers' Compensation Commissioner are sent directly to the HR department for review. Following a careful examination of reports and correspondence related to the case, the HR department determines if USA Inc. should protest the awarding of benefits.

Return to Work Notice

A "Return to Work Notice (WC Form)" is issued by the supervisor.

NOTE: PROCEDURES MAY VARY FOR EACH STATE; THE PRECEDING HAS BEEN AN EXAMPLE.

Reference C

ANALYSIS AND REPORTING

A. Causal Factors Analysis

Causes can only be determined through proper investigation to ascertain all factors that contributed directly or indirectly to the disaster. The investigation's findings will reflect on the thoroughness and effectiveness with which evidence is collected and properly analyzed.

Deductive reasoning, which begins after disclosure of the basic facts and continues through the process of analysis, should be the basis for all investigative findings. It may be necessary to resort to a process of elimination to arrive at a conclusion as to what happened.

An often overlooked but important byproduct of investigations is the identification of potential causes of other accidents in the future. Such factors may have had little to do with the accident being investigated; however, the investigator should be aware that such factors do exist and often precipitate future accidents of greater magnitude. The investigator's report should include recommendations for corrective action to eliminate the identified potential causes of future accidents.

I. Analytical Techniques The following paragraphs describe some of the approaches that can be used for analyzing the gathered evidence.

As early as possible after collecting the evidence you should develop a chronological order of events leading to the accident. This may be accomplished by using recordings, telemetry data, test procedures, logs, testimony, and other pertinent data obtained or impounded earlier. This type of time-based sequence of events is an invaluable tool for

- Sustaining evidence
- Pointing out specific areas where detailed examination is needed
- Categorizing causal factors, as will be described

The concept of "known precedent" should be kept in mind during analysis. This concept is based on the theory that events will repeat themselves, given enough trials. When applied to investigation, actual precedents provide a basis for quickly identifying tentative causes of the accident under investigation. Factors such as previous accident reports, hazard analyses, and failure histories may provide precedents to the over-

all accident or to some specific aspect of it. The search for known precedents should include not only the history of the operation in question, but also the histories of similar types of operations.

After an investigation of an accident of even the slightest amount of complexity, you can expect to have accumulated a great deal of information in the form of interview statements, photos and sketches, lab reports and medical reports, and the like. In preparing your analysis, you should develop a framework for organizing your information.

Everything that can be seriously considered as a possible cause should be explored and evaluated. It also would be helpful to apply logic models to ensure that all facets of the problems are given ample consideration. One or more of the hazard analyses may be used in constructing causation models and developing recommendations. The use of logic models, causal factors, and recommendations for corrective action may be categorized by areas in which deficiencies exist. The following is a suggested approach to constructing a logic model:

- Select the line of reasoning to be followed
- Pose hypothetical causes and corrective actions
- Test these hypothetical causes through examination of evidence

The investigator will find that the traditional problem-solving technique of posing hypotheses and developing them to the point where they are proved or disproved is an effective means of arriving at mishap causes. Initially, data should be collected for accuracy and thoroughly analyzed in relation to the hypothesis. The logical consequences of the data tested through comparison with actual conditions are thereby validating or invalidating the hypothesis.

II. Three Types of Causes The causes of an accident are actually a combination of simultaneous and sequential circumstances, all of which must have been present for the accident to happen. Any circumstances that contribute to an accident may be spoken of properly as one of the causes of the accident, making it only one circumstance of a combination. Specifically, a cause of an accident is any behavior, condition, act, or negligence without which the accident would not have happened. Therefore, in seeking causes of an accident, remember that an accident may be the result of the interaction among various conditions and events.

Investigators who are concerned with all unsafe conditions and practices involved in each accident cannot properly talk about the "cause" of an accident. Investigators who came up with a single cause may have conducted an inadequate investigation and analysis. Although there may be a predominant factor, regarding that factor as the only factor involved in the accident is not likely to be either scientific or professional. Such thinking contributes very little to understanding how the accident might have been prevented.

Adverse circumstances are other factors that may be present, without necessarily contributing to a given accident. It is not always easy to determine whether an obviously unfavorable circumstance actually contributed to an accident. For example, while intoxication is an important factor in some vehicle accidents, there may be times when

the driver's intoxication is not the cause of the accident. A sober driver may drive a vehicle into the rear of one operated by a drunken driver who had quite properly stopped his or her vehicle at a traffic signal. The drunken driver should be arrested for intoxication, but the accident might have occurred even if the driver had been completely sober.

As mentioned earlier in this chapter, an accident may be the result of the interaction of the drunk driver and the sober driver in the above scenario. Examples of accidents through the direct *cause* are:

- Defective conditions, equipment, materials, or structures. These must have been present before the accident.
- Unusual conditions of weather, visibility, controls, or terrain.
- Conditions of personnel (by far the most common type of indirect cause), including:

  1. Permanent though correctable conditions, such as poor eyesight, lack of certain kinds of knowledge, or psychological faults.
  2. Temporary conditions, such as intoxication, physical exhaustion, or emotional upset.

Accidents also have contributing causes, all of which are acts of negligence on the part of some person or organization not directly involved in the accident. Some examples are inadequate codes and standards, lack of policy, failure of supervisors to perform their duties, lack of enforcement, faulty design, inadequate maintenance, inadequate training, and lack of safety training.

To avoid accepting the first cause as the only cause (because it usually is the most apparent), the investigator should strive toward the more effective multiple-cause concept where all the factors involved are known and considered. The multiple-cause concept improves investigation techniques and ensures better analysis and sets the stage for more accurate and comprehensive corrective action.

III. Sources of Failure As you sort out all of the evidence in search of the combinations of events and circumstances that brought about the accident, it may be useful to consider several possible types of deficiency. In any particular accident, causal factors will be found in one or more of the following areas:

- Human Failure—This category includes physical, physiological, and psychological limitations. An example is the failure to follow approved checklists or to follow the use of authorized procedures or techniques. The category also covers factors associated with physical limitations such as illness and blackout and psychological problems such as claustrophobia. Human factors may be underlying or well hidden, becoming apparent only after a careful evaluation. The failure of a person to perform an act may be classified as a human failure, although it may not be possible to determine why he or she failed to perform it.
- Technical Data Deficiency—This deficiency results from use of inadequate technical data or operating instructions, omissions, or erroneous data.
- Organizational Deficiency—Often underlies other types of deficiencies. Organizational deficiency exists when an element of management clearly caused or con-

tributed to the mishap because of inadequate planning, supervision, training, or work practices.
- Material Failure—The physical breakdown or chemical deterioration of any part, structure, or component.
- Design Deficiency—Though sometimes difficult to differentiate from material failure, a design deficiency exists if a part or component is designed in such a way that failure can occur under predictable circumstances.
- Natural Phenomena—Defined as acts of nature, this deficiency area does not apply when there is evidence of failure to take preparations against these contingencies.

In the final step of analysis it would be useful to reexamine your thinking in terms of types of causes and sources of failure.

B. Preparation of Report

The final step in the accident investigation procedure is preparation and submission of your final report. Because the forms that are used change from time to time, it is recommended that employees consult the OSHA Field Operations Manual for the proper forms and for instructions on completing them.

Questions

1. In your organization, how would you notify the fire department of a mishap?

2. Explain why you believe that the supervisor or manager should or should not investigate incidents in his or her department.

3. In your workplace, an incident was reported to your office. List three or more procedures you should follow before reporting to the scene.

4. List at least three specific recommendations for corrective action based on an incident that you have been involved with in your workplace.

5. List the five methods of acquiring accident facts.

6. True or false: The occurrence of an accident represents some failure on the part of management to exercise control over conditions and acts in the workplace.

7. Explain why the Federal Workers' Compensation Statutes are limited to federal employees.

8. True or false: The OSHA Form 300 involves work-related injuries and illnesses.

9. True or false: Once an accident has been reported, the most difficult step confronting the supervisor is the interview.

10. True or false: Across the United States, the information required for various accident report forms changes according to the company or industry.

Case Study

ACCIDENT INVESTIGATION

Date of Accident: March 2003
Time of Accident: 2:58 p.m.
Location of Accident: Jones Manufacturing Plant—Salem, OR
Supervisor: Frank Jones
Losses Incurred: The supervisor was hospitalized for two months and was treated for serious head, back, and internal injuries.

Summary Description of Event

A store supervisor was seriously injured by an unsafe stack that collapsed as a forklift driver tried to lift it. The supervisor, Mr. Frank Jones, was explaining to the new forklift driver how to remove certain bins containing parts for the assembly plant. He was training the driver to remove a row of six drums from a stack so that a bin on the lower level could be accessed. As the driver was positioning the forks of the forklift truck under the stack, one of the support legs of the stack gave way, causing the entire stack to collapse.

The driver was protected by the cage of the fork lift truck. Frank Jones, standing to one side, bore the brunt of the accident and was trapped under the heavy parts bins for several minutes before he could be rescued.

The accident investigation revealed that one of the legs of a bin on the lowest level had recently been repaired in the workshop. It had been welded on by an unqualified workshop assistant and was not strong enough to carry the load of the entire stack.

Post-response Assessment

There were many things that led to this accident. The supervisor should have made sure that all bins in the stack were sufficiently safe before using them again. The forklift driver had a similar duty to make sure that the stack was safe.

The person in charge of the workshop should not have permitted unqualified people to make repairs and should have ensured that the bin was strong enough to be used for stacking.

The assistant who made the repairs should also have been made aware of the importance of the bin. It was more than just a container. The bin is an important link in a chain, and could cause damage and injury if not in good working order.

It is evident from all these factors that either the employees' duties were not made clear to them or employees purposely chose to ignore their responsibilities.

This situation points to one glaring omission in the workplace: a lack of training and motivation. Remember the old but true saying, "If you don't train them, you can't blame them."

GROUP DISCUSSION

Discuss and expound on the level of performance of the incident relative to permitting an unqualified person to make repairs. What are your recommendations for averting further problems—for example, by implementing training programs for the forklift operator to avoid a similar situation? Review the response assessment closely for other responsibilities.

Resources

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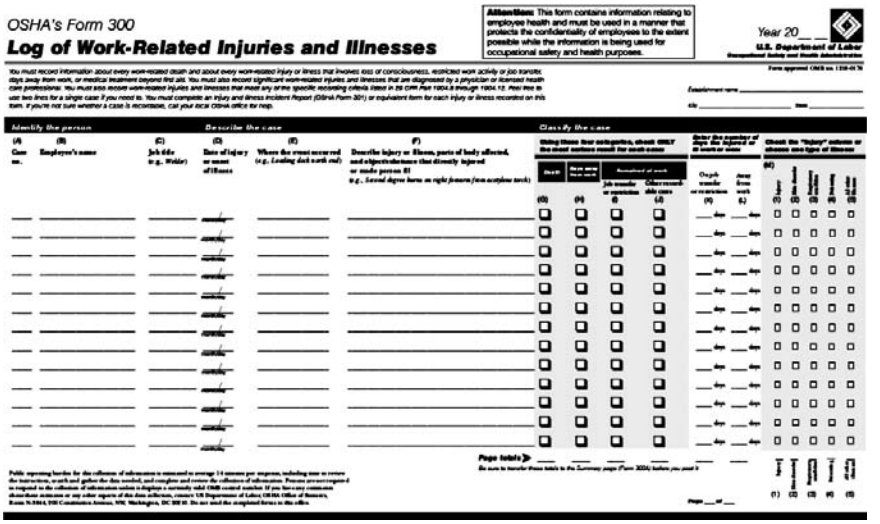
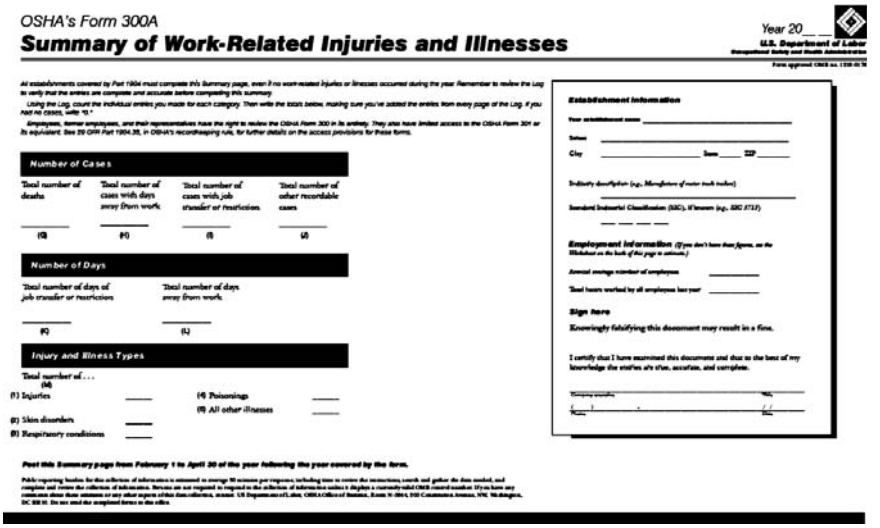


OSHA's Form 300

Log of Work-Related Injuries and Illnesses

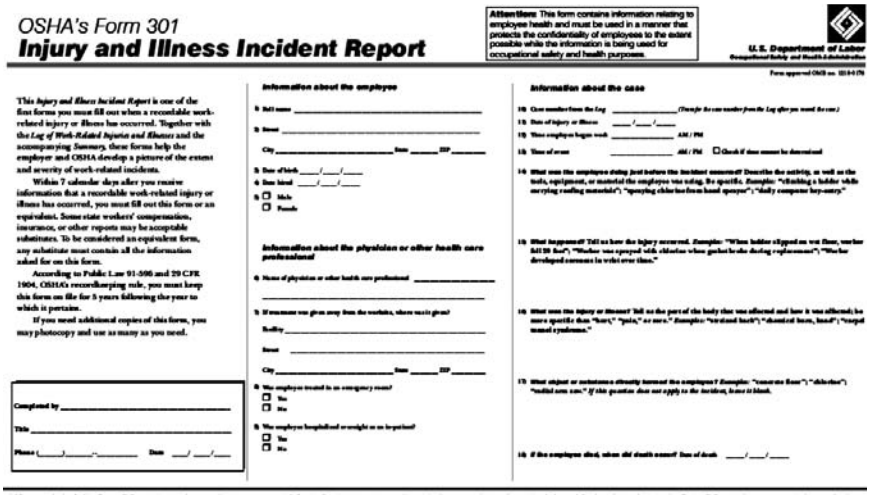
Figure 2.1. OSHA 300 Form



OSHA's Form 300A

Summary of Work-Related Injuries and Illnesses

Figure 2.2. OSHA 300A Form



OSHA's Form 301

Injury and Illness Incident Report

Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health purposes.

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

This *Injury and Illness Incident Report* is one of the first forms you must fill out when a recordable work-related injury or illness has occurred. Together with the *Log of Work-Related Injuries and Illnesses* and the accompanying *Summary*, these forms help the employer and OSHA develop a picture of the extent and severity of work-related incidents.

Within 7 calendar days after you receive information that a recordable work-related injury or illness has occurred, you must fill out this form or an equivalent. Some state workers' compensation, insurance, or other reports may be acceptable substitutes. To be considered an equivalent form, any substitute must contain all the information asked for on this form.

According to Public Law 91-596 and 29 CFR 1904, OSHA's recordkeeping rule, you must keep this form on file for 5 years following the year to which it pertains.

If you need additional copies of this form, you may photocopy and use as many as you need.

Completed by _____

Title _____

Phone (____)_____-_____ Date ___/___/___

Information about the employee

1 Full name _____

2 Street _____

City _____ State _____ ZIP _____

3 Date of birth ___/___/___

4 Date hired ___/___/___

5 ☐ Male
☐ Female

Information about the physician or other health care professional

6 Name of physician or other health care professional _____

_____

7 If employee was given away from the workplace, where was it given?

Facility _____

Street _____

City _____ State _____ ZIP _____

8 Was employee treated in an emergency room?
☐ Yes
☐ No

9 Was employee hospitalized overnight as an in-patient?
☐ Yes
☐ No

Information about the case

10 Case number from the Log _____ *(Transfer the case number from the Log after you record the case.)*

11 Date of injury or illness ___/___/___

12 Time employee began work _____ AM / PM

13 Time of event _____ AM / PM ☐ Check if time cannot be determined

14 What was the employee doing just before the incident occurred? Describe the activity, as well as the tools, equipment, or material the employee was using. Be specific. *Examples:* "climbing a ladder while carrying roofing materials"; "spraying chlorine from hand sprayer"; "daily computer key-entry."

15 What happened? Tell us how the injury occurred. *Examples:* "When ladder slipped on wet floor, worker fell 20 feet"; "Worker was sprayed with chlorine when gasket broke during replacement"; "Worker developed soreness in wrist over time."

16 What was the injury or illness? Tell us the part of the body that was affected and how it was affected; be more specific than "hurt," "pain," or sore." *Examples:* "strained back"; "chemical burn, hand"; "carpal tunnel syndrome."

17 What object or substance directly harmed the employee? *Examples:* "concrete floor"; "chlorine"; "radial arm saw." *If this question does not apply to the incident, leave it blank.*

18 If the employee died, when did death occur? Date of death ___/___/___

Figure 2.3. OSHA 301 Form

CHAPTER 3

Emergency Response

Contents of Chapter

Introduction
Purpose
Communications
Emergency Phone Numbers
General Emergency Plan
Evacuation Procedure
Is Your Company Prepared for a Disaster?
Natural Emergencies and Disasters
Manmade Emergencies and Disasters
Homeland Security
Considerations for Emergency Operations
Disaster Recovery
Summary
Questions
Case Studies
Resources

Introduction

This chapter is designed to provide direction and procedures for the development and implementation of a comprehensive disaster preparedness program. The chapter addresses eight main subject areas: communications, general emergency plans, evacuation procedures, company assessment, natural emergencies and disasters, manmade emergencies and disasters, considerations for emergency operations, and disaster recovery.

It is essential to design plans of action in the event of a disaster to ensure the safety and well-being of individuals and property. A disaster is a sudden calamitous event that

brings widespread damage or suffering, loss or destruction, and great misfortune, and often arrives without warning.

This disaster plan will provide established procedures and guidelines for the management and staff to follow in the event of a disaster-related emergency. The following disaster plan will assist in protection of life and property by preparing the occupants and facility with a plan of action, reducing the unknown, anticipating potential problems, determining possible solutions to disaster-related problems, and establishing recommendations that will improve the readiness of the facility and its occupants in the event of a disaster.

Purpose

The emergency response plan or disaster plan is designed to provide guidelines that will

1. Limit or contain an emergency or disaster from occurring
2. Protect lives and property
3. Improve preparedness in the event of an emergency or a disaster
4. Provide for orderly and efficient transition from normal to emergency operations.

Communications

EXTERNAL

1. Telephone (private and public)
2. Paging systems
3. Cellular phones
4. Satellite phones

INTERNAL

1. Intercom
2. Walkie-talkie (security)
3. Personal contact (verbal or sign)
4. Warning systems (alarms and lights)

It is necessary to assign a command to a predetermined location in the event that the area is incapacitated. The function of the command center will be to serve as the reporting area for all emergencies, central post for all emergency/disaster communications and an information source for all emergency personnel employees and visitors of the organization.

Emergency Phone Numbers

A working relationship should be developed with the following agencies that can respond in the event of a disaster. (The following are examples of emergency numbers to keep on hand.)

AVAILABLE EMERGENCY SERVICES

1. Fire Departments	
a. Morgantown	291-7474
b. Westover	911
c. Star City	911
d. Osage	911
e. Granville	911
f. Cheat Lake	911
g. Brookhaven	911
h. Clinton District	911
i. Fire Tower	292-4352
j. Cool Springs	911
k. Tribune Halleck Road	911
l. Morgantown River Road	911
2. Police Departments	
a. Morgantown	291-7444
b. Westover	911or 296-2324
c. Star City	599-3550
d. West Virginia State Police	285-3200
e. Granville	599-5080
f. Sheriff	296-6424
3. Medical Services	
a. Monongalia County General Hospital	598-1212
b. Ruby Memorial Hospital	598-4000
c. Ruby Memorial Emergency Department	598-4171
d. Emergency Medical Center	296-4494
e. Health Net (Air Ambulance)	1-800-255-2146/598-4100
f. Monongalia County EMS	296-4494
g. Red Cross	296-6521
h. Poison Control Center (Med Center)	293-5431
i. Department of Health	599-8606
j. Health Department	599-0670
k. WVU Medical Corp.	599-9104
4. National Guard (Mileground)	292-3283
5. U.S. Army Reserve	296-7759
6. Civil Air Patrol	292-6692

7. Ambulance Service	
a. Morgantown Ambulance Service	599-5380
b. Ambulance Emergencies (Morgantown)	296-4494
8. Water	
a. Morgantown Water Company	292-8443
b. Star City Water System	599-3550
9. Electricity	
a. Monongalia Power Company	296-0066
10. Telephone	
a. C & P Telephone Company	292-9911
11. Gas Companies	
a. Columbia Gas	292-0302
b. Hope Natural Gas	296-3481
12. Contractors	
a. Lynn Construction	599-4008
b. Commercial Builders	599-2139
c. City Neon	599-1852
13. Pharmacies	
a. Revco Drug Store	292-8278
b. Rite-Aid	292-9219
c. Thrift Drug	292-9418
14. Fire Protection Agencies	
a. Schirmer Engineering	1-312-272-8340
b. State Fire Marshall Office	1-800-348-2191
c. WVU Environmental Health and Safety	293-3792
15. CHEMTREC	1-800-424-9300
16. West Virginia University	
a. Department of Public Safety	293-3136/3940/2677
b. Environmental Health and Safety	293-3792/3795
c. CENTREX operator	293-0111
d. Physical Plant	293-6481
17. Public Information	
a. WCLG	292-2222
b. WAJR	296-0029
c. WWVU-92	293-3329
d. WVUQ	292-1101
18. Communications Equipment	
a. Mountaineer Mobile	291-6565
19. U.S. Department of Transportation	202-366-4000
20. National Response Center	800-424-8802 202-267-2675
21. Federal Emergency Management Agency (FEMA)	202-566-1600
22. U.S. Environmental Protection Agency	202-272-0167
U.S. Environmental Protection Agency (emergency number)	800-424-8802
23. U.S. Department of Homeland Security	202-282-8000

General Emergency Plan

Training and education include those activities that promote disaster awareness among all employees and provide preparation for emergency evacuation when responsibilities of employee duties are implemented. Effective disaster response education programs do not just happen. They are well-thought-out plans. They have measurable goals and objectives. Proper and effective disaster response education and training can lead to one of the best ways to combat disasters through prevention and limited damage and loss.

Emergency responses will vary among manufacturing and construction facilities, chemical plants, schools, and other workplaces, and all staff personnel must receive orientation and training on safety rules, regulations, protocols, and procedures. On initial assignment, the employer shall review with each employee the parts of the prevention plan that the employee must know to protect the employee in the event of an emergency. A written plan should be kept in the workplace and made available for employee review. For employers with 10 or fewer employees, the plan will be communicated verbally to employees and the employer need not maintain a written plan.

Information must be given to employees regarding the hazards of the material and processes to which they are exposed in the work site. All disaster prevention plans are required to meet OSHA standards. Personnel responsible for specific duties should regularly maintain, according to established procedures, equipment and systems installed within their operation. Maintenance procedures should be included in the written disaster prevention plan. Since the purpose of the plan is to limit or contain the event, a continual concern in the facility is to train periodically and implement simulated drills for emergency procedures.

The safety and protection of employees, company assets, and the community in which the enterprise resides is incumbent upon the corporation. Hopefully, an emergency response plan will only need to be used during testing and exercises. However, should an incident occur, a good plan will save time, resources, money, and most importantly, lives. It will also preserve community confidence in the company, which is a very important aspect of continued successful business.

EMERGENCY PLAN

1. Warning from outside agencies
   Warnings of severe weather (tornados, ice, wind, floods, blizzards, electrical storms) or any other emergencies (terrorism and nuclear attacks) that can be predicted or foreseen may be received by the Communications Emergency Manager by telephone from the weather bureau or from any civil authority.
2. Warning from within
   It is the responsibility of the Communications Manager to notify all personnel and visitors when it is necessary to evacuate the facility or building or to seek alternative shelter. This notification should be by voice through the intercom system or by an otherwise audible warning device.

3. Shelter in place
   In the instances of a tornado, nuclear attack, or other emergencies that require the population to remain in the building, the Shelter Manager shall take the appropriate actions upon notice that the facilities are threatened.

   Personnel and visitors will immediately proceed to the safe area as designed by the Shelter Manager. Specific instructions are given later in this plan.
4. Education and Training

   a. Personal and Personnel Survival
      It is recommended that key employees take the American Red Cross Advanced First Aid Course and either the American Red Cross or the American Heart Association CPR (Cardiopulmonary Resuscitation) Course. The Basic Life Support: Cardiopulmonary Resuscitation course is a key component for all work sites. The focus of the course is on specific lifesaving skills that are critical for victims who are not breathing or who have no pulse. Because the use of automated external defibrillators (AEDs) can save the lives of workers who experience cardiac arrest while on the job, OSHA encourages employers to consider making this equipment available in their workplace. The American Red Cross strongly advocates the widespread deployment of defibrillators, particularly in the workplace, schools, and other places of public occupancy. Information on foreign-body airway obstruction management (choking) has saved countless lives over the past forty years. CPR skills are easy to learn and, if practiced often, are easy to recall. Management should designate key workers to enroll in these courses and to use these skills when called upon during an emergency. An effective AED program should include a centralized management system that also is integrated into an overall emergency preparedness plan for the workplace. The manager overseeing the program should coordinate with local emergency medical services (EMS) and conduct periodic reviews and quality assurance of the devices.
   b. Drills

      - Fire drills shall be held at least quarterly or more often if deemed necessary.
      - The evacuation routes as designated should be practiced for all pertinent scenarios, including fire, to ensure that every person in this structure is familiar with them, so that the plan can be activated and accomplished quickly and efficiently.
      - Drills shall be held at both opportune and inopportune times to cover almost any situation. Everyone in the building including visitors and sub-contractors must obey the instructions as posted in the building they occupy when the alarm is sounded.

5. Special Duties

   - Department heads shall take notice of their personnel's attendance when each drill is conducted.
   - Upon arrival at the designated area, department heads shall count their personnel to ensure that all are present.
   - The disaster plan provides for checking of restrooms, vacant rooms, and specialty rooms to ensure that all persons are aware of and are obeying the warning.

- During his or her shift, each employee is assigned certain tasks to conduct if a disaster happens such as closing doors and windows and turning off lights in accordance with instructions as described in the following section.
- Maintenance personnel shall shut off electricity in an emergency. Disconnect the main electrical power handle and any other switches controlling pumps, machines, and any other equipment powered by electricity. If the main switch is located in the basement, be sure there is no water on the floor. If there is water in the area, make sure that the water is pumped out before you attempt any work on the electrical system. Before you re-enter the facility, make sure that all electrical systems have been turned off. Contact a utility company representative or qualified electrician to do this. Do not use electrical appliances, motors, lights, or gas systems until they have been tested and are safe.

6. Employees

    1. Employees are not to take time to get coats or other belongings when the alarm is sounded.
    2. Certain employees will be designated by supervisors to be responsible for closing windows and doors, turning off the lights, and other duties found to be necessary.
    3. Employees will go to the nearest exit and evacuate the building in an orderly fashion to the designated area.

Evacuation Procedure

In the event of a disaster or emergency, the designated officer will communicate with all emergency agencies. The decision to evacuate may be made and communicated by the designated officer, fire marshal, or other emergency officials. Occupants of the building or the industrial plant will only use the stairways and exits designated for evacuation of the facility. Copies of the exit routes should be provided and posted throughout the building. Evacuate as quickly as possible to a designated site outside the facility. Stay clear of the exit once outside of the building and proceed to the designated rally location.

Occupants who have physical handicaps that may not be obvious (e.g., heart condition, asthma, etc.) but which would hinder their movement down stairways should inform management prior to any emergency.

Elevators should not be used, as they are conducive to smoke and fail during a fire.

1. General

    a. Employees seated near windows shall close and secure the windows.
    b. Any employee next to a restroom or vacant room shall check that room and, if anyone is in the room, instruct that person(s) to proceed to the staging area.
    c. Employees are not to take anything with them.
    d. The employees closest to the door will leave first; the last person out of the room will close the door.
    e. Employees should move as quickly and safely as possible without creating more hazards than already encountered.

f. Keep calm and listen for information and instructions.
g. If primary exits are blocked for any reason then employees should go to an alternative exit.
h. Department heads should account for all personnel.
i. If a fire is in the corridor just outside the room or close enough to the exit route, then close the door and block all gaps around the door until a move can be decided.

2. Delegation of Duties
There are many possible incidents that may affect the enterprise, both within and outside the boundaries of the organization. The implementation of such a plan should be through the corporate management team as directed by senior management where the responsibilities and duties are assigned relative to employees' competencies and normal work functions. To ensure that employees are properly prepared to handle such conceivable incidents and to keep them in the area of the emergency rather than the disaster, a Site Emergency Response Plan (SERP) is recommended. There are a number of elements that are necessary for emergency situations. The following elements for these responsibilities and duties follow:

A. Leaders—Personnel with leadership ability shall lead the group to the staging area.
B. Notification of neighboring room—Personnel next to a restroom or other rooms not under direct supervision shall be sure that everyone has evacuated the room. Everyone should meet at the staging area.
C. Head-count and reporting—The department head shall do a head-count once they have reached the staging area. If anyone comes up missing, then it shall be reported to the person in charge at the time.
D. Door guards—All outside doors shall be closed and a person stationed near each door to make sure that no unauthorized persons re-enter the building.
E. Employees' coats and belongings—Employees shall be instructed to leave all belongings where they are. No employee shall be allowed to return to the building once it has been vacated until the all-clear has been issued.
F. Evacuation lines—At the time of evacuation of the building, there should be as little talking as necessary so that instructions can be clearly understood.
G. Exits and routes—The occupants of each room will exit from the building according to the evacuation plan as posted in the room. If the exit is blocked, the alternative route posted in the room shall be used.
H. Portable fire extinguishers—Fire extinguishers are placed in strategic locations as recommended by the fire chief. Each shall be inspected monthly (NFPA-1: Fire Prevention Code—7-6.4.1.3) It would be best if they were checked once a month. Employees should be instructed in the operation of fire extinguishers. Portable fire extinguishers will be used by fire brigades to fight fires in the incipient stage only. All employees can use portable fire extinguishers in their immediate work areas. Employers must provide training in extinguisher selection and use to all employees when first hired, and annually thereafter.

I. Persons in charge—A chain of command shall be set up beforehand, so if someone is absent then the next person in line shall assume the responsibility.
J. Frequency of drills—The operating manger shall hold a sufficient number of fire drills at various times during the day to be sure that all employees understand the procedure and exits to use, so that the evacuation will become routine. There should be at least one drill a month at the implementation stage of the plan, then about once every three months to keep everybody familiar with the procedure.
K. Staging area—Upon reaching the staging area, employees shall await further instructions.
L. Handicapped persons—One or more employees should be assigned to assist any handicapped persons near them when asked to evacuate the building. This procedure should be implemented during the preplanning meetings.

3. Returning to the Building
   The operating manager, upon collaboration with all agencies involved, will decide whether to remain in the primary evacuation area, to move further away from the building, or if the building is declared "safe" to return to work.

Is Your Company Prepared for a Disaster?

Is your facility (plant, shop, office building, bank, or other institution) prepared for a disaster? How should you prepare? What kind of disaster might occur? Floods? Hurricanes? Explosions? Nuclear attack? These are only a few of the questions that must be answered in order to develop and implement an effective plan to cope with such disasters.

This is a guidance approach, not a prescription. However, it does apply to most businesses and industries.

Any plant or facility is vulnerable to some extent. Analysis of vulnerability to a particular hazard can provide the basis for developing a practical, workable emergency operations plan or checklist along with appropriate standing operating procedures. A local vulnerability analysis (Hazard Identification) should be a matter of record at the city or county level emergency management organization. There has been considerable effort at the federal and state levels to identify hazards such as earthquake, hurricane, and dam failures. Check with all of these sources, and obtain a copy of the government-perceived threat in your locale to help you conduct an on-site vulnerability analysis of your facility.

In analyzing and assessing the vulnerability of individual facilities, you must consider environmental, indigenous, and economic factors, as well as reasons for the following:

1. Estimating the likelihood of damage, either by direct effects or by indirect effects resulting from dependency on a facility damaged elsewhere;
2. Making plans for protective measures within individual facilities or complexes of facilities to minimize damage and casualties; and
3. Reviewing insurance policies for liability and coverage.

As an example of an environmental factor in determining vulnerability, an industrial facility may be endangered because of proximity to: a flood plain; other businesses and industries that manufacture, store, or transport toxic industrial chemicals; or likely nuclear target facilities (ports, military bases, national defense industries). A state example is Charleston, West Virginia. In the late 1970s and early 1980s, the city was one of the first twenty places toward which Russian nuclear missiles would be launched if war broke out.

Industrial or business facilities also may be vulnerable because of indigenous factors; lightweight construction; processes of materials that in themselves would be hazards or that might generate hazardous by-products; stored combustibles such as lumber; floor layout and arrangements, such as crowding of equipment; critical equipment such as machine tools; inadequate exits for rapid clearance of the building; lack of shelter areas; and limited evacuation routes.

Economic factors include criticality of product, exclusiveness of product (where an industrial plant is the only one of its kind), and the presence of stockpiled or reserve materials.

Natural Emergencies and Disasters

For planning purposes, you must assume that most disasters considered likely will arrive with very little warning, have a rapid onset, and have a potential for substantial destruction. The likelihood may be very small that the kinds of disaster events cited in this section would ever strike your company, but you should have the capability to react to, cope with, and recover from any emergency situations that could occur at your location. The following discussion of specific hazards also includes some survival tips for protecting people, equipment, and other company property from the direct effects of these hazards.

Preseason Storm Preparedness Measures—For areas that experience seasonal storms such as hurricanes, tornadoes, heavy snow or icing conditions, or flooding, make the following preseason preparations as appropriate to the size of your facility:

1. Contact your local government or the National Weather Service and learn the winter storm warnings that pertain to that area.
2. Inform employees of storm safety rules.
3. Establish a system for early release from work and "employee stay-home" announcements.
4. Designate flood/hurricane evacuation and snow emergency routes and place identifying signs within the yard areas of the company facilities.
5. Determine location and the number of available sand bags, pumps, emergency generators, snow fencing, sand, and salt. Obtain and position supplies as required.
6. Organize mobile emergency rescue and medical teams if these people would be useful in your area.

Hurricanes—The National Weather Service is responsible for issuing warnings when hurricanes appear to be a threat to the United States mainland, Puerto Rico, the Virgin Islands, Hawaii, and the Pacific Territories. As soon as conditions intensify to

the tropical storm level—even if it is a thousand miles or more from the mainland—the storm receives a name and the Weather Service begins issuing advisories. The advisories are issued every six hours when a hurricane is more than 24 hours away from land and every three hours or fewer when it is closer. Advisories tell where the storm is located, the intensity of its winds, and the speed and direction of movement.

If a hurricane moves toward the mainland a hurricane watch notice is given. HURRICANE WATCH indicates that (1) the hurricane is a threat to coastal areas and that (2) everyone in the area covered by the watch should listen for further advisories and be ready to take precautionary action including evacuation if directed.

If the forecaster determines that a particular section of the coast will feel the full effects of a hurricane within 24 hours, a hurricane warning is issued. HURRICANE WARNINGS specify coastal areas where winds of 74 miles per hour (mph) or higher or a combination of dangerously high water and very rough seas are expected. TROPICAL STORM WARNINGS are also issued for those areas that are expected to receive gale-force winds (greater than 40 mph).

Take prestorm actions at the beginning of the hurricane season (late May or early June). Check all drainage pumps, battery-powered equipment, and backup power sources. Ensure that sewers and drains for floodwater removal are in working order. Brace storage tanks and all other structures that may be vulnerable to high winds. Keep company vehicles fueled. When the warning is issued, immediately take all precautions against the full force of the wind. Board up windows or protect them with tape. Secure all outdoor equipment. Store drinking water for post-hurricane operations. Listen for local emergency weather advisories or special instructions from local government before, during and after the storm. Prepare to evacuate if the order comes. Be alert for tornado warnings, as hurricanes often spawn tornadoes. Since some industries may require one to three days to prepare (e.g., petrochemical manufacturers, offshore oil drill rigs, etc.), carefully planned procedures will need to be enacted as soon as advisories indicated a hurricane may affect facilities in this category.

The local office of the National Weather Service will provide all severe storm data following a general storm warning, including tornadoes and hurricanes. The latest forecast lines for the local office should be listed under the Department of Commerce in the U.S. Government listings in the local telephone book. These lines are often answered 24 hours a day. There will be a regularly updated taped forecast, or in some cases an individual will answer questions. The National Oceanic and Atmospheric Administration provides hurricane forecast information on the telephone at numbers 1-900-410-NOAA for the U.S. mainland and 1-900-410-KANE for Hawaii.

Stay indoors during the hurricane. After the storm, turn off all damaged utilities at the central control points and report problems to the appropriate utility services. Avoid loose or dangling wires and check for gas leaks or hazardous materials release. Take special precautions to prevent fires because lowered water pressure would make firefighting difficult. Also, to avoid the risks of contaminated drinking water, the Federal Emergency Management Agency (FEMA) may deploy liaisons to local and state emergency operations centers to introduce and manage the systems.

Local, state, and federal responders had to face numerous cleanup challenges associated with Hurricane Katrina. As floodwaters receded and debris management

and infrastructure repair began, monitoring and analysis continued to inform decisions about whether neighborhoods would be safe for returning residents. Throughout the Katrina-affected region, drinking water and sewage treatment plants were damaged and had to be restored. These are some of the unique issues associated with the cleanup and environmental considerations that emergency response managers must face after a disaster.

The U.S. Department of Homeland Security (DHS) has updated the National Response Plan (NRP) to incorporate modifications based on organizational changes within DHS as well as the experiences of responding to hurricanes Katrina, Rita, and Wilma in 2005. Designed to incorporate critical changes in advance of future hurricane seasons, DHS intends to initiate a comprehensive stakeholder review of a new plan (2006), following which the NRP will be reissued. DHS and FEMA have taken strides to increase the nation's preparedness for catastrophic events and smaller scale disasters since Katrina. While emphasizing that states and communities have the lead in emergency response, DHS and FEMA insist they are better prepared to coordinate the federal government's supporting role if the need arises. FEMA has implemented some new measures designed to strengthen the essential functions for more effective overall response.

Tornadoes—Tornadoes are violent local storms with whirling winds of tremendous speed that can reach 200 to 400 mph. The individual tornado appears as a rotating, funnel-shaped cloud, which extends toward the ground from the base of a thundercloud. It varies from gray to black in color. The tornado spins like a top and may sound like the roaring of an airplane or locomotive. These small, short-lived storms are the most violent of all atmospheric phenomena and, over a small area, are the most destructive. The best protection is an underground area. In buildings without basements, designate interior hallways on the lowest floor as tornado shelter areas. High-rise building occupants shoulder shelter in small interior rooms or hallways. Continuously monitor news broadcasts following a tornado watch announcement. When a tornado warning is issued, direct employees to take shelter immediately and to crouch down and cover their heads with their arms. Close all doors to the outside rooms. Conduct periodic training drills to ensure that employees know where and how to best protect themselves. Employees who work outside should be advised to lie flat in the nearest ditch, ravine, or culvert with their hands shielding their heads if there is not time to reach indoor shelter. In the aftermath of the tornado, check all damaged facilities for survivors. Avoid downed powerlines, check for gas leaks, and contain small fires.

Winter Storms—Winter storms vary in size and intensity. A storm may affect only part of a state or many states and may be a minor ice storm or full-blown blizzard. Freezing rain or sleet, ice, heavy snow or blizzards can be serious hazards. A company can lessen the impact of hazardous winter storms if management observes storm warnings and makes adequate preparations to protect its employees and operations.

The forecast terms for hazardous weather conditions that should alert a company to take precautionary measures include: WINTER STORM WATCH, which indicates that severe winter weather conditions may affect the area (freezing rain, sleet, or heavy snow may occur either separately or in combination of the three forms of precipitation); WINTER STORM WARNING, which indicates that severe winter weather

conditions are imminent; HIGH WIND WATCH, which indicates sustained winds of at least 40 mph or gusts of 50 mph or greater, and is expected to last for at least 1 hour (in some areas this means strong gusty winds occurring in shorter time periods); HEAVY SNOW WARNING, which indicates that snowfalls of at least four inches in 12 hours or six inches in 24 hours are expected (heavy snow can mean lesser amounts where winter storms are infrequent); BLIZZARD WARNINGS are issued when sustained wind speeds of at least 35 mph are accompanied by considerable falling or blowing snow. Visibility is dangerously restricted; TRAVELERS' ADVISORIES are issued to indicate that falling, blowing, or drifting snow, freezing rain or drizzle, sleet, or strong winds may make driving difficult.

Take all preseason preparedness measures appropriate to your geographical area before the first snowfall. Ensure that employees are aware of cold weather safety rules and understand company policy for operations and closing under adverse weather conditions.

Floods—Except in the case of flash flooding from thunderstorms, coastal storms, or dam failure, the onset of most floods is a relatively slow process with adequate warning. The build-up usually takes several days. Progressive situation reports are available from the National Oceanic and Atmospheric Administration through its Weather Service River Forecast Centers and River District Offices.

FLASH FLOOD WARNINGS are the most urgent type of flood warnings issued. These are transmitted to the public over radio and television. They should be transmitted also through local warning systems by sirens, horns, or whistles; through telephone alerts; or by police cars using loudspeakers.

If your community has a history of recurring floods, the community's minimum requirement is to establish continuing communications with the National Weather Service. For example, flood forecasters and warnings should be telephoned to the local police headquarters or some other centralized facility at agreed-upon periods. The location of your company with respect to potential flooding is critical and planning must be done accordingly. Therefore, you should contact your local or state emergency management agency to determine vulnerability of your company's location and to obtain information (and maps, where appropriate) and other details pertaining to flood plains and other flood prone areas.

Water damage can be prevented or lessened by flood-proofing buildings, constructing levees, sandbagging, relocating equipment and records, and installing pumps and emergency power supplies. Sandbags are not watertight, but they are usually adequate as short-term emergency flood barriers for shallow flooding conditions. Sandbags may be fabric or plastic sacks, which are usually filled with sand or soil at the site when they are to be used. Sandbags are commercially available throughout the country. The local emergency management office can usually provide information on suppliers in the area. You should stockpile a reasonable number of sacks for any anticipated flooding. The cost is small, the storage space is minimal, and when the flooding occurs sandbags may not be available in adequate supply. Placing items off the ground onto shelves and tables may provide enough clearance to prevent damage from minor flooding. In multistory buildings, items can be moved to an upper level. Relocation to another facility may be required if the expected flood water elevation will be more than

two or three feet above the facility's floor level. In new construction, key pieces of equipment, such as emergency generators, can be located above an expected flood wary elevation by steel support legs, by bolting to the wall supports, or by placement in upper stories or on roofs. Quick-disconnect electrical plugs can be installed to permit rapid removal and reinstallation of larger machinery.

Pumps can be used to drain water in localized areas (e.g., basements or areas protected by berms or sandbags). Care must be exercised in selecting pumps with adequate capacity to pump the water out faster than it enters. Also, there must be adequate power supply to drive the pumps. It should not be assumed that normal electric power will be available. Gasoline powered pumps or emergency generators may be required.

Earthquakes—Although many earth scientists are searching for means of predicting impending earthquakes, accurate predictions of the exact time and place of earthquakes are not yet possible. However, it can be assumed that earthquakes will continue to occur most of the time in areas where they have been relatively common in the past years. They may range in intensity from slight tremors to great shocks and may last from a few seconds to as much as five minutes. They could come in a series over a period of several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Most casualties result from falling materials. Severe quakes usually destroy power and telephone lines and gas, sewer, or water mains. They may also trigger landslides, rupture dams, and generate seismic waves (tsunamis). During the shaking, warn employees to (1) stay indoors if already there; (2) take cover under sturdy furniture such as work tables, brace themselves in a doorway, or move into a corner and protect the head and neck in any way possible; (3) stay near the center of the building; (4) stay away from glass windows, skylights, and doors; and (5) not run through or near buildings where there is danger of falling debris. If employees are outside, they should stay in the open, away from buildings and utility wires.

After the shaking, employees should exit the building by the stairs, never the elevators. They should stay out of damaged buildings; the aftershock can shake them down. Company officials should check utilities. If water pipes are damaged or electrical wires are shorting, turn them off at the primary control point. If gas leakage is detected, shut off the main valve, open windows, and keep the building cleared until utility officials say it is safe. At some facilities, shutdown of high-voltage and fuel systems is necessary immediately following earthquake damage and before evacuation so personnel will not be endangered by lines that might be ruptured. In other plants, evacuation might not be jeopardized, but recovery operations might shut down unless they were completed beforehand.

Manmade Emergencies and Disasters

Facility Fires—Because prompt and well-directed action can be decisive in escaping a major fire loss, it is important to have in place an organization to prepare for and conduct emergency function. The size, style, and makeup of your company's emergency organization will depend on many factors, such as plant size, the hazard present, the type and condition of available fire equipment, and nearness and reliability of the lo-

cal fire department. Local ordinances or state or federal regulations may require your company to choose from among several response options for fire control and to define it in written procedures. These procedures would be inspected periodically and reevaluated for merit. The following options are representative of the choices industry has for responding to facility fires:

Option One calls for immediate evacuation on alarm. The employer is not required to train employees in firefighting but must take steps to ensure safe evacuation.

Option Two requires every employee to be trained in the use of fire extinguishers. Employees in the vicinity of the fire make initial attempt at control. If the fire is beyond self-help control, the alarm is sounded and all employees evacuate.

Option Three assigns designated employees only to self-help firefighting. The other employees in the affected area, who have not been assigned emergency duties, should evacuate.

Option Four establishes a fire brigade to fight only incipient fires that can be controlled without resorting to breathing apparatus or protective clothing. Beyond this level, the brigade must break off and evacuate.

Option Five establishes a structural fire brigade. Employees assigned to the brigade must be trained and equipped to fight fires beyond the incipient stages, using breathing apparatus and protective clothing.

The most important aspect of planning to cope with major facility fires is the development of mutual assistance agreement with local governments, other plants, and nearby federal installations. Smaller businesses usually cannot afford to maintain the standing forces required to meet a major fire situation, so they rely on local government services and mutual aid. To be effective in case of large fires, industrial explosions, and forest fires, mutual aid requires good communication, accessibility to the fire scene, prearrangements for use of apparatus and personnel, and centralized command.

The biggest single need usually is not personnel and equipment. Most often, it is the ability to respond quickly and to confine the fire to manageable limits before it reaches the disaster stage. This calls for a prefire plan of action for mutual aid by existing local fire organizations. Where such plans exist at the time of a large fire, the emergency usually is manageable, with life and property loss held to a minimum. For the safety of employees, install a fire alarm system with automatic notification to the local fire department and smoke detectors; adequately mark fire escapes and ensure that they are accessible at all times; post evacuation plans in prominent areas throughout the building; conduct periodic fire drills; and install a fire suppression (water sprinkler) system where practical.

FIRE AND/OR EXPLOSION PROCEDURES

1. WARNING

   A. Primary—Fire alarm system
   B. Secondary—Intercom system
   C. Alternative—Messenger

2. ACTIONS OF OPERATIONS MANAGER

   A. Activate disaster committees
   B. Make sure evacuation has started
   C. Call the fire department and give the following information:

      1. The type of fire
      2. The location of the fire
      3. The number and type of injuries/casualties

   D. Supervise the evacuation of building
   E. Notify their superiors
   F. If the operations manager is not in the building, then the designated replacement shall undertake all responsibilities.

3. PROCEDURE

   Immediately upon hearing the fire alarm, employees and all other visitors in the building shall evacuate via the prearranged escape route, which should be posted in every room on charts that show both primary and secondary routing.

Table 3.1. Fire Drill Report

DATE: _____
TIME ALARM SOUNDED: _____
SHIFT: _____
NO. EVAC.: _____
TIME EVAC. COMPLETED: _____
1. Response of Personnel _____
_____
2. Attitude of Personnel _____
_____
3. Number of Personnel Present _____
_____
4. Efficiency of Personnel _____
_____

5. Personnel Instructed as Follows:	Yes	No
A. Transmission of Alarm	___	___
B. Response to Alarm	___	___
C. Isolation of Fire	___	___
D. Evacuation of Area	___	___
E. Preparing Building for Evacuation	___	___
F. Use of Extinguishing Equipment	___	___

Comments: _____
_____
_____
_____
_____
_____

Signature _____

Table 3.2. Bomb Threat Call Checklist

PAGE 1

Questions to Ask	*Exact Wording of the Threat*
1. When is bomb going to explode?	_____
2. Where is it right now?	_____
3. What does it look like?	_____
4. What kind of bomb is it?	_____

PAGE 2

CALLER'S VOICE:

_____ Calm	_____ Laughing	_____ Lisp	_____ Disguised
_____ Angry	_____ Crying	_____ Raspy	_____ Accent
_____ Excited	_____ Normal	_____ Deep	_____ Familiar
_____ Slow	_____ Distinct	_____ Ragged	If voice sounded familiar, who did it sound like? _____ _____
_____ Rapid	_____ Slurred	_____ Clearing Throat	
_____ Soft	_____ Nasal	_____ Deep Breathing	
_____ Loud	_____ Stutter	_____ Cracking Voice	

BACKGROUND SOUNDS:

_____ Street Noises	_____ House Noises	_____ Factory Machinery	_____ Local
_____ Crockery	_____ Motor	_____ Animal Noises	_____ Long Distance
_____ Voices	_____ Office Machinery	_____ Clear	_____ Booth
_____ PA System	_____ Static		Other _____ _____ _____
_____ Music			

Hazardous Materials—Several thousand chemicals and other hazardous materials in daily use can cause an emergency that would affect a substantial number of employees and others in the neighborhood of the facility. These effects could include massive injury to the eyes, respiratory system, and skin; massive contamination of a community; explosions; and fires. Facility officials should ensure that extreme care is taken in the use of hazardous materials in all processes, production stage, storage, and shipment. Management should also be aware of their use in neighboring facilities.

Post a plot plan throughout the plant that indicates the location, hazardous properties, and characteristics of individual chemicals and their potential hazardous reaction to each other. Provide a copy of this plot plan, including location of storm drains, shutoff, hydrants, and the like, to the local fire department along with a list of who to notify during an emergency in nonworking hours.

The major planning requirements for employee protection include an audible warning system and evacuation plans. Once basic personnel safety has been addressed, the next management decision point is how to control, contain, and conclude on-site incidents. Management may rely on outside agencies to handle the situation or may maintain an on-site emergency response team (ERT) for this task. The choice will probably depend on facility size and how much property damage is acceptable as the result of a delayed response.

If your company decides to leave the response to on-site hazardous materials incidents to the community emergency services, you should inform them of the decision and provide them with a detailed plot plan. Determine exactly how they wish an incident reported, and develop an acceptable backup incident reporting system.

If management decides to maintain an on-site ERT for hazardous materials incidents, then in addition to the above you need to set bounds on what these incidents might be and the extent of on-site team response, develop response procedures to deal with them, and initiate a program of preventative countermeasures. The bulk of these additional planning needs can be determined from the inventory of hazardous materials, their quantities and locations, the manufacturers' Material Safety Data Sheet (MSDS), the range of the threat from each material, and what is at risk. The preventative and response countermeasures that address the specific circumstances of hazardous material should take into account complications from possible concurrent incidents such as fires. Also, remember that your on-site problem could become a neighbor's off-site hazard, so give adequate warning of the danger to the surrounding community.

Transportation Accidents—Almost every facility is exposed daily to the possibility of air, highway, railroad, space, or shipping accidents in or near its boundaries. Company officials should be prepared to handle the types of problems they will have to face if their facility is involved in major transportation accidents.

The U.S. Department of Transportation (DOT) regulates the movement of hazardous chemicals. When chemicals that would pose a significant public hazard if released from their packings are transported interstate, they must be labeled with appropriate words of identification and caution. Shipping papers identifying the hazardous material being transported are required to be in the cab of the motor vehicle and in the possession of an aircraft pilot. Marine Emergency "Cargo Information Cards" are carried on tank barges and in the pilot house of the vessel towing the barges. The information on these cards includes the hazards of the chemicals and recommendations for handling fires, chemical leaks, and human exposure threats.

Since not all facilities have the same exposure or the same resources to handle such emergencies, each facility should develop its own plan of action—including agreements for giving and receiving mutual aid. These plans should include listings of the type of equipment or services needed, the source and location of the equipment or services, the person or point of contact to give or obtain immediate response to an emer-

gency request, and the means and method of compensating (if appropriate) for the use of the equipment or services in an emergency.

Major transportation accidents often cause chemical spills, fires, explosions, and other problems, which call for special operations such as rescue and evacuation. Usually, transportation accidents affect only relatively small areas and involve only a small number of people.

An airplane crash may create the need for firefighting and other operations in the area of impact. An automobile crash with a bus or a carrier of hazardous cargo can involve substantial rescue, firefighting, and evacuation operations. A railroad accident can produce hazardous situations when it occurs in or near plant facilities, particularly if the cargo is flammable or explosive. This can also involve substantial rescue, firefighting, and evacuation operations.

Regardless of the type of transportation accident, the first consideration should be to save lives. This can be accomplished through quick response and coordination of the facility's emergency services and local police, fire, and medical services. Again, effective warning devices and evacuation procedures are essential.

When a transportation accident involves chemicals or other hazardous materials, the appropriate emergency response teams' Action Checklist should be used along with DOT's Emergency Response Guidebook.

Public Demonstrations/Civil Disturbances—Recent years have seen a variety of demonstrations for different purposes in many locations throughout the country. Some demonstrations develop slowly, allowing the authorities to assess the problem, to conduct negotiations with the organizers, and to arrange for control measures. On other occasions, violence may flare up with little advance indications of a build-up of tensions and pressures.

In a situation that is developing slowly and deliberately, company officials may operate out of their regular offices during the preliminary or negotiating phase (calling in staff directors as required) and routinely circulate information to departments concerned.

In a scenario where there is a sudden eruption of violence, accompanied by attempted arson and assaults, company security personnel usually will be involved initially and will serve as the source for information regarding the characteristics and extent of the disturbance. They should cooperate completely with local law enforcement agencies, which will provide the information needed to make appropriate decisions. Keep analyses informal. Consider early release or requesting that employees stay home. An effective employee notification and recall system is a must.

Homeland Security

In the wake of the September 11, 2001, attacks on the United States companies must now become proactive in their own security and planning for a disaster of any nature. That day changed life in the United States and throughout the world. The biggest change in the U.S. was the eventual creation of the Department of Homeland Security. On January 24, 2003, President George W. Bush named Tom Ridge the first Secretary

of the Department of Homeland Security. This Cabinet-level position merged 22 federal agencies employing 170,000 employees to this new department. In the event of a disaster of any nature, organizations must have a detailed disaster plan in place. The disaster plan must be kept current to keep updated with the changes that may be taking place within the organization. The Department of Homeland Security also formed the Homeland Security Advisory System, designed to provide the American people with an ongoing indication of the level of potential terrorist activity in the United States.

The National Incident Management System (NIMS) establishes standardized incident management processes, protocols, and procedures that all responders—federal, state, local, and tribal—will use to coordinate and conduct response actions. With responders using the same standardized procedures, they will all share a common focus, and will be able to place full emphasis on incident management when a homeland security incident occurs, whether terrorism or natural disaster. In addition, national preparedness and readiness in responding to and recovering from an incident are enhanced since the nation's emergency teams and authorities are using a common language and set of procedures.

NIMS was created and vetted by representatives across America including:

- Federal government,
- States,
- Territories,
- Cities, counties, and townships,
- Tribal officials,
- First responders.

Key features of NIMS include:

- **Incident Command System (ICS).** NIMS established ICS as a standard incident management organization with five functional areas—command, operations, planning, logistics, and finance/administration—for management of all major incidents. To ensure further coordination during incidents involving multiple jurisdictions or agencies, the principle of unified command has been universally incorporated into NIMS. This unified command not only coordinates the efforts of many jurisdictions, but provides for and ensures joint decisions on objectives, strategies, plans, priorities, and public communications.
- **Preparedness.** Preparedness incorporates a range of measures, actions, and processes accomplished before an incident happens. NIMS preparedness measures include planning, training, exercises, qualification and certification, equipment acquisition and certification, and publication management. All of these serve to ensure that preincident actions are standardized and consistent with mutually agreed doctrine. NIMS further places emphasis on mitigation activities to enhance preparedness. Mitigation includes public education and outreach, structural modifications to lessen the loss of life or destruction of property, code enforcement in support of zoning rules, land management, and building codes, and flood insurance and property buy-out for frequently flooded areas.

- **NIMS Integration Center (NIC).** To ensure that NIMS remains an accurate and effective management tool, the NIMS NIC will be established by the Secretary of Homeland Security to assess proposed changes to NIMS, capture and evaluate lessons learned, and employ best practices. The NIC will provide strategic direction and oversight of the NIMS, supporting both routine maintenance and continuous refinement of the system and its components over the long term. The NIC will develop and facilitate national standards for NIMS education and training, first responder communications and equipment, typing of resources, qualification and credentialing of incident management and responder personnel, and standardization of equipment maintenance and resources. The NIC will continue to use the collaborative process of federal, state, tribal, local, multidiscipline and private authorities to assess prospective changes and ensure continuity and accuracy.

NATIONAL RESPONSE PLAN: PREVENTION, PREPAREDNESS, AND RESPONSE

Along with NIMS comes the National Response Plan (NRP) from the Department of Homeland Security. The National Response Plan establishes a comprehensive all-hazards approach to enhance the ability of the United States to manage domestic incidents. The plan incorporates best practices and procedures from incident management disciplines—homeland security, emergency management, law enforcement, firefighting, public works, public health, responder and recovery worker health and safety, emergency medical services, and the private sector—and integrates them into a unified structure. It forms the basis of how the federal government coordinates with state, local, and tribal governments and the private sector during incidents. It establishes protocols to help

- Save lives and protect the health and safety of the public, responders, and recovery workers;
- Ensure homeland security;
- Prevent an imminent incident, including acts of terrorism, from occurring;
- Protect and restore critical infrastructure and key resources;
- Conduct law enforcement investigations to resolve the incident, apprehend the perpetrators, and collect and preserve evidence for prosecution or attribution;
- Protect property and mitigate damages and effects on individuals, communities, and the environment; and
- Facilitate recovery of individuals, families, businesses, governments, and the environment.

Prevention—The National Response Plan may be implemented for threats or potential incidents of national significance to prevent or intervene to lessen the impact of an incident. Prevention activities may include heightened inspections; improved surveillance and security operations; public health and agricultural surveillance and testing; immunizations, isolation, or quarantine; and, as appropriate, specific law enforcement

operations aimed at deterring, preempting, interdicting, or disrupting illegal activity and apprehending potential perpetrators and bringing them to justice.

Preparedness—Preparedness is a continuous process involving efforts to identify threats, determine vulnerabilities, and identify required resources. The National Response Plan provides the basis for federal department and agency compliance with Homeland Security Presidential Directive 8: National Preparedness.

Response—The National Response Plan provides the policies and processes for coordinating federal support activities that address the short-term, direct effects of an incident. These activities include immediate actions to preserve life, property, and the environment; meet basic human needs; and maintain the social, economic, and political structure of the affected community.

Recovery—Recovery involves actions needed to help individuals and communities return to normal, when feasible. Recovery actions include the development, coordination, and execution of service- and site-restoration plans and the reconstitution of government operations and services through individual, private-sector, nongovernmental, and public assistance programs.

PLANNING FOR DISASTER AT HOME

It is critical for businesses to prepare for the worst-case disasters. However, businesses need to assist their employees in planning for a disaster at their homes. Improving our national preparedness is not just a job for the professionals in law enforcement, firefighting, and elsewhere. All Americans should begin a process of learning about potential threats so we are better prepared to react during an attack. While there is no way to predict what will happen, or what your personal circumstances will be, there are simple things you can do now to prepare yourself and your loved ones.

1) **Assemble an Emergency Kit**—All of us should be able to survive comfortably on our own for at least a three-day period. That is the amount of time you may need to remain in your home until the danger from a biological, chemical or radiological attack has passed. You will need:

   - A change of clothes
   - Sleeping bags
   - Food and water. A gallon of water per person per day should be enough. Canned and dried foods are easy to store and prepare.

   Our advice is to start now by gathering basic emergency supplies—a flashlight, a battery-powered radio, extra batteries, a first-aid kit, prescription medicines and toilet articles. Duct tape and heavy-duty plastic garbage bags can be used to seal windows and doors. Make sure all household members know where the kit is kept. You should also consider bringing a disaster supply kit to work or leaving one in your car.

2) **Develop a Family Communication Plan**

   - Your family may not be together at home when an attack occurs. Make sure everyone knows contact numbers and how to get in touch.

- It may be wise to have everyone call an out-of-state friend or relative.
- Keep a list of emergency numbers near the phone.
- Select a "safe-room" where everyone can gather. The best choice is an interior room above ground with few windows and doors.

3) **Learn More about Readiness**—Planning helps. If your family knows what to expect, they will be calmer in the aftermath of a terrorist event. For example, you should find out where to turn for instructions, such as local broadcasting networks. Local authorities will broadcast information as quickly as possible concerning the nature of the emergency and what you should do next. Be sure to keep listening for updates.

There are other ways to plan ahead. Take a first aid and CPR class so that you can provide emergency medical help. Review your insurance policies to reduce the economic impact of a potential disaster. Remember to make accommodations for elderly family members and neighbors or those with special needs. Finally, try to make arrangements for pets not allowed in public shelters. Businesses can also make their employees aware of the Community Emergency Response Team (CERT) Program which is available in their communities.

Terrorism—Compared with other facility emergencies, the covert and criminal nature of terrorism, including bombing incidents, bomb threats, and the taking of hostages, is a highly complex problem for management and emergency service personnel. Consequently, planning to meet the threat must include prompt contact with the local or neighboring city law enforcement agency—particularly if it has a bomb disposal unit—and the local office of the Federal Bureau of Investigation (FBI). Arrange to obtain the assistance of experienced personnel. Law enforcement professionals at the state and local levels have become the frontline defense in the domestic war against terrorism. There is no doubt that the methods and strategies for fighting this war (terrorism) are very different than anything ever faced by the officers and agencies that were leading the charge in this new war. A few years ago there were a small number of individuals at the state, county, and local levels that had fully dedicated responsibilities addressing antiterrorism activities. Today, there are a number of domestic law enforcement teams and departments developing programs in response to the public outcry for homeland security intelligence systems. Homeland Security Management is an evolving field that is rooted in a number of diverse fields of specialized knowledge and practice. One of the compelling challenges Homeland Security faces as it moves into the future is the need to integrate these specializations and to create a broader and more comprehensive understanding of how they coordinate and interact. The strategic and operational challenges for fighting the war on terrorism are unlike any faced prior to this dedicated group of professionals becoming involved.

Bomb Threats—Experience shows that over 95 percent of all written or telephoned bomb threats are hoaxes. However, there is always a chance that a threat may be authentic. Appropriate action should be taken in each case to provide for the safety of employees and the public and to decide where to send the people who are evacuated. Also, individuals who know what does and does not belong in or near the building should be contacted to search for a suspected bomb.

If a suspicious object is located and thought to be a bomb and the local law enforcement personnel cannot dispose of it, the services of a bomb disposal unit previously arranged for should be requested. Contact the state police or a military Explosive Ordinance Disposal team, if there is a military installation located nearby, for assistance and training.

Sabotage—No facility is immune to sabotage. However, the types of targets for sabotage usually can be predicted with reasonable accuracy. The saboteur will generally look for a target that is critical, vulnerable, accessible, and at least partially conducive to self-destruction. Saboteurs in general are enemy agents, disgruntled employees who commit sabotage for revenge, or individuals who are mentally ill or have been duped by propaganda. Sabotage may be linked to or be another form of terrorism.

Industrial Radiological Accidents—The widespread and rapidly increasing industrial and commercial use and transportation of radioactive materials have increased the possibility of radiological hazards resulting from accidents involving these materials. Accidents may occur in facilities where radioactive materials are used, processed, or stored.

In the event that the emergency services of the company and both local and state governments are not adequate to cope with the situation, federal assistance can be requested by calling a Department of Energy (DOE) office or a military service installation. (The offices of emergency preparedness will have these numbers.) In accordance with an Interagency Radiological Assistance Plan, the radiological emergency response capabilities of federal agencies can be used to protect the public health and safety or to assist organizations and individuals needing immediate radiological emergency assistance. Coordinated by DOE, personnel and equipment are available around the clock to assist on request at the scene of all kinds of radiological incidents that require capabilities beyond those available locally.

When a radiological incident occurs in a facility, some degree of immediate response by state and local public-safety personnel usually will be required. Initial action may be by the company and local government emergency services (fire, police, medical) first at the scene of the incident. Also, an effective warning system and evacuation procedures for employees are essential.

Nuclear Power Plant Incidents—Since the Three Mile Island nuclear power plant incident, the public has expressed increasing concern over the risks from power plant accidents. As a result, considerable emergency response planning and preparedness has been and continues to be undertaken to develop the capabilities to handle such accidents. On December 7, 1979, President Carter directed FEMA to assume the lead responsibility for all off-site emergency planning and preparedness. The Nuclear Regulatory Commission retains responsibility for on-site emergency planning and preparedness. The utility's emergency planning is closely integrated with that of involved state and local governments and other industries, especially those associated with the food chain. All business and industry located within ten miles of a commercial nuclear power plant should consider this possible radiological hazard in developing their emergency capabilities to protect their employees from the direct effects of radiological release at these plants, through such protective measures as evacuation and sheltering. Requirements for evacuation and sheltering should be coordinated with local government. Also, all business and industry associated with the food chain and located within

fifty miles of a commercial power plant should consider their role in assuring that commercial water and food supplies are protected from contamination. They should take measures to ensure that no contaminated food or water is distributed to the public in the event of a radiological accident.

Secondary Disasters—A range of these disasters may strike communities at any time, with or without warning. The probability of secondary disasters should be anticipated. For example, an earthquake could cause a structural fire, which may, in turn, burn out circuits resulting in a power failure. Severe winds may damage a chemical plant; spilled chemicals could start a fire that would release toxic smoke. Intense rain can cause flooding, which may set off landslides.

The multihazard situation creates an environment in which resource availability and priorities may be radically different from the norm. In large-scale events, services and options would likely be severely curtailed and/or adversely affected. Your company would still be responsible for doing what can be done to protect lives and property. A change in priorities as a result of a multihazard disaster might influence critical decisions, especially when the event is in your control, such as an on-site toxic smoke release, and when it affects people both on- and off-site. Your planners should take into account the extra demands secondary disasters would place on the company resources and emergency capabilities. Assessing these ramifications will involve considerations that are site and operations specific and should be made by someone familiar with the site and the operations—someone who has given thought to what sorts of events may be expected on-site from the primary hazards that pose threats to the facility.

Whether the emergency preparedness program developed for multihazard situations is comprehensive, there is a certain minimum legal (Occupational Safety and Health Act of 1970) obligation to life safety. Your employees are among your most important resources, and the most fundamental functional responses are to protect lives and prevent injuries. In addition to life-safety aspects, additional preparedness measures will be profitable to consider from an operational standpoint to ensure continuity of operations, protect property, and reduce potential product and market loss.

Considerations for Emergency Operations

1. **Direction and Control—**This function includes the use of a centralized management center for emergency operations (emergency operating center, or EOC) to facilitate policymaking, coordination, and control of operating forces in a large-scale situation. It must cover the process of obtaining and analyzing emergency management information to provide a basis for decision-making. Along with designing an EOC, a disaster management team should be established when writing the disaster plan. The disaster management team should be small and have certain characteristics to deal with the events and problems of the disaster. All disaster team members should have the following characteristics:

   - Be physically and psychologically able to fulfill duties while avoiding injury.
   - Be available to the scene when crisis occurs.

- Be cross-trained in the duties of several members of the team.
- Be willing to follow orders of the organization's senior management.
- Be able to function at all times under stress.

Along with the disaster management teams comes disaster management authority. The disaster management authority is justified by the following:

1. A person's special expertise.
2. The need for a particularly formal organization structure and unquestioning compliance so that the organization can respond promptly to the disaster.
3. The need for the organization to continue operating despite the absence of some executives.

After the disaster management team and authority has been established the company should design and designate the EOC. The company should also describe the use of alternate EOCs and disaster site command posts, as appropriate.

Things to consider in designing the EOC include the following:

- Indicating who is in charge for each emergency or disaster situation and citing the location of the EOC or on-the-scene command post from which direction and control will emanate.
- Determining the need to evacuate the facility or site and when to issue evacuation orders.
- Identifying the individual responsible for issuing evacuation orders and how they will be announced.
- Lines of succession to ensure continuous leadership, authority, and responsibility in key positions.
- Assigning operational and administrative support for emergency response activities.
- Describing EOC functions, layout, concept of operations, duties of staff, use of displays, and process to bring the EOC to full readiness on a 24-hour basis.
- Disaster effects monitoring and reporting capability.

2. **Communications—**Communication is essential after any event involving a disaster. Communication helps preserve marketing standing by combating negative rumors and ensuring everyone of the continuing viability of their relationship with the company.

Communication should be all of the following:

- Tailored to each group's interest
- Consistent to reduce differences in emphasis
- Coordinated through one department to ensure consistency
- Sufficient to protect the organization against unintended admissions of liability

Communications also deals with establishing, using, maintaining, augmenting, and providing backup for all channels of communications needed for emergency response and recovery for an effective response and communication procedures that everyone understands. Further, experience has shown that communications options will be more likely to work in an emergency if they are part of the day-to-day op-

erating systems. Systems that are critical to everyday operations should be immediately repaired when failures are encountered.

Include these aspects:

- Primary and backup radio communications with gas generators or extra batteries.
- Describing the methods of communications between the EOC and response teams, dispersed throughout company operating locations.
- Two-way radio communications between the EOC and emergency response forces.
- Listing key telephone numbers for industry emergency assistance organizations.

3. **Alerting and Warning—**Systems must be in place to disseminate information to key emergency response staff and all other employees in a timely forecast of all hazards that require emergency preparedness or response actions. All aspects of existing warning systems must be identified, and provisions must be made to implement them as needed. Management must receive timely information on impending threats to the facility and be able to transmit information rapidly to key staff and all other employees.

   Include these aspects:

   - Receive warnings from the weather service or local government when hazardous situations threaten the facility.
   - Warning employees in the event of a disaster.
   - Describing the warning system used to alert the workers of danger.
   - Alternate means of warning to back up the primary system.
   - Defining the responsibilities of department or personnel and describing activation procedures.

4. **Facility Shutdown—**This function requires well-established procedures to shut down equipment and utilities during an emergency or the entire facility when evacuation is necessary. It provides for the protection of company facilities, equipment, and supplies that will be essential to rapid restoration of operations after the disaster. It covers damage assessment and control and emergency protection measures. It defines and assigns the responsibilities for the protection of company property and classified materials before employees leave their workstations. Each of the provisions listed below may play a critical role in preserving life and/or preventing property damage. To be properly prepared for any hazard, the shutdown procedures plan must be developed based on a thoughtful consideration of what additional events might occur in conjunction with each threat and each required action involving an emergency response.

   Include these aspects:

   - Indicating under what conditions shutdown must occur or be considered.
   - Identifying who will make the decision to shut down equipment, utilities, or the facility.
   - Specifying who is responsible for carrying out shutdown procedures.
   - A complete checklist for emergency shutdown.
   - Diagrams to show where to turn everything off.

5. **Evacuation—**The goal of this function is to evacuate people and move resources out of threatened areas. Evacuation is an expedient option that depends on sufficient warning time to get away from an impending disaster. An assortment of evacuation options should be available to the decision maker that is tailored to the different types of hazards. The plan should establish clear and detailed procedures for carrying out complete or partial evacuations from the buildings.

   Include these aspects:

   - Describing the conditions under which evacuation would be ordered.
   - Developing evacuation procedures, with appropriate options for the various hazards, in order to avoid potential secondary hazards.
   - Coordinating site and area evacuation procedures with local government.
   - Safety lighting in stairwells or corridors.
   - An organized head count to ensure that all facility occupants have exited.
   - Periodic evacuation drills for all facilities.

   a. Organization Relocation—Vital industries and other large corporations may elect to evacuate threatened areas as organizational units and, if feasible, continue operation in a limited capacity at an alternate location. Movement of employees and their families to reception area shelters in advance of a natural disaster or a nuclear attack requires extensive planning and coordination, both with your company's emergency organization and with the hazard and reception area governments' emergency management officials.

      Include these aspects:

      - Coordinating evacuation activities with the local governments of the jurisdictions through which the employee convoy will travel.
      - Designating primary and secondary evacuation routes, including detailed maps of the routes with staging areas.
      - Identifying and establishing a liaison with reception area authorities.
      - Coordinating lodging and shelter assignments for employees and dependents with reception area authorities.

   b. Essential Operations—Essential businesses and industries may be called on to continue operating during the crisis to meet national defense needs or to support the community and the evacuated population. These facilities must determine the minimum number of key workers needed to continue operations, arrange for commuter transportation from the reception area, and provide special shelter and care on-site for these key employees.

      Include these aspects:

      - Identifying and continuing essential operations.
      - Identifying the key workers who will continue essential operations.
      - Supplying essential workers in the hazard area with food, water, and medical care.

6. **Shelter in Place—**Appropriate shelters should be provided when needed to protect employees from the effects of any disaster. Use of shelters within the workplace or

in nearby public buildings may be the most effective way to protect people when evacuation from the site is not feasible. This function addresses the conditions under which people should be placed in protective shelters and how the decision to do so would be implemented. The plan should describe any on-site shelter capacity, for both peacetime disaster and nuclear attack. The federal government conducts a continuing nationwide survey of public and private structures to identify shelter space that can be used to protect the public from natural hazards and nuclear weapons effects. Those companies that have not been surveyed under this program may request assistance from state and local emergency management agencies to ensure that their proposed shelter areas provide adequate protection for their employees. Responsibility for shelter maintenance and management should be established for on-site shelters. If there are no adequate shelter spaces in company buildings, the plan or checklist should identify those public shelter facilities that local emergency management officials have allocated for the company employees.

Include these aspects:

- Identifying existing shelter space in company facilities.
- Arranging training for shelter managers and radiological monitors from local and state emergency management officials.
- Coordinating all key worker shelter needs with the local government.

7. **Emergency Services—**Implementation of the plan depends on the availability of trained personnel. Emergency services for security, firefighting and rescue, medical and health, and engineering should be geared to the size and complexity of the facility involved and to the problems likely to arise. In many business and industry firms, emergency duties can be assigned to teams from the regular company organizations. In this publication, the individuals that perform *emergency* services are identified as emergency response team members. They form the nucleus of the operating forces that will be called upon to accomplish vital jobs during an emergency.

   Include these aspects:

   - Maintaining current notification/recall rosters for each ERT.
   - Advising personnel of specific risks associated with handling hazardous materials and of the best means to protect themselves.
   - Establishing a routine for team members to check for contamination and to dispose of contaminated clothing.
   - A plot plan including: Utility shutoff locations; water hydrants and mains; storm drains and sewer lines, fences, gates; natural gas, chemical pipelines; name of each building; and street names and street number directions.
   - A building plan including: room layout indicating the materials to be typically found in each room or area, with notes on quantities and storage container; alarm locations (with file on equipment specifications and maintenance); fire extinguisher locations; exits, stairs, elevators, escape route; sprinkler layout and control point; HVAC system control point and notes on control for smoke ventilation and air distribution system; and notes on type of construction of walls, floors, and roof.
   - Traffic control during an emergency.
   - Security for critical resources.

- Deploying fire/rescue teams and equipment in the event of an emergency.
- Storing fire control equipment where it will be accessible despite direct hazard effects.
- Alerting all emergency services of the dangers associated with technological hazards and fire during emergency operations.
- Selecting and setting up emergency casualty stations for screening casualties, administering first aid, initiating identification and casualty records, and arranging transportation to medical facilities if necessary.
- Obtaining emergency medical support during an emergency.
- Establishing and testing shutdown procedures.
- Maintaining drawing showing locations of utility key valves, switches, feedlines, and hazardous areas.
- Damage assessment reports.
- Maintaining adequate water supply after shutdown for drinking, firefighting, decontamination, and sanitation.

8. **Emergency Information—**This function activity should increase employee awareness of hazards and provide active channels for informing and advising them about appropriate actions before, during, and after emergencies. Effective collection and dissemination of information will help to control rumors and minimize dysfunctional responses. Plans for developing and disseminating information materials on preparedness, safety measures, evacuation procedures, and the like should be covered. Consideration should be given to establishing procedures for dealing with the media during an emergency in case the company's facility is affected by a disastrous situation.

   Include these aspects:

   - Assigning responsibility to ensure that all employees understand the warning signals, receive general instructions on what to do in an emergency, and know where to go and how to get to their shelter areas and/or disaster situations.
   - The dissemination of emergency information and instruction materials for any visually impaired and non-English-speaking workers.
   - Including emergency response activities on the agenda of regularly scheduled meetings for supervisory staffs.
   - Designating an information officer to act as official point of contact during an emergency.

9. **Administration and Logistics**

   Include these aspects:

   - Review and written concurrence from all company departments assigned emergency responsibilities.
   - Updating, as necessary, based on deficiencies identified through drills and exercises, change in organizational structure, and technological changes.
   - Statements that identify additional emergency resource requirements for personnel, equipment, and supplies.

10. **Supporting Materials—**The basic emergency operations plan or action checklist should be supported by appropriate appendices that may be needed during an emergency. We recommend six specific appendices:

    a. *Maps*—Building floor plans, plot plan, street maps, and other appropriate maps that can be tacked to sheets of wallboard in the EOC. The EOC staff can use pins, stick-ons, and grease pencils, erasable marking pens, or clear plastic overlays to depict emergency situations and show the locations of available manpower and equipment. This method of illustrating what is happening will help to direct and control staff to decide what emergency actions should be taken.
    b. *Procedure Charts*—Simple organizational charts with the name, titles, addresses, and telephone numbers of key emergency personnel. These charts will be useful before and during emergency operations. The charts also should show which members of the direction and control staff are responsible for certain actions, such as dealing with the local governments, other industries, or contractors who have emergency equipment or supplies on hand.
    c. *Call-up Lists*—Call-up lists of key personnel should be available for activating the basic plan. These lists should include names, addresses, telephone numbers, and organizational responsibilities for emergency operations. Alternates should be listed in case primary personnel are not available. Company officials should carry pocket cards containing the company emergency services staffs and facilities.
    d. *Listing of Local Resources*—A resource listing of major sources of additional work force members, equipment, and supplies. The data would list by company and location the kind and the number of skilled workers, equipment, and supplies available in the community. The resource listing should be updated at least annually.
    e. *Mutual Aid Agreements*—Agreements among companies and government agencies to assist one another, within defined limits, during major emergencies. The direction and control and emergency service staffs should be aware of the provisions of these agreements.
    f. *Glossary of Terms*—To be effective, the plan should use terms that mean the same thing to everyone concerned. To accomplish this, include a glossary of terms as a separate appendix.

11. **Providing Emergency Funds—**After a disaster the need for immediate funds is crucial. Insurance funds will cover a loss of property that is insured. However, these funds may not be available for some time. The disaster plan should establish procedures for authorizing several of the disaster team members to have access to several sources of the organization's funds. The plan should specify when sources become available. Sources include cash, automated teller machines (ATMs), checking accounts, and credit cards.

Disaster Recovery

CONTINUITY OF MANAGEMENT

Leadership and direction are requirements in all emergency programs. It is essential that business and industry emergency operation plans and procedures for responding to emergency situations cover the maximum extent possible, so that continuity of leadership and direction is readily available in the immediate post-disaster period.

Specific Measures

Specific measures needed to develop a plan for continuity of leadership include the following:

1. Ensure a continuous chain of command.
2. Establish lines of succession for key officers and operating personnel.
3. Establish an alternate company headquarters.
4. Ensure records preservation.

Emergency Lines of Executive Succession—Leadership required for continuation of the management of the corporation could become virtually nonexistent, unless plans are made for lines of succession. Corporate management has the responsibility to anticipate such post-disaster management problems and provide for them by developing a management personnel succession list for each key executive or key position.

A simple form can be used for all levels of management executive planning. Replacements for each position should be listed in sequence. Each name may appear often with varied priority of succession. The next available person on the list would assume temporary responsibility for each respective position.

Alternate Headquarters—Another factor relating to the continuity of management is the establishment of an alternate company headquarters. The purpose of a remote site is to provide a safe location, if permanent offices are unusable, to maintain vital production in times of disaster. The backup facility could also serve as a command center for contact with government authorities, company offices, and employees in the central office area.

The following example explains how to staff the alternate headquarters in the event of an emergency. Assignments of executives and other critical technical staff positions are made on a three-deep basis: principal, first alternate, and second alternate groupings. Select an emergency staff group such as secretaries and clerks, in the ratio of one to every three executives.

To ensure that the facilities of the alternate headquarters are kept active and ready for use, keep executives and support staff familiar with alternate headquarter records, plans, and equipment. Conduct periodic drills to test the company evacuation plan to seek out flaws and to maintain equipment. Exercise the plan at least once each year and assign one of the emergency groups to the alternate headquarters for simulated emer-

gency duty. Develop simulated problems for the group to resolve as they run the corporate structure from the alternate headquarters during the test period.

CONTINUITY OF PRODUCTION

Preservation of Records—Preservation and protection of vital records in an emergency is essential for a quick return to normal operations. Destruction, disruption, or loss of records can significantly delay recovery operations. To ensure that these records deemed essential for continuity of business are properly safeguarded, take the following steps:

1. Identify priority categories of essential records.
2. Label all records within the priority categories with identifiable markings. Evacuation priority should be noted on record containers.
3. Assess the vulnerability of stored records to direct and secondary damage from various disaster threats (e.g., fire, water damage, chemical damage, aftershock, vandalism, etc.).
4. Evaluate alternate records storage locations, depending on hazard analysis.
5. Make arrangements for transportation to relocate records to alternate locations, if necessary.
6. Identify and retain copies of the records that will be needed during the emergency operations by management or the emergency response teams.

Selecting Records to be Protected—The vital information protection program is an administrative tool for safeguarding vital records. Management begins by systematically determining what information is vital, and which records contain this information. The following procedures can be used to analyze the company's vital records:

Step 1: The project team classifies company operations into broad functional categories (e.g., finance, general administration, etc.).
Step 2: The project team determines the role of each function in an emergency. Some activities must be suspended during the recovery period.
Step 3: The project team identifies the minimum information that must be easily accessible during a post-disaster emergency to ensure that vital functions perform properly.
Step 4: The team identifies the particular records that contain this vital information and the departments in which they are, or should be, maintained.

The majority of vital records are processed by computers. However, certain vital information must be maintained as hard-copy paper records. Planning considerations should be given to protecting both kinds of vital records.

Before determining the best method for protecting vital records, consider the hazards to which the site, building and computer equipment are available.

The use of alternate computer facilities presents several problems. Primarily, the alternate computer facilities to be used in an emergency must be truly compatible with the company's computer system.

The vital records protection program must be tested and evaluated at least once a year to note any problems. The test should verify that vital records needed after a disaster are:

1. Current;
2. Protected against hazards; and
3. Retrievable as needed.

Summary

The key to controlling an emergency or disaster situation is a well-conceived and developed program. The eight major subject areas that should be included in any emergency response and disaster preparedness program are: communications, general emergency plans, evacuation procedures, company assessment, natural emergencies and disasters, manmade emergencies and disasters, consideration for emergency operations, and disaster recovery. Action plans should be designed to ensure the safety and well-being of individuals and property in the event of an emergency or disaster.

There are many actions your employees can take prior to an emergency that will positively impact both their performance and outside agency performance when and if an emergency should take place. Your action plan should include the mechanism that will be implemented if populated areas near the enterprise must be evacuated.

Questions

1. True or false: The HAZWOPER standard was developed to protect workers from hazardous materials.

2. True or false: A tsunami is a large, long water wave caused by earthquakes, land slides, and other violent movements along the ocean floors.

3. True or false: On January 24, 2003, General Colin Powell was sworn in as the first Secretary of the Department of Homeland Security.

4. True or false: The National Oceanic and Atmospheric Administration provides hurricane forecast information on the telephone.

5. True or false: Vehicles containing hazardous materials cannot be moved before they are placarded.

6. True or false: Containing a leak is strictly a job for experts. Explain.

7. True or false: Elevators may be used to evacuate a building as long as they remain operable.

8. Name two types of emergencies.

9. What is the most important aspect of creating an emergency response plan?

10. Name two possible consequences of a large-scale emergency.

Case Studies

I

Date of Accident: May 8, 2003
Time of Accident: 5:08 p.m.
Location of Incident: General Motors Production Plant—Moore, Oklahoma
Supervisor: William Young (Safety Manager)
Losses Incurred: Two-thirds of the 3.9 million square foot facility was destroyed and $100 million in damages to employee and plant vehicles.

Summary Description of Events

On May 8, 2003, a tornado ripped through a community several miles southeast of Oklahoma City, leveling everything in its path. The GM plant received the first tornado warning at 4:33 p.m. from the National Weather Service broadcast. The plant's emergency response group, which includes the plant safety representative, the United Auto Workers safety representative, and the shift manager, quickly gathered to monitor the storm's path. Seventy-five TVs through the facility were tuned into the weather report.

At 5:08 p.m. the response group made the decision to activate the emergency system and all employees were instructed to head for the tornado shelters. By 5:18 p.m. all employees were sheltered. At 5:30 p.m. the storm hit the plant. A few minutes later, the plant was in ruins.

The May 8th tornado tore a 19-mile path from Moore, Oklahoma, to southeastern Oklahoma City, injuring more than 100 people and destroying 300 homes. When the damage was assessed, the costs tallied $100 million, not including the loss of production. Although the facility sustained significant monetary losses, the plant did not have one injury or loss of life.

Post-response Assessment

The GM plant did receive major structural damage, putting the plant out of business for nearly 7 weeks. However, the emergency response plan implemented by the plant safety manager, William Young, was prepared for the worst. The plant manager

decided that after a near-miss of a class F-3 tornado three years before, the plant should adopt an emergency response plan in case of such an event. The contingency plan was accepted and implemented for each shift. The plan was tested annually. Every employee had a primary and secondary evacuation route to an internal shelter. The shelters were constructed of solid concrete and reinforced with steel. Each shelter provided a survival kit including a flashlight, batteries, radio, water and first-aid kit. The plan included employees' responsibility to shut off all power, valves and lights.

Without the contingency plan and the implementation of the plan and practice drills, GM could have sustained more than just structural damage. The plant manager, safety manager and all the employees should be commended for their effort in being prepared for this natural disaster.

II

EMERGENCY RESPONSE

Date of Accident: September 15, 2003
Time of Accident: 3:30 p.m.
Location of Accident: private swimming pool
Supervisor: Mr. Frank Voice (grandfather)
Losses Incurred: Five-year old boy saved from drowning

Summary Description of Events

Three children were swimming in their neighbor's private swimming pool under the supervision of their grandfather, Mr. Frank Voice. The doorbell rang and, prior to answering the door, Mr. Voice told the children to get out of the pool area. The three children were John, 5; David, 8; and Lisa, 10.

They did obey, but only for a short time. John returned to the pool to get his boat sailing in the water. While reaching in to grasp the plastic boat, John lost his balance and fell into the pool. He was not a good swimmer and he panicked, swallowing water and vigorously splashing around the water in the five-foot-deep section.

John's ten-year-old sister Lisa immediately jumped in after him, pulled him to the pool stairs, and tried to call the grandfather. Mr. Voice was trained in CPR and first aid and he started to administer the emergency treatment. John had not swallowed too much water, and after a short period of time his condition was stabilized. The quick reaction by Lisa saved her brother John from drowning.

Post-response Assessment

During the past 30 years, a significant number of private swimming pools have been constructed. According to the National Electronic Injury Surveillance System (NEISS), approximately 1,150,000 accidents that require hospitalization have been recorded. There is a concern on the more than 13,000 serious diving accidents and more than 1,000 drownings that occur each year.

It takes only a minute or two for a child to drown, and there doesn't have to be a large amount of water. As a matter of fact, in the late eighties there were 100 reported accidental infant drownings in four- to six-gallon buckets. The CPSC now has recorded about 200 such drownings.

The need for adult supervision is critical, but the real key is that adults should be trained in administering emergency CPR and first aid. Children should also be taught to swim at a very early age.

In following the same objectives as safety in the workplace, domestic safety should follow the principles of identification, recertification, and evaluating the system.

- Assess the situation for potential causes of accidents in and around the pool. Be aware of electricity, physical hazards (e.g., broken glass, nails, etc.), along with mechanical hazards.
- Identify the problems (hazards) and eliminate them either by securing the area (locking gates to the pool) or by removing the dangerous situation.
- Preventative measures must be carried out because it is estimated that a residential swimming pool is 14 times as likely as a car to be involved in the death of a child less than five years of age.
- Childproof fencing 4.5 to 5 feet high is recommended around swimming pools.

GROUP DISCUSSION

Discuss and expound on the level of performance for each of the emergency response situations in the two case studies. What are your recommendations for further preparation in each scenario?

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CHAPTER 4

Fire Safety

Contents of Chapter

Introduction
Program Goals
Program Elements
Preparation and Prevention
Mitigating a Fire Emergency
Recovering from a Fire Emergency
Summary
Questions
Case Studies
Resources

Introduction

Everyone concerned must understand a fire loss control program. Support and understanding by top management is necessary to substantiate the corporate loss control programs, whether they pertain to life safety or conservation of property. Most corporate fire programs are economically sound and correlate to cost effectiveness. However, the greatest loss of life from fire today occurs in single-family dwelling units, while the greatest monetary losses from fire are still in the commercial occupancies.

Losses from fire include life, property, the organizational efficacy, medical losses, environmental losses, legal losses, and non-tangible losses such as reputation and community standing. Clearly, the operative terminology used in each of these examples is losses.

As such, all concerned must understand a fire loss control program. Total support and understanding by top management is necessary to substantiate the corporate loss control programs, whether they pertain to life safety or conservation of property. This

top-level support can only be achieved if a fire loss control program is cost effective and the safety manager is knowledgeable enough and articulate enough to convey this information in a convincing manner. In addition, safety professionals must remain innovative and energetic in order to motivate employees for the support of the corporate loss control programs that are established.

This chapter is dedicated to providing a cursory understanding of the basic components of a fire loss control program. By providing the reader with this rudimentary understanding of these components, it is hoped that a greater desire for knowledge will be stimulated. If so, there are many volumes of information available for each area of concentration presented in this chapter.

Program Goals

Whether you are designing a fire loss control program, an emergency action plan, a hazard communications program, or just a home fire plan, there are certain common questions that must be answered. These questions follow a basic logical format and the answers to them form the foundation for the response plans. These questions include the following:

- What is the physical description of the structures involved in the program?
- Where are these structures located geographically?
- What occupancy types are within these structures?
- What are the processes being carried out within these structures?
- Who, how many, and what type of personnel are utilized in these processes?
- What are the hazard potentials?
- What materials contribute to the hazards?
- Where are these materials stored and in what quantities?
- What proactive measures are being taken to avoid these potential hazards?
- What resources are available if a hazard becomes an event?
- What policies and procedures have been developed to mitigate or control those hazards?
- What plans are in place to recover from an event?
- Are the plans current, effective, and properly presented?

Each of these questions can spawn a dozen more specific questions. Only when all of the primary and subsequent questions have been answered can an effective fire loss control program be developed.

Although these questions appear to be simplistic and direct, the answers are neither. To properly answer them, a considerable knowledge base must first be acquired. The proceeding section breaks a fire loss control program into its elemental components and offers expository information for each. After reading each of these segments, the reader should then be able to properly answer the preceding questions with confidence.

Program Elements

There are several considerations when developing an effective fire safety program. First and foremost is the prevention of fires. Second is the mitigation of a fire if and when it should occur. The final consideration is the recovery from a fire.

Each of these three areas can be further broken down into their individual components. For example, an effective program for preventing fires must include: 1) inspections; 2) education and training; 3) evaluation of fire possibilities; and 4) fire prevention activities. The mitigation of a fire includes 5) fire suppression activities; and 6) emergency services. Finally, recovery will include both 7) communication and 8) reports and recordkeeping activities.

Consequently, we now have established the three main program objectives and the eight corresponding program elements. Still further analysis reveals that these eight objectives can be broken down into tasks and activities. The accomplishment of project activities (day-to-day tasks) will achieve the corresponding program objective, which in turn contributes to the program structure. Ultimately, the protection of life and property will be the desired result.

This systematic approach to program structure provides organization and clarification of duties and activities needed to implement a fire loss control program. A brief description of the eight program elements follows to clarify their purpose (N.F.P.A. Fire Codes, 1980).

Inspection—Periodic inspections should be conducted by trained safety inspectors or fire brigade members to assure that fire protection systems are operable and capable of performing their functions, and to detect hazard areas that may create fires. Inspection is a tool used by the safety manager to comply with applicable regulations.

Education and Training—Must be provided by the safety manager to all employees with reference to regulatory requirements, fire hazards, evacuation routes, and use of fire control equipment. Specialized training must be provided for fire brigade members with regard to fire control equipment, personal protective equipment, and procedures.

Evaluation of Fire Possibilities—A thorough, periodic inspection, audit, and evaluation of the enterprise by the safety manager must be conducted to analyze possible fire hazards. This audit takes into consideration the building and complex layout features, products, processes, storage, and so on.

Fire Prevention—A comprehensive fire prevention set-up permeates all other program elements, such as inspection and education, and incorporates them as a basis to prevent fire losses before they occur.

Fire Suppression—This area of consideration includes the control of fire by purchase and installation of fire control equipment and the establishment of a fire brigade. Equipment includes but is not limited to alarm systems, sprinkler systems, other extinguishing systems, portable extinguishers, and standpipe systems.

Emergency Services—The safety manager needs to develop procedures and protocols for contacting and using community emergency services during any emergency or disaster. These organizations (police, fire, medical responders, hazardous material

response units) can be used as consultants involving training, equipment, regulations, and many other areas of concern.

Communication—Open lines of communication must be made, not only within the organization itself but also outside the organization to local emergency services needed during a fire or other emergency.

Reports and Recordkeeping—Accurate records must be kept involving equipment, inventories, fire losses, inspections, training, history, and other recording aspects to aid management in fire prevention, suppression, investigation, and regulatory compliance. Records need to be kept on activities, accomplishments, and the needs of the fire program.

Preparation and Prevention

As previously stated, the first step in any fire safety program is to prevent an incident from occurring in the first place and to prepare for a response should it happen despite efforts to the contrary. With this primary objective in mind, a safety manager must be aware of programs, concepts, regulations, and terminology relating to this first objective.

A fire safety loss and prevention program should be based on sound fire safety concepts. Applying these concepts in a logical approach is the best method for achieving an efficient and cost-effective fire safety management program. Such a program should be developed in an organized fashion. Too often, managers develop programs haphazardly only to wonder why their programs achieve unfavorable results or make very little impact on the enterprise. Safety managers should follow well-developed risk management principles when developing any type of program, especially a fire safety management program.

NFPA National Electrical Code 70E—Most building codes define building utility systems as those systems that are essential to the function of a building. The National Fire Protection Association's (NFPA) National Electrical Code 70E brings to you the complete facts needed to minimize worker exposure from electrical hazards and business exposures related to financial and liability repercussions.

NFPA National Electrical Code 70 is the most widely adopted set of electrical safety requirements in the world and is offered for use in law and for regulatory purposes in the interest of life and property protection In the workplace, this code is the only document that provides requirements that address all widely recognized electrical hazards and specify how to meet OSHA electrical safety mandates. The NFPA 70E Handbook is the key to applying NFPA 70E correctly. It includes the full standard text, authoritative commentary, practical advice, and scores of visuals that clarify provisions.

The reason your employees should be trained to identify electrical hazards when working around electrical equipment is based on the data compiled by NFPA that states that over 30,000 non-fatal electrical shock accidents occur each year. In addition, over 600 people die from electrocution annually in the United States and electrocution remains the fourth highest cause of industrial fatalities.

The purpose of NFPA 70E is to safeguard people and property from hazards arising from the use of electricity. In the workplace, electricians are not the only professionals that need to be concerned with electrical hazards. It is very difficult to imagine a workplace without electricity, and where there is electricity there are going to be electrical hazards. Hazards often occur because of overloading of wiring systems by methods or usage not on compliance with the code. Whatever the work environment, almost everyone is involved with potential sources of electrical shock. The code is intended to be suitable for mandatory application by governmental bodies exercising legal jurisdiction over electrical installations and also by insurance loss control professionals. The most severe hazard related to electricity is electrocution and this is the reason for employers to make sure their employees are aware of potential hazards and that they know how to prevent them from turning into accidents. In essence, workers must respect all electrical equipment and keep in mind that even low voltage levels can be fatal. In the workplace everyone must be prepared for an electrical emergency.

Hazardous Materials—The OSHA Hazard Communication Standard (29CFR 1910.1200) requires Material Safety Data Sheets (MSDSs) in addition to labels and warnings on containers. A question to ask is what is being produced or in storage within your facility. Also, what are the fire hazard characteristics relating to these materials, both individually and when exposed to each other? The standard assigns responsibility to the chemical's supplier for the content of the MSDS.

It is important to know where and how these materials are being stored. What outside catalysts might cause these materials to ignite? By carefully evaluating these questions, many fire prevention initiatives become readily apparent.

Process Evaluation—Now that we know and understand what we are using to produce our end product, we must now look at how we are using these raw materials. This will involve a careful analysis of our processes. Are we using these materials in such a way as to promulgate a fire? Is there a better way to get the same result in a safer manner? Can we substitute a volatile material for another material that is less volatile? Can we engineer a better process that will reduce the potential for a fire or an explosion? The answers to these questions will be as diverse as the workplace itself. In many cases, however, the answers will be that there is a safer way to process our raw materials into our finished product. That is the essence of any fire prevention program. Refining our processes to reduce the potential for fire, while still maintaining an acceptable level of production, is the primary goal.

Included in any process evaluation is how materials are being stored and transported throughout the facility. It is of little value to refine our in-house storage and process systems only to have an off-site transportation contractor come into the facility with faulty equipment and work practices and blow the plant up! Remember a material and processes evaluation begins at the moment raw materials enter the gate and finished products leave the gate. Don't limit your fire prevention activities to only those people who work within the company itself.

NFPA 101—Life Safety Code—Ensuring the life safety of workers in the event of a fire or other emergency is a paramount responsibility of employers. Today, the Life Safety Code exists because a number of devastating, catastrophic fires focused

national attention on the fire problem and the inadequacies of life safety features in the buildings. Fires and other emergencies occur with regular frequency in the workplace. Employers must be ready by ensuring that all employees are warned when an emergency is discovered and can be safely evacuated from the premises. Fires and other emergencies can occur at any time in any part of a facility. Fires are highly likely to occur, especially in industrial facilities. A small fire can rapidly progress into a major catastrophe within a few minutes.

The administration and fundamental requirements of the Life Safety Code specifies the intended goals in order to meet the code's requirements. They are as follows:

- Provide for adequate safety without dependency on any single safeguard
- Ensure that construction is sufficient to provide structural integrity during a fire
- Provide an appropriate degree of life safety considering the size, shape, and nature of the occupancy
- Ensure that the egress paths are clear, unobstructed, and unlocked
- Ensure that the exits and egress routes are clearly marked to avoid confusion
- Provide adequate lighting
- Ensure prompt occupant response by providing warning of the fire
- Provide for back-up or redundant egress arrangements
- Ensure suitable enclosures of vertical openings
- Allow for design criteria that exceed the scope of the code

Life safety hazards can also be identified by conducting regular inspections. Two types of inspections are recommended for facilities—a self-inspection program and management-led quarterly life safety inspections of the facility. The two types of inspections should analyze the factors that influence life safety assurance.

There are many factors to consider when evaluating a structure with regard to fire potential. The primary question to be answered is how a structure is being utilized. In other words, what's going on inside of the structure? The National Fire Protection Agency has many classifications of buildings in their NFPA 101 Life Safety Code manual. Each building classification has corresponding fire safety requirements. For example, a building being used for "Assembly" occupancy has much greater safety requirements than a building being used for "Business" occupancy.

It is at this point where the safety manager must understand the NFPA fire standards. The National Fire Protection Agency develops standards that may be adopted by the local jurisdiction as law. Until they are adopted as law, they remain only recommendations. These standards consider all of the inherent characteristics of a building or structure regarding fire safety and prevention and also take into consideration whether the structure is new or existing. The NFPA 101 Life Safety Code offers recommendations regarding the preservation of life through protective construction features, fire mitigation systems, alarm systems, and exit planning. A competent safety manager will use these NFPA standards or laws as a guideline for planning a fire safe building or complex.

Simply stated, a safety manager will first identify the occupancy type of a building as outlined in the NFPA 101 Life Safety Code and will then apply the applicable code provisions to the type of building or buildings within his or her fire plan.

In summary, the Life Safety Code establishes minimum requirements that will provide a reasonable degree of safety from fire and similar emergencies in buildings and structures.

Community Awareness—It is not enough to know our own materials, processes, or structures. Any facility must operate within a community. Depending upon our hazards, the effects of a fire may extend beyond the borders of our own organization. A fire does not know boundaries. A fire may pose a considerable hazard to life, property, and the environment of those who live or work near a facility. As such, the safety professional must give due consideration to that possibility.

In your assessment, the safety manager must be able to predict how far the negative effects of a fire may extend beyond the plant or business border and plan accordingly. Some considerations might include the occupancy types of the surrounding community. Are there schools, assembly occupancies, homes, or other types of high life-hazard occupancies just outside of your facility borders? If so, you must consider terrain, traffic patterns, evacuation routes, weather patterns, etc. in order to protect others from a fire that may occur in your facility.

In other words, be very aware of your community and the exposure threats presented to them by a fire or explosion in your plant. The community offers other features that may assist you in the event of an emergency. What resources are available to you to contain a fire or explosion in your plant? Where are those resources located? What might inhibit those resources from reaching your facility? These issues will be discussed further in another section of this chapter.

Develop Policies and Procedures—The fire service has adopted procedures and protocols that govern policy statements. For policies and procedures to be effective, they must be understood by every participating member or organization. A common mistake that many safety managers make is to compile complicated plans and directives that encompass volumes of written documents. These plans and procedures make very good doorstops or paper weights, but they are relatively worthless in their application. Most people do not read them, or if they do, they do not understand them. Other responding agencies do not use them because they do not have the time or resources available to use the information in a hurry.

Policies and procedures must be task-specific and easily understood. They must also interface with other emergency response plans throughout the community. Don't reinvent the wheel, so to speak. Before preparing your own procedures, it is a good idea to first evaluate the community response plan and the standard operating procedures of outside response agencies that might be called to assist you. Your fire plan should flow with the larger plans adopted by the community.

Remember that your fire plan is site specific. It should be developed to handle fire emergencies within your own facility and should coincide with community plans should the event extend into the community.

The easiest way for a safety manager to distinguish between policies, procedures, and fire plans is to separate them in their design. Company policies and procedures should be developed with day-to-day operations in mind. These policies and procedures are designed to prevent a fire or other emergency from happening by outlining how materials are to be stored, used, and processed. Fire plans are designed to mitigate an emergency when these policies and procedures fail to prevent a fire.

Training and Education—All the plans, policies, and procedures will only be as good as the effort spent in training and in implementing simulated drills.

Once a safety manager has developed a plan in conjunction with input from all involved personnel and agencies, the manager needs to know how to implement the key components of the plan. This is not a one-time endeavor. A definitive training schedule must be developed as well. In addition, the skills required to perform the lessons taught must be periodically practiced. This type of training must include everyone who may be involved in an event in order to maintain continuity and coordination. Remember the hundreds of fire drills you participated in as a student? The benefits of this type of hands-on training are obvious.

It is no secret that most people do not like to take classes or participate in drills. Safety managers may be able to require employees to take training and participate in safety drills but the results of this mandated participation may be far less than is desired. Inversely, the safety manager cannot mandate that an outside response agency or the community at large shall participate in this type of proactive fire response training. The best safety managers will develop programs that are not only educational but are also fun. If employees and citizens have a good time while they learn and practice skills that may save them from disaster, then, they will continue to participate. Encourage participation through recognition, rewards, and humor. The success of any fire plan will directly be proportionate to the safety manager's ability to solicit willing participation.

In the evaluation process of evaluating fire vulnerabilities, protection guidelines should be developed after analyzing the data collected. The fire protection guidelines should include the following:

1. The NFPA codes and standards, OSHA standards, local and state building codes, and requirements for types of building construction necessary for safeguarding life and property.
2. A ranked list of areas which have a significant value to the continuity of the organization's operation.
3. A schedule for conducting life safety evaluations.
4. Design review processes and inclusion of insurance carrier's recommendations.
5. Fire protection assessment schedules.
6. Water supply requirements for high-value areas.
7. Fire protection criteria for high-value areas or facilities requiring a primary means of fire protection to be automatic and secondary means to be manual.
8. Guidelines for protecting special hazards such as computer rooms.

The safety manager has the responsibility for delegating authority, while the staff will implement the program.

Mitigating a Fire Emergency

Prehistoric man lived in a cave. He had no electricity, gas, matches, candles, or processes that used heat. As such, he might freeze to death or die of exposure but he certainly would not burn to death, right? Wrong! Just when he thought he didn't have a care in the world, lightning struck the woods surrounding his aggregate domicile and he died in the ensuing fire. I'm sure his last thoughts were, "Wish I'd had a fire response plan."

You would think that mankind would have gained a healthier respect for fire over the last million years but it seems that the same mistakes are still being made today. Inadequate fire response planning results in billions of dollars worth of property loss and many hundreds of lives lost in any given year. Fire continues to be a substantial threat in the home as well as in the workplace.

There is good news, however. Technological advances, regulations, planning, and education can reduce this threat substantially. It is paramount that safety managers know what is available and how to apply what is available in order to keep the workplace safe from fire and explosion. This section offers some insight into available technology.

Alarm Systems. You can't put a fire out or survive a fire situation if you don't know that there is a fire. In large buildings, or even in homes, this can be very problematic. Over the years, great strides have been made in this area.

Fire alarm systems can be very simple. One of the simplest and most effective is a single station smoke detector. These units have been placed in millions of homes and are considered to be the greatest lifesaving tool in the home. Now, these single station smoke detectors can be wired in series and when a fire occurs all of the single units in the home will activate. Many of these in-home detectors are now hardwired and have a battery backup in case the electrical power in the home fails. As stated, this type of detection and warning system is the simplest and most effective in small areas.

When a structure has many thousands of square feet under one roof, or when a complex involves many such structures, single station smoke detectors are not nearly enough. Hundreds and thousands of people may need to be notified immediately. This calls for a more complex system of detection and notification. In order to accomplish

Figure 4.1. Smoke Detector

Figure 4.2. Alarm Panel

Figure 4.3. Pull Box

Figure 4.4. Horn and Strobe

this task, electrically supervised systems have been developed. These types of systems incorporate series wired smoke and heat detectors that activate horn and strobe units throughout the structure or complex. In addition, these systems include pull-station devices that will activate the alarms and they are located at all of the exits. All of these activation devices will activate an indicator light at a conveniently located enunciator panel. This enunciator panel is carefully located at the fire department's arrival point so that they can quickly determine where a fire might be located within the structure or complex.

Electrically supervised detection and alarm systems may have one, two, or three functions depending upon the type of system installed. The primary function of any electrically supervised alarm system is to notify the occupants of a building that an incident is occurring and allow them to quickly and safely evacuate the structure or complex. These simplest forms of electrically supervised alarm systems require an occupant to then notify the fire department that there is a fire in the building. Many times the occupants hear a fire alarm and assume that a fire department has been notified when, in fact, they have not been. It is incumbent on the safety manager to designate a person or persons to contact the fire department if this type of local alarm system is used. Often, these types of local alarm systems are installed because once installed, there is no further cost to the company.

A step up from a local electrically supervised alarm system is a monitored electrically supervised alarm system. This is basically the same alarm system with one exception. These types of systems are also wired into either an emergency center or a privately owned monitoring company that will automatically notify the responding agencies anytime an alarm has been activated. These types of monitored alarm systems negate the need for a building occupant to call for help in the event of a fire or other emergency. These types of systems, however, require a monthly monitoring fee to be paid. The safety manager or company management must decide if the cost of monitoring the system on a 24-7 basis is worth the monitoring costs.

The third type of system can be employed by either an in-house or monitored electrically supervised alarm. This third feature activates certain fire suppression systems when an alarm sounds, or when a suppression system has been tampered with. This feature is used primarily with deluge sprinkler systems and pre-action sprinkler systems. Both of these suppression systems will be addressed later in this chapter.

Figure 4.5. Stairwell Standpipe

Standpipe Suppression Systems. Once a fire has been detected, there are many devices designed to suppress it. One such device is a standpipe system. Standpipe systems provide immediate access to a water source for fire fighting purposes. Instead of a fire department having to string hose throughout a structure, a standpipe system provides piping for this purpose with outlets at various locations in the structure or complex. Usually, these gated outlets are located in the stairways or in the hallways.

There are three types of standpipe systems as outlined in the NFPA 14 standards. They are Class I, II, and III. Class I systems are designed for fire department use only and have no hose attached to them. Class II systems have hose cabinets and nozzles for building occupants to use. Class III systems have hose and are designed to be used by either the fire department or the building occupants.

Standpipe systems may be either wet or dry. A wet standpipe system has water in it at all times. These types of systems are problematic in areas where vandalism may be present such as college dormitories. Dry standpipe systems require the fire department to supply them with water from a hydrant or other water source through a connection located outside of the structure.

Class II and III systems require continued maintenance since fire hose must be tested annually and may deteriorate over time. In addition, when untrained personnel use these types of systems, they put themselves in a life-threatening situation. They can also cause considerable water damage when overzealous users fail to shut down a line immediately after a fire has been extinguished.

Over the years, Class II and III systems are being phased out due to the liability issues mentioned. Many fire departments or other authorities having jurisdiction do not accept any standpipe systems other than Class I.

Older fire codes mandated that separate water piping be used for standpipes and sprinkler systems. More recent code changes, however, allow both types of systems to be fed from a common riser.

Sprinkler Systems. By far the most effective fire suppression devices are sprinkler systems. They are constantly in a ready position to fight a fire even when a building or structure is unoccupied. Here again, these systems can either be wet, dry, or a combination of both.

There are certain components common to all sprinkler systems. All sprinkler systems have a system of piping throughout the structure. They begin with the main line coming into the structure and this is called the sprinkler riser. At each floor another

Figure 4.6. OSY Valve

Figure 4.7. Siamese and Fire Pump Connection

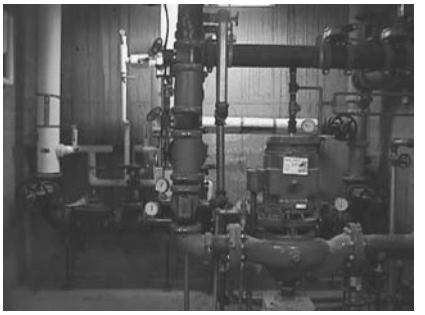

Figure 4.8. Sprinkler Room 2

secondary system of piping provides a piping system to deliver the water to the sprinkler heads. This secondary piping diminishes in size as it branches out from the main riser. Where and when the pipe sizes are reduced is based upon hydraulic calculations by a certified engineer. This is so adequate flow and pressure will be assured at each head.

Most systems have a sprinkler room where valves, clappers, and gauges are installed. Here, too, air compressors are designed to hold back the water in dry system areas. Outside of the structure are connections that allow a fire department to supplement the water supply or to provide added pressures when multiple heads are activated. These connections are referred to as Siamese hookups because they allow at least two lines to be connected to them from a hydrant or fire department engine. Valves used in a sprinkler or standpipe system allow an inspector to readily recognize if a valve is open or closed. These valves are called open stem and yoke valves (OSY valves). In addition, tamper switches are wired into the alarm system and will trip an alarm when any OSY valves have been closed. This ensures that a system will not be shut down accidentally or intentionally. Another type of valve used in sprinkler and standpipe systems is called a post indicator valve or PIV. A PIV is a buried valve that allows either system to be shut off outside and will not allow the valve to freeze up in cold weather since it is buried. These valves protrude out of the ground and have a glass indicator that allows an inspector or firefighter to know if the system has been shut off.

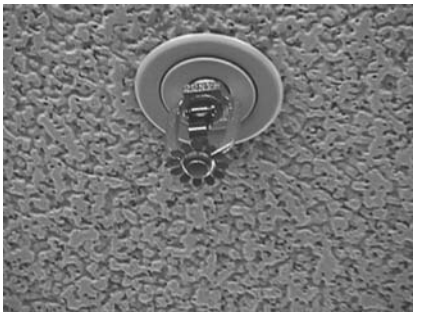

Figure 4.9. Sprinkler Head

The termination or delivery point for a sprinkler system is the head. Heads are designed to open and allow the flow of water when the ambient air temperature reaches a predetermined point. When a fire is present and the fusible link that holds the sprinkler head closed is melted or activated due to heat, the sprinkler head opens and water is discharged. Normally water continues to flow even after the fire has been extinguished or until the system is shut down and the head replaced. Codes require that additional heads be placed in the sprinkler room so that an immediate head replacement is available when one is activated. There are four primary types of sprinkler systems. They include wet systems, dry systems, deluge systems, and pre-action systems. A brief review of each will be discussed now.

The most prevalent type of sprinkler system is the wet system. This means that the water piping is continually full of water and water is immediately available at any sprinkler head that may be activated. These types of systems require that the environment remain above freezing temperatures. As stated, most buildings employ this type of system. Examples include shopping malls and office buildings.

Dry systems are used where there is a possibility of the pipes freezing. When these systems are used, either the fire department supplies water to them or air is used to keep water from filling the system until a sprinkler head is activated. Many wet systems employ a partial dry system where piping is apt to freeze. An example of this would be a mercantile structure that is well heated but which has an outside loading dock area. The heated area of this structure would have a wet system and the loading dock area would have a dry system. This is accomplished by installing a clapper valve in the piping leading out to the loading dock area and holding the clapper valve closed with compressed air. When a sprinkler head on the loading dock is activated, it allows the pressurized air to escape and the clapper valve will open allowing water to flow to the activated head. Combination wet/dry systems require clapper valves to be installed and an air compressor to provide the compressed air pressure needed.

In certain applications, leaking sprinkler piping could cause staggering property damage. Libraries and museums are good examples of these types of occupancies. Oftentimes, the contents of these types of structures are far more valuable than the structures themselves. In order to protect these institutions, a form of a dry-pipe sprinkler system is used. Even though the protected areas are well heated, the sprinkler piping is kept dry. The difference between a true dry system and a pre-action system is that any alarm activation causes the piping in a pre-action system to fill with water even though

a sprinkler head may not have been activated. This removal of the compressed air holding back the water is accomplished through an air evacuator. When an alarm is sounded, the air evacuator valve opens and displaces the air in the system with water. At this point, the system is full of water and ready to respond if an actual fire trips a sprinkler head. This system can be problematic because when an accidental alarm is activated, such as smoking under a smoke detector, the system fills with water and this water must be removed and the system reset after the accidental alarm has been reset. This involves a considerable amount of effort and time.

Inversely, some structures are so inherently volatile that when an alarm is activated the whole area needs to be flooded immediately. Some good examples of these types of structures are airplane hangars and fireworks factories. Obviously, a small fire in either of these structures can quickly escalate into an explosion. For this reason, a deluge sprinkler system is employed. A deluge system is a dry system with a valve that is either opened with a manual switch or through alarm activation. The sprinkler heads do not have any fusible links, and therefore they remain fully opened at all times. When the triggering valve is opened, all heads immediately flow water and flood the entire area very quickly. As such, even a small fire is quickly extinguished before an explosion can occur.

Sprinkler design and types are much more complicated than can be written in this short chapter. Many books have been written about sprinkler systems. One very good source of additional information is the National Fire Protection Association (NFPA) standards for sprinkler systems (Specifically, NFPA 13, NFPA 13D, and NFPA 13R).

Fire Brigades. In large and remotely located facilities, fire brigades are an integral part of any fire plan. Over the years, however, many smaller companies have chosen to discontinue their in-house fire brigades in favor of mutual aid agreements with established fire departments in the area. Several factors have contributed to this decision. The increased training requirements for fire brigade members make this an unattractive option for most companies. Also, the skyrocketing costs of fire suppression equipment in addition to the medical monitoring requirement contribute greatly to disbanding established fire brigades. Most small companies have found it far more economically feasible to simply provide additional support to their local fire departments in exchange for their professional services.

Still, there are large companies who have retained their fire brigade organization because of their timely responses and familiarization with the site and the processes being employed. In those instances, fire brigades are an essential part of the plant emergency organization and should be designed to fit the specific location.

A fire brigade uses manual firefighting methods for initial suppression of fire. This may be considered the action phase of the entire loss-control effort available to suppress a fire in its early stages. The first objective is to suppress a fire in the event of impairment of automatic protection and to provide extinguishing capabilities where automatic protection is not provided.

We have made the point that the fire brigade will vary considerably with each facility, depending on a variety of factors. Let us turn our attention to manpower requirements for a fire brigade established to provide manual protection for an important facility. It is obvious, in this particular instance, that management must make

some decisions as to what they expect from a brigade and how they will support it. These decisions will include staffing the brigade and providing equipment needed to successfully fight and suppress fires.

The revision of Subpart L (chapter 1) of the OSHA Standards, effective December 1980, influences management decisions involving manpower and equipment. The portion of the standard directed to fire brigades is intended to assure that employees who must fight fires are provided with adequate personal protective equipment, training, and leadership to assure their safety and health during fire fighting and rescue operations. In the event of fire:

Option 1—Employees will evacuate the building, because no portable fire protection equipment is available. Employers must provide a written emergency action plan, fire prevention plan, and evacuation operations shutdown training under this option.

Option 2—Employees will evacuate the building, with portable fire protection equipment provided. Employers must meet the same requirements as Option 1 along with maintaining and testing portable fire equipment in compliance with standards.

Option 3—All employees will use portable fire equipment in their immediate work areas. Employers must provide training to all employees when first hired and annually thereafter on fire extinguisher selection, use, and so on.

Option 4—Portable fire equipment shall be used only by designated employees in their assigned areas. Employers must provide training to designated employees as in Option 3 and also an emergency action plan, evacuation training, and critical shutdown training.

Option 5—Portable fire equipment will be used by a fire brigade to fight incipient stage fires only. Employers must provide training, a fire brigade organizational statement, annual training, specific hazards training, and higher level training for instructors and leaders.

Option 6—The fire brigade will fight all fires including interior structural fires. Employers must provide a brigade policy and organizational statement, training when assigned, training for special hazards, higher level training for leaders and instructors, brigade training, quarterly physical examinations of all brigade members, and OSHA-required protective equipment and clothing (Davis, 1991).

In selecting the fire brigade chief, it is important that personnel involved in these areas have good leadership and administrative abilities. To a lesser extent, this will also apply to assistant chiefs who will be in charge of the brigade on second and third shifts and perhaps during non-operating periods such as holidays and vacations. It is most important that brigade capabilities be provided at all times. Consequently, this may indicate the desirability of using maintenance employees rather than those who are heavily involved in the production processes. After selection of the chiefs and assistant chiefs, the structuring of the brigade into squads and those who will have special assignments such as electricians will depend on the availability of manpower. These squad members will have the responsibility, in addition to actual extinguishment, of taking salvage actions, handling electrical problems, operating fire pumps, and operating sprinkler valves. In large facilities, it is possible with the availability of manpower to designate specific assignments; in smaller organizations, however, multiple functions will probably have to be vested in one brigade.

Portable Fire Extinguishers. Portable fire extinguishers are probably the most common of all private fire protection equipment. They are also the most misunderstood. Even though OSHA and NFPA both require that employees receive annual training in the use of fire extinguishers when they are provided, they seldom do. If you ask most employees where the closest fire extinguisher is located, what type it is, how much fire can it put out, and how to activate it they will not know. Consequently, the fire extinguisher becomes useless when it is most needed.

Once again, the safety manager should consult with the NFPA 101 Life Safety Code to determine if a fire extinguisher is required for a specific occupancy type. If so, then a suitable extinguisher designed for the anticipated type of fire should be purchased, properly located, and properly installed. Then each employee must receive adequate training in the operation of the extinguisher and it must be checked and tagged at least annually to ensure that it is functioning properly.

Although there are many classifications of fire extinguishers, there are five primary ones:

Class A extinguishers—used for normal combustible materials such as paper, wood, and so on.
Class B extinguishers—used for combustible liquid fires such as gasoline or kerosene.
Class C extinguishers—used for electrical fires such as electrical motors and switches.
Class D extinguishers—used on metal fires such as magnesium, sodium, potassium, and zirconium.
Class K extinguishers—newly developed for kitchen fires involving greases and oils.

The extinguisher classification is determined by the properties and characteristics of the extinguishing agents placed in them. Many extinguishers can be used on several different types of fires and may have a multiple classification rating. An example would be an ABC extinguisher that could be used on normal combustibles, flammable liquids, and electrical fires.

Some of the extinguishing agents used in fire extinguishers include water, dry chemicals, carbon dioxide, halogen gases, or foams. The safety manager must determine the likely types of combustibles that may be involved in a fire and then purchase an appropriate extinguisher for those expected hazards.

As previously suggested, the most crucial factor involving the use of portable fire extinguishers is the proper training of employees. A common training acronym used in fire extinguisher training is PASS. It represents the four steps to be used when employing a portable extinguisher: **P**ULL the pin; **A**IM the discharge tube or opening; **S**QUEEZE the initiating lever on the extinguisher; and **S**WEEP the fire directing the discharge at the base of the fire.

Other types of fixed extinguishing devices. Some site-specific extinguishing devices incorporate technology from both the portable extinguishers and the sprinkler systems. One such device is a hood system used in restaurant kitchens. This system uses a pre-piped delivery system for a designated fire extinguisher using a K agent. It can be initiated by a fused link that is released by the heat of a cook top fire, or can be activated remotely by an employee.

Similar systems are used in areas that have computer systems or communications equipment that could be damaged by the application of water. What is important to know is that any suppression agent can be applied to site specific locations using a prepiped system of delivery.

Fire Departments. It is critical that a safety manager becomes aware of what outside resources are available to the company in the event of an emergency. Some factors to consider are response times, manpower, training levels, services provided, and reliability.

Some fire departments only respond to fires. Others provide varying levels of medical responses as well. Still others offer Hazardous Material Incident Responses. Some even have dive teams, public education teams, training teams, fire investigation teams, and a host of other services available upon request. A professional safety manager will research what services are available for his company and will utilize those services in his training and response programs.

There are three types of fire departments. The most common are volunteer fire departments. These types of departments may or may not have a high standard of training; however, recent laws and standards mandate that all departments have a minimum level of training in order to keep their certification as a department. The major flaw with volunteer departments is the subjectivity of a response. It has become harder and harder to find volunteers who are willing to commit the time and energy required to become a certified firefighter. Most people do not have the time or dedication to acquire the minimum mandated training that allows them to volunteer further. As such, there are times when a volunteer fire department is unable to respond or to respond adequately. In those cases, the safety manager might want to explore the possibility of developing an in-house fire brigade or seek out other neighboring fire departments to contract for their services.

Fully paid professional fire departments offer a totally reliable and definitive response to emergencies. Most have minimum staffing levels that they do not go below. They are on duty 24-7 and usually have exemplary response times. Most have mutual aid agreements with surrounding fire departments in case a situation exceeds their capability of adequately handling it. These types of agreements are reciprocal and are beneficial to all parties involved. Departments of this type are funded by municipalities or other government entities and pass these costs on to their citizenry in one form or another. If a company is located within the jurisdictional boundaries of a fully paid professional department, then it can anticipate a tax or a fee that is imposed by those governing agencies to pay for this professional service.

The third type of fire department is a combination department consisting of both fully paid members and volunteers. Some paid members on combination departments are only paid per call. This means that even though they are paid, the fire department is not their full-time employer and they still may not be able to make all of the calls if they are at their primary places of employment when the call comes in. Combination departments are the next best alternative to a fully paid professional department.

Water Systems. Water always has been and will continue to be the best way to put out a fire. As such, the amount of available water and the efficiency and reliability of the delivery system for that water are of primary importance to any fire safety plan.

Water systems used for fighting fires can range from farm ponds to municipal water systems. It is very important to know what type of water system will be used to put out a fire at your workplace.

There are two important factors involving the delivery of water to a fire. They are volume and pressure. You must have both in order to put out a fire. For example, a lake has a huge volume of water in it but no pressure to propel that water through a fire hose and onto the fire. Inversely, a garden hose hooked to a municipal water system may have a very high pressure but will deliver only a few gallons of water per minute. In order to understand your water system there are a few things you must first learn.

For every elevation of drop from a water source to its destination, approximately 0.5 pounds of pressure is exerted. If, for instance, our water source was an elevated tank that was 100 feet higher than where we wanted the water to be delivered, we would have 0.5 pounds per square inch (psi) multiplied by 100 feet, or approximately 50 pounds of pressure, being exerted at our destination point. Inversely, if we wanted to pump water up to that same storage tank from a lake that was located right beside our destination point, we would have to overcome that same 50 pounds of pressure in order to get it there. This pressure is described as "head" pressure.

You may have heard the old saying, "You can only put fifty pounds of potatoes in a fifty-pound sack." The same is true for water pipes. How much water you can move through a pipe is contingent upon the size of the pipe. Sure, you can apply more pressure to the water being moved inside the pipe and gain a little more volume of water but only a little. The size of the pipe determines how much water can be moved through it! That is why a fire department has different sizes of hose. Larger hose is used to move higher volumes of water and smaller diameter hose is used when smaller volumes of water will do. It's just that simple!

Now let's put this knowledge together and apply it to a water system. Municipal water systems take water from a huge water source such as a lake and then treat the water so that it is potable. Then they pump this treated water through pipelines up to elevated storage tanks. These tanks may be located on the highest hills in the community or, if the community is in flat land, they may build high towers and place water tanks on top of them. This water is stored in these tanks until a water faucet or a fire hydrant is opened. Then this same water will flow out of the elevated tank, using gravity that produces head pressure, and is delivered to the customer through a series of underground piping. If that piping is large enough, an adequate amount of water will

Figure 4.10. Elevated Water Tank 2

be delivered. As you can see, the more vertical distance between the water tank and the delivery point, the more pressure you will have at that delivery point. If you have a large vertical distance but your water mains are small, then you may not have a large enough volume of water to put out your fire even though the pressure of that water will be high. These types of municipal water systems are called gravity fed systems because once the treated water is pumped to an elevated tank, the delivery system works from gravity from there on out.

In rural areas where there are no municipal water systems, fire departments must rely on static water sources or on water sources that have no pressure. When this type of water source is used, then the fire department must place a fire engine at the water source and use the engine to make pressure to force the water through their hoses. This operation is called drafting water. Just as a municipal water system places pumps at their water source to push water up to their storage tanks through underground piping, a fire department places its engines at the source and pumps the water to their delivery point.

If a facility is large enough, it may install its own elevated water storage tank and feed it from either a municipal water main or from a local static water source. This will ensure that they will have an adequate water source even if the municipal system fails or their static water source dries up.

In summary, water pressure is produced either by a pump or gravity. Water volume is determined by the amount of water at the source, in addition to the size of the vessel delivering it.

Pumps. As seen in the previous section, pumps are vital to move liquids such as water. Even gravity water systems rely on pumps to deliver the water to the elevated water storage tanks. Fire departments rely on pumps to deliver water from static water sources and to build pressures on water being delivered from a municipal water source.

How hard is it to move water? Well, if you're moving it down a hill you simply let it flow down the hill using gravity. However, if you're moving it up the hill it is considerably more difficult. A gallon of water weighs 8.434 pounds. A master stream water device used by most fire departments is capable of delivering over 1,000 gallons of water per minute onto a structure. If you do the math you'll soon find that you are moving over 4 tons of water every minute! This is all done with pumps. Keep in mind that you are not only moving 4 tons of water per minute, but you are literally throwing it many hundreds of feet into the air at the same time.

The movement of any liquid is called hydraulics. This is a science in and of itself; however, the point is that pumps are an integral part of this science. They are used in hundreds of applications. Let's take a look at some of those applications and the types of pumps being used.

Although there are variations of each type, there are still only two basic types of pumps. One is a positive displacement pump and the other is a centrifugal pump.

Positive displacement pumps are the most durable, reliable, and forgiving. They are commonly used to move materials such as sludge, concrete, or other types of materials that centrifugal pumps cannot. A positive displacement pump takes in a given volume of liquid and then applies pressure to it to move it on down the line. If there is some foreign material in that liquid, these types of pumps are rugged enough that

the material will not harm them. The best example of a positive displacement pump is your heart. Think about the sludge that it is probably moving right now. It is so durable that it will continue to pump through your whole lifetime.

You might be wondering why we need centrifugal pumps if the positive displacement pump is so good? Well, there is a very good reason why we do. If you were to hook a positive displacement pump onto a municipal water supply that had a static head pressure of 100 psi, this head pressure would be reduced to zero by the positive displacement pump and then built back up again to the desired output pressure. On the other hand, if a centrifugal pump were placed on that same municipal water source it would take in that original 100 psi of pressure and simply add to it. In other words, centrifugal pumps use existing head pressures while positive displacement pumps do not. In addition, centrifugal pumps can be used in a series and can build tremendous water pressures. For example, if a centrifugal pump were placed on that same water main with a head pressure of 100 psi and it then augmented that pressure by 50 psi, the pump would be producing 150 psi. Then, if the 150 psi delivered by this centrifugal pump were sent to another centrifugal pump, that second pump could augment the 150 psi it was receiving by another 50 psi, resulting in a total pressure of 200 psi. As you can see, extremely high pressures can be achieved by continuing this progression through many centrifugal pumps. This is commonly referred to as pressure pumping.

If we used positive displacement pumps in the preceding scenario, no advantage would be achieved since each time the liquid was sent to a positive displacement pump the head pressure would be reduced to zero and then be built back up.

Clearly, centrifugal pumps are better for high pressure pumping but what about volume pumping? Here again, centrifugal pumps are at least comparable to positive displacement pumps. If I had three positive displacement pumps and each had a flow rating of 500 gallons per minute, and I had three centrifugal pumps each with a similar flow rating, both types are capable of collectively producing 1,500 gallons per minute of flow. In this sense, both types of pumps are equal. This is referred to as pumping in volume.

So, if the centrifugal pump is better at producing pressures and equal at producing volumes, then why have a positive displacement pump? The answer is quite simple. Centrifugal pumps are delicate and can be damaged by debris in a liquid being pumped. They are also not very good at pumping liquids with high viscosity. Therefore, each type of pump is superior in different applications. Each has its place in the workforce and neither one can totally replace the other.

In the fire service, centrifugal pumps are primarily used. They can be used to pump in pressure mode if high pressures are required or in series mode if high volumes are required. Since water is the only thing being pumped onto a fire, these are the ideal pumps for this application. However, positive displacement pumps are still used as priming pumps and debris pumps for flooded basements.

Many high-rise structures or large plants have fire pumps located in them in order to boost the pressures for the sprinkler and standpipe systems. What types of pumps are these? That's right—they are centrifugal pumps, since they are superior at building pressures and will only be used to pump debris-free water.

International Building Code. The first draft of the International Building Code was prepared in 1997 by the International Code Council (ICC) and consisted of representatives of BOCA, ICBO, and SBCCI. The International Building Code was designed to meet the needs through model code regulations that safeguard the public health and safety in all communities, large and small. This comprehensive building code establishes minimum regulations for building systems using prescriptive and performance related provisions. Today the International Building Code is available for adoption and used internationally. In addition, the code is kept up to date through review of proposed changes submitted by code enforcing officials, industry representatives, design professionals and other interested parties.

The provisions of this code shall apply to the construction, alteration, movement, enlargement, replacement, repair, and demolition of every building or structure or any attached buildings. Also, the International Fire Code shall apply to matters affecting or relating to structures, processes and premises from the hazard of fire and explosions associated with the buildings.

Training programs developed by the Insurance Services Office, Inc. discuss building construction through a study of basic components and features. The Hartford Steam Boiler Inspection and Insurance Co. was involved in developing standards for the following:

1. Standard for an Electrical Preventive Maintenance (EPM) Program—Recommended maintenance practices for electrical distribution system equipment. In addition a self-inspection guide for electrical equipment to assist in the development of this comprehensive program was instituted.
2. Guidelines for providing surge protection at commercial, institutional, and industrial facilities.

Local building codes are concerned with structures to be built. However, after construction, a building may never come to the attention of local building inspectors. Codes may not deal with complex design consideration such as shopping malls, industrial buildings, schools with open and flexible layouts, domed stadiums, hotel exhibition halls, windowless buildings and some high-rise buildings. Local codes require that all buildings be structurally stable. Buildings of certain sizes are required to be fire resistant—that they be able to withstand collapse during fires. Even the best building codes can have technical deficiencies. Provisions are handed down from code to code, often without any valid basis. Based on the building codes the in following section, the Insurance Service Office discusses the minimum requirements for design and construction of buildings.

Insurance Service Office (ISO). ISO is not to be confused with the well known International Safety Organization. ISO is a loss control agent where large insurance carriers define the classes of building construction as a study of basic components and features used by the Insurance Services Office (ISO)

As a safety manager, you need to know the level of service you can expect from your fire department in the event of a fire. As shown, there are many factors to consider.

A fire department may have great equipment but poor training. It may have great equipment and training but lack manpower. The fire department may be great, but the water system might be terrible. A fire department cannot be effective without water. With all of these factors to consider, how can you determine if your fire protective services are good or bad without doing a great deal of research? There is a way.

To remain competitive but still make money, an insurance company must know their probabilities for losses. This is certainly true for fire insurance underwriters, yet it would be cost prohibitive for these insurance underwriters to conduct this type of research in every city or area where they write fire insurance policies. Consequently, an independent research organization was developed to compile this data, rate a city or area according to their findings, and then sell this service to the insurance industry. The insurance industry will then establish their premium rates for fire insurance based upon the ISO rating of a particular area. This rating information is also available to the safety manager and will provide a very accurate picture of the fire protective services being provided. It is incumbent on the safety manager to know how this ISO rating is compiled and exactly what it represents in order to use the rating information in his or her own fire plan compilation.

Basically, the ISO looks at a city or region with three criteria in mind. First and foremost, they rate the fire department's efficiency. Next, they rate the water system, and finally they rate the emergency dispatching capabilities. These three criteria do not receive equal consideration in the overall rating system used by ISO. In fact, the fire department's rating comprises 50 percent of the overall rating with the water system comprising 40 percent and the dispatching capabilities comprising the remaining 10 percent.

ISO uses many individual elements in their evaluation of the fire department, water system, and dispatching. For example, a fire department will receive points for its training, equipment, manpower, response times, station locations, and so on. A water system will receive points for the reliability of their main water source, the efficiency of their delivery system, water grid sizes, and pump sizes. Finally, an emergency dispatching center will receive points for multiple ways of dispatching, number of dispatchers, backup generators, and the like.

Clearly, ISO does a very thorough job of assessing the response capability of a community with regard to fire suppression and providing this information to the insurance industry as well as the community at large, but how is this information interpreted?

When ISO has completed their analysis of the three areas of concern and awarded points for each of those areas accordingly, they will then calculate a final rating based upon a scale between one and ten. The higher the final rating number a city or community receives, the lower the fire suppression capabilities of that community are. Consequently, the higher the ISO rating, the higher the insurance premium rate will be for a given amount of insurance protection. If a city receives an ISO rating of 1, then their fire protection capability is nearly perfect. The property owners in this city will pay a very low rate for their fire insurance since the potential for fire losses to the insurance industry is low. Inversely, a city with an ISO rating of nine has very little protection from fire losses and the property owners can expect to pay a very high premium for fire insurance if they can get it at all.

In conclusion, an ISO rating is an excellent yardstick with which to measure the overall fire protection services offered by a community or a city.

Recovering from a Fire Emergency

The Boy Scouts of America have a very simple creed: "Be Prepared." The importance of applying this creed to post-fire recovery cannot be overstated. The time to consider how to recover from a fire is long before a fire ever happens. Safety managers will certainly include this information in their fire safety plan.

NFPA 1500, the Department of Occupational Safety and Health Program, requires two members to be on standby when a crew enters the hazard area of a working structure fire. Standard 8.4.7 (commonly referred to as the two-in-two-out rule) requires a minimum of four individuals to be available for assistance or rescue at emergency operations where entry into the danger area is required, consisting of two individuals working as a crew in the hazard area and two individuals present outside this hazard area. However, an exception to this rule is permitted when the initial crew is confronted with an imminent life-threatening situation.

THINGS TO CONSIDER:

A fire of any magnitude will have a dramatic effect on the workplace environment. Policies and procedures must be developed in order to aid in the transition from the initial post-fire chaos through the total recovery process. Questions that must be answered include:

- What processes are out of commission?
- How much structural damage has been done?
- Can affected workers be retained and reassigned during the recovery or will they have to be temporarily laid off?
- Where will business be conducted during the rebuilding process?
- Who will conduct the incident investigation?
- Who will handle the media communications?
- What records will have to be compiled?
- Are there any environmental regulations that need to be addressed?
- Who will handle the insurance claim?

These are just a few of the issues that will need to be addressed during a post-fire incident. These questions should precipitate policies and procedures that will be included in the company fire plan.

An efficient safety manager will develop a worst-case fire scenario for his or her company. He or she will then determine all of the effects that this worst-case scenario would have relating to the company operations and personnel. By doing so, the safety manager will be better prepared to develop post-fire incident procedures and policies that will be invaluable to the company should a fire incident occur.

Summary

The purpose of this chapter was to provide the reader with a broad base of understanding regarding the development of a fire loss control program, as well as the components of such a program.

The institution of a fire loss control program in an enterprise is dependent on key factors for its success. First, upper management must provide whole-hearted support for the program and aid in developing some type of organizational structure for administration and program control. Second, the fire loss control program must be developed using a management by objectives approach and include program elements of inspecting, education and training, fire suppression, emergency services, evaluation of fire possibilities, fire prevention, reports and recordkeeping, and communications.

A first step for starting a fire loss control program would be to conduct an audit of the enterprise facilities. From this audit, fire hazards can be evaluated and efforts concentrated accordingly. Human-element-type problems can be addressed in any fire loss control program. These include emergency planning, self-inspection, notification of deficient equipment, cutting and welding permit systems, and controls on smoking. The elements of emergency planning will consist basically of the audit of possible catastrophes that could occur in an enterprise.

Following an audit, a plan must be established to combat those catastrophes. Corporate guidelines can outline the areas that must be considered in the formation of the plans. Asking searching questions will help lead to the discovery of other potential areas of loss. Another cornerstone on the corporate loss prevention program is the self-inspection. This can be designed to ensure that the fire protection equipment and systems are in good working order and able to perform the job they were designed to do. This inspection can also detect hazardous areas and practices. It is important to have reliable and knowledgeable qualified inspectors to carry out this task. The frequency and types of items inspected each time are determined by a number of variables such as cost, delay, past history, codes, and recommendations.

When deficiencies are uncovered, an appropriate and efficient notification system is required. All personnel directly related to safety and fire control must be notified and the equipment tagged. Portable cutting and welding equipment results in a number of fires and requires special controls to safeguard equipment and the environment.

The permit system is critical in most areas that are cluttered or contain flammable materials. There is another tag system that allows cutting and welding operations in specified areas. The permit is granted by a designated person for a specified time period and requires that the work area be checked before granting permission. Basically, this permit provides a safe area for these operations and ascertains that these areas are protected. Uncontrolled smoking is high on the list of causes of industrial fires. To prevent the start of fires from smoking, regulations must be posted and enforced. Designated smoking areas must be identified and developed. Special attention must be given to storage, shipping, and receiving areas where most fires begin from careless smoking.

In summary, fire loss control programs are one of the most intensive and important areas of concern for a safety manager. Considerable effort must be expended in or-

der to obtain the necessary knowledge, experience, and cooperation to make such a program successful.

Questions

1. State the four classes of fire and the substances involved.
2. State the three elements required for fire or combustion.
3. What are some critical items of training for supervisors?
4. What are Class D fires?
5. Discuss the formation of emergency response plans.
6 What are the goals of an effective loss-control program?
7. What are the major reasons for placing labels and placards on packages and vehicles?
8. What is fire-loading? How does one determine fire-loading?
9. Explain the terms flash point and ignition point.
10. Floor design is an important factor in planning fire safety. Why?

Case Studies

FIRE INCIDENT EVENT I

Date of Accident:	June 2004
Time of Accident:	2:30 a.m.
Location of Accident:	Oxford Apartment Complex Second Floor, Apt. 215
Supervisor:	Duke Shaneyfelter
Losses Incurred:	Major property damage, loss of two lives

Summary Description of Event

A fire started in a garbage can of Mr. and Mrs. James Jones's laundry room. The Joneses lived on the second floor of a one-year-old, three-story apartment complex. Each floor contained six apartments, similar in layout, clustered about a stairwell. Construction of the complex was mainly wood, and it met local and FHA codes, including those for fire walls and doors. The outer walls consisted of one layer of brick veneer. Building access was provided through a main hallway, located in the front of the building, to an open stairwell. Since there were only three levels, there were no fire

escapes or other provisions for secondary exits. The furnishings were made partially or entirely of polymeric materials. The plumbing consisted of plastic piping; the combination tub-shower stall was also constructed of plastic.

Mr. and Mrs. Jones had just gone to bed after cleaning up after a late-evening basketball party. As they cleaned, they emptied cigar ashes and other trash into a garbage can lined by a plastic bag. The cigar ashes smoldered for approximately 30 minutes before a flame appeared. The flame grew out of the garbage can and ignited the wall and shelves that held a wide variety of household cleaning products. Heat pyrolysis and combustion gases rose to the ceiling and burning intensity increased rapidly, spreading smoke and hot gasses into adjacent rooms. Flashover occurred in less than 10 minutes, propagating flames into the other rooms of the apartment.

When the Joneses opened the front door to escape, hot combustion products and smoke poured into the center hallway and up the stairwell. Smoke and flames began to follow the plastic plumbing system to the floor above. The fire continued to grow on the third floor. By this time, firemen were called and began arriving. They rescued some residents with their ladders through windows, contained the blaze within 20 minutes, and had it completely extinguished in less than two hours.

The Joneses' apartment and the one directly above theirs were completely gutted. Two elderly people living in the upper apartment died as a result of smoke inhalation and burns. The first-floor occupants escaped unharmed but experienced extensive water damage.

Post-response Assessment

Building supervisor Duke Shaneyfelter and the state fire marshal investigated the fire and concluded this fire was a result of many careless oversights and omissions on the part of the building owner and contractor. They determined the appropriate codes were not specified, applied, or incorporated into the building plans and specifications.

The reports show there was a lack of proper fire walls between apartments that permitted lateral spread and inadequate fire stops in framing accelerated vertical fire progression. Exposed, charred remains and neighboring undamaged structures afford basis for comparison of construction details with regulatory requirements.

After review of the architect's and building contractor's records, they discovered unauthorized alterations that nullified code requirements. They stated that no escape plan was drawn and there had been no analysis of the finished building for fire escape routes. The stairwell walls were covered with decorative panel board (three plywood board with a plastic finish) making it easy for fire to spread rapidly. No heat or smoke detectors were installed in the units or stairwells. There were no sprinklers in the stairwell that could have controlled the spread of the fire in the exit path, providing additional escape time. Fire control methods were too simplistic, consisting of two CO_2 extinguishers, one in the lower hallway and one in the furnace room. Though a fire hydrant was located just outside the building, the parking lot arrangement was unsatisfactory, making it difficult for the fire trucks and ladder trucks to get past the few rows of cars. All hoses had to be carried in by the firemen until the small utility truck arrived.

In summary, the application of fire safety standards during all modes of the design operation, building, and use stages would have provided substantial fire-safety improvements and possibly prevented a fatal fire.

FIRE INCIDENT EVENT II

Date of Accident: November 21, 1963
Time of Accident: 7:17 a.m.
Location of Accident: Las Vegas, Nevada
Losses: 85 dead, 700 injured, $300 million in damages

Summary Description of Event

The blaze began with an electrical ground fault in a wall soffit in the first floor deli that resulted when the uninsulated wires of a refrigerator unit were stretched and rubbed as the unit vibrated. Once the fire ignited, it quickly traveled to the ceiling and the giant air-circulation system above the casino. In the casino, flames fed on flammable furnishings, including wall coverings, PVC piping, glue, fixtures, and even the mirrors on the walls, which were made of plastic. The fire burned undetected for hours until it flashed over just after 7 a.m., and began spreading at a rate of 19 feet (5.8 meters) per second through the casino.

About 5,000 people were in the resort when the blaze started to burn in earnest. Many were trapped in their rooms, in the corridors, and in stairwells, and most of the victims died at the scene or in Las Vegas Valley hospitals. Another handful of victims succumbed to fire-related injuries within a year. Fourteen firefighters were hospitalized, most suffering from smoke inhalation.

Upon entering the casino, the Las Vegas Fire Department observed black smoke stratifying in the east portion of the casino, emitting from the deli. The crew walked inside toward the casino pit, a distance of approximately 36 to 40 feet, and observed heavy black smoke lying motionless in the atmosphere. They looked toward the deli, stopped, and observed a fireball rolling out of the area. It spread back into the casino and the crew began to evacuate. The smoke had now dropped down on an angle, within 8 feet of the floor. Because of the large and vast nature of this fire, rescue efforts and scene control were as much a part of the firefighters' duties as fire suppression.

This fire and the destruction and losses it incurred was caused and enhanced by poor and faulty construction. A hot wire at the point of the origin of the fire had been improperly grounded and could have been discovered had the area been inspected. A fire alarm never sounded. A stairwell that was a crucial escape route was filled with smoke. The building was partially sprinkled. A manual alarm system, with bells and public address system, had not existed in the MGM at the time of the fire.

Post-response Assessment

Due to the drastic and deadly nature of a fire of this magnitude, buildings are now built safer and stronger. Today, buildings are not built of the same flammable materials

as they were in 1963. Where sprinklers were located in this building, the fire was suppressed and damage was minimal, while today sprinklers are located in every area of a building. These are just a few of the things to note on this case, which have changed the scene of fire safety since this tragic event.

GROUP DISCUSSION

Discuss and expound on the level of performance for each of the fire problems in the two case studies. What are your recommendations for averting further fire disasters for each of the case studies?

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CHAPTER 5

Lockout/Tagout

Contents of Chapter

Introduction
Control of Hazardous Energy Lockout/Tagout
Procedures for Multiple Lockout
Key Components in Lockout/Tagout Procedure
Outside Personnel
Shift and Personnel Changes
Periodic Inspection Program
Training Program
Employee Retraining
Summary
Reference A—Control of Hazardous Energy Source 29 CFR, 1910.147
Reference B—Standards for Various Industries
Reference C—Standard Print and Format of Tags
Questions
Case Study
Resources

Introduction

OSHA believes that failure to lockout or tagout properly results in approximately 10 percent of the serious accidents in many industries. Although the majority of injuries and fatalities result directly from energized equipment, many occur from residual energy stored in equipment. For example, hydraulic fluid in a line that has not been properly bled of the fluid and pressure may spray unexpectedly when the line is cut. Even if the equipment or machine has been shut off, and even if residual energy has been released, an accident can still occur if there is an inadvertent activation of the machine or equipment. This is the main reasoning behind the lockout or tagout standard.

OSHA believes that the most effective means to prevent an employee from being injured as a result of unanticipated movement of a component of a machine or equipment is to release or minimize the potential for residual energy in the system, or to use a restraining device to prevent movement. In combination with these precautions, a lock should be placed on the energy sources that relate to that piece of equipment or the machine that is having maintenance work performed on it. The lockout device will prevent any inadvertent reactivation of the energy source to the equipment or machine. In addition to the lockout device, a tag is recommended. The tag should explain when the lock was placed on the energy source, who placed it there, and why it was placed there. The last and perhaps the most important step in the lockout process is tryout. This step will allow the authorized and affected employees to determine that the equipment or machinery is safe for maintenance.

The details of the lockout/tagout/tryout procedures discussed in this chapter will provide the reader with insight into what potential causes of accidents and injuries exist. These procedures outline a program for compliance with the OSHA standard. It is OSHA's belief that compliance with the standard will prevent accidents and in turn result in fewer injuries or fatalities.

Control of Hazardous Energy Lockout/Tagout

This document has been developed to provide you with a guideline to implement a hazardous energy control compliance program. Table 5.1 provides some general guidelines on how to implement the lockout/tagout program for your company.

Written Program
Hazardous Energy Control Program
(Lockout/Tagout)

_____
(NAME OF COMPANY)

_____
(LOCATION—DIVISION)
It is the intent of _____
(NAME OF COMPANY)
_____ (ADDRESS)

_____
(LOCATION—DIVISION)
to comply with the requirements of the Control of Hazardous Energy Source (Lockout/Tagout) standard (29 CFR Part 1910.147) in our continuing effort to provide a safe and healthy workplace for our employees.

This program is designed to help employers develop and implement a comprehensive hazardous energy control program. This program includes the research of current procedures, the development of new procedures, and the training of employees. The program procedures will consist of:

- Steps for de-energization of equipment;
- Isolation of the equipment from all energy sources;

- Verification of de-energization before servicing and maintenance is performed on equipment; and
- Training of the lockout/tagout procedures for the employees who either perform the servicing or maintenance or are affected by those operations that apply to their work.

Written Lockout/Tagout Program: A copy of the written lockout/tagout program is available from the office of _____ who is responsible for
(PROGRAM COORDINATOR)
the implementation and supervision of the hazardous energy control program. Additional copies of the written lockout/tagout program will be located in the following area offices: _____

It is the policy of _____
(NAME OF COMPANY)

Table 5.1. Lockout/Tagout Implementation

The following are some steps that a program coordinator can take to help get the lockout/tagout program started at a facility.

1. Highlight the lockout/tagout standard, who is affected by the standard, and what the training plans are at employee meetings and in the company newsletter.
2. Have the managers prepare a list of authorized and affected employees by name and job title.
3. Have locks with names engraved and tags with pictures of employees on them ordered and delivered in time for training programs.
4. Audit each machine to find all energy sources and to see where tags must be used because locks would be impossible to use.
5. Have plant engineers or maintenance managers look at all machinery and equipment to see what must be done in order to comply with the lockout/tagout standard. They will also determine what the cost will be to comply with the standard.
6. Have engineering changes made to the nonconforming machinery and equipment.
7. Develop a written lockout/tagout program that includes: scope and purpose, authorization, steps for shutting down equipment, steps for locking out, steps needed to test energy control, steps for restoring machines or equipment to normal production operations, steps for outside personnel, multiple lockout/tagout, shift changes, training and retraining programs, and annual inspections.
8. Develop the training procedures that will be used to educate authorized and affected employees.
9. When all training has been completed, review the plan once more with all the employees.
10. The lockout/tagout standard will be in operation after the meeting.
11. Establish the principle that any machinery or equipment entering the plant will be able to be locked out.
12. Assign the responsibility to either the maintenance manager or to the plant engineer that any new machinery or equipment is lockout ready before being used by the operating personnel.
13. Ensure that the lockout/tagout program is being used properly.

to have in place a hazardous energy source program that includes employee training and requires that each piece of machinery or equipment where the unexpected energizing, start up, or release of stored energy could cause injury be isolated and made inoperative via an established procedure before any employee performs maintenance or service.

It is our policy that all machinery and equipment will be locked out unless:

- An energy isolating device is not capable of being locked out, in which case a tagout system will be used, and
- It can be demonstrated that a tagout will provide full employee protection.

It is our policy that full employee protection is obtained in a tagout system and that proof is available that the tagout system provides the same level of protection as a lockout system. To do this, _____
(NAME OF COMPANY)
will demonstrate full compliance with all tagout related provisions under 29 CFR Part 1910.147 and also provide additional necessary elements to ensure equipment protection equal to a lockout device. Additional necessary elements include:

- Removal of an isolating circuit element,
- Blocking a controlling switch,
- Opening an extra disconnecting device, or
- The removal of a valve handle to reduce the risk of inadvertent energization.

PURPOSE

The purpose of establishing _____'s
(NAME OF COMPANY)
uniform lockout/tagout procedure is to protect all employees from personal hazard or injury from the unexpected energization, start-up, or release of stored energy from machine, equipment, or process. As of _____, _____
(DATE) (COMPANY NAME)
has established the proper requirements under (29 CFR Part 1910.147) for the lockout/tagout of energy isolating devices.

Definition: _____
(COMPANY NAME)
defines an energy-isolating device as a mechanical device that physically prevents the transmission or release of energy. [A list of other important terms can be found in Reference A, Section 3, Part b.] Some examples of energy isolating devices include, but are not limited to, the following: A manually operated electrical circuit breaker; a disconnect switch; a manually operated switch by which the conductors of a circuit can be disconnected from all underground supply conductors, and in addition, no pole can be operated independently; a valve line; a block; and any similar device used to block or isolate energy. This term does not include push buttons, selector switches, or other control circuit type devices. The following page contains a sample letter to the machine or equipment manufacturer requesting information regarding energy sources.

Sample Letter

Dear _____,

The Occupational Safety and Health Administration (OSHA) Control of Hazardous Energy Source Standard 29 CRF Part 1910.147 requires that all machines and equipment be located or tagged out before any servicing or maintenance is to be attempted.

In order for us to meet the requirements of this law, we are requesting information on the potential energy hazard(s) associated with _____
(MACHINE OR EQUIPMENT NAME)

Its serial number is _____
(SERIAL NUMBER)

The purchasing date for this equipment was _____
(PURCHASE DATE)

Please consider this letter as a standing request to your company for any information concerning the safety and health aspects of using this piece of machinery or equipment that may become known in the future.

We would appreciate receiving this information within 10 days. If there are any problems that will not allow this information to be forwarded in this period of time, please contact the program coordinator listed below. Send the requested information to:

(COMPANY ADDRESS)

Thank you for your timely response to this request. If you have any questions concerning this matter please contact

_____ at _____
(PROGRAM COORDINATOR) (TELEPHONE NUMBER)

Sincerely,

AUTHORIZATION

Authorized employees shall be instructed on the importance of the lockout/tagout procedure. The names and job titles of authorized employees will be recorded, describing the type of equipment they are trained to lockout (see Table 5.2).

Definition: An authorized employee is defined as a person who locks out or tags out machines or equipment in order to perform servicing or maintenance on that machine or equipment. Affected employees and all other employees whose work operations are or may be in the area shall be instructed in the purpose and use of the lockout/tagout procedure.

Definition: An affected employee is any employee whose job requires him or her to operate or use a machine or equipment on which servicing or maintenance is being performed under lockout or tagout, or whose job requires him or her to work in an area in which such servicing or maintenance is being performed.

Table 5.2. Employee Lockout/Tagout Sheet

EMPLOYEE LOCKOUT/TAGOUT SHEET				
AUTHORIZED EMPLOYEES				
Name	*Employee ID Number*	*Work Area*	*Machine(s) or Equipment Authorized to Lockout/Tagout*	
AFFECTED EMPLOYEES				
Name	*Employee ID Number*	*Work Area*	*How to Notify*	
NAMES OF AUTHORIZED EMPLOYEES FOR GROUP LOCKOUT/TAGOUT				
Name	*Employee ID Number*	*Work Area*	*Machine or Equipment That Is Authorized to Lockout/Tagout*	

An affected employee becomes an authorized employee if his or her duties include performing any servicing or maintenance on machines or equipment.

PREPARATION FOR LOCKOUT

An audit has been conducted to locate and identify all isolating devices to be certain which switch, valve, or other energy isolating device applies to the equipment that will be locked or tagged out _____ recognizes that more than
(COMPANY NAME)
one type of energy source may be involved in certain areas.

Definition: An energy source is defined as any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy (see Table 5.3).

Table 5.3. Equipment Lockout/Tagout Form

EQUIPMENT LOCKOUT/TAGOUT FORM

MACHINE NAME AND NUMBER _____

NUMBER OF ENERGY SOURCES MACHINE OR EQUIPMENT HAS _____

ALL TYPES OF ENERGY SOURCES TO WHICH THE MACHINE OR EQUIPMENT IS CONNECTED
(An energy source can be electrical, thermal, mechanical, hydraulic, pneumatic, chemical, or gravity.)

_____

_____

METHOD USED TO DISCONNECT HAZARDOUS ENERGY SOURCES

_____

TYPES OF EQUIPMENT CHECKED TO ENSURE DISCONNECTIONS

_____

ADDITIONAL SAFETY FEATURES

_____

AUTHORIZED EMPLOYEES FOR THIS MACHINE—NAME AND SOCIAL SECURITY NUMBER

_____

_____

_____

AFFECTED EMPLOYEES FOR THIS MACHINE—NAME, SOCIAL SECURITY NUMBER, AND NOTIFICATION INFORMATION

_____

_____

_____

Locks, tags, chains, wedges, key blocks, adapter pins, self-locking fasteners, or other hardware will be supplied by _____ for isolating,
(PROGRAM COORDINATOR)
securing, or blocking of machines or equipment from energy sources. Lockout and tagout devices will be distinctively identified, as well as the only devices used for controlling energy. Lockout and tagout devices will not be used for any other purpose and will be:

I. Durable

A. Lockout/tagout devices will be capable of withstanding the environment to which they are exposed for the maximum period of time the exposure is expected. The

authorized employee will inspect his or her lock daily, and if the lock is defective, immediately stop and report to _____.
(PROGRAM COORDINATOR)

B. Tagout devices will be constructed and printed so that exposure to weather conditions or wet and damp locations will not cause the tag to deteriorate or the message on the tag to become unreadable. The authorized employee will inspect his or her tag daily and if a tag is defective, report to _____
(PROGRAM COORDINATOR)
for repair or replacement.

C. Tags will not deteriorate when used in corrosive environments such as areas where acid and alkali chemicals are handled and stored.

D. Before working in a corrosive environment or with chemicals, the employee must refer to _____'s
(COMPANY NAME)

Hazard Communication Written Program for further information.

II. Standardized

A. Lockout and tagout devices will be standardized within the facility in the following area:
   1. COLOR _____.
   (COMPANY NAME)
   will use _____
   (COLOR)
   as a standard color to identify lockout and tagout devices.*
   2. SHAPE _____
   (COMPANY NAME)
   will use the _____
   (SHAPE)
   as the standard shape to identify lockout and tagout devices.
   3. SIZE _____
   (COMPANY NAME)
   will use the _____
   (SIZE)
   as the standard size to identify lockout and tagout devices.
   *It is recommended that different divisions use different colored locks. For example, a company might have electricians using blue locks and welders using red locks.

B. _____ will use _____
(COMPANY NAME) (PRINT)
and _____ on its tagout devices.*
(FORMAT)

*See Reference C for some examples of standardized print and format.

III. Substantial

A. Lockout devices shall be dependable enough to prevent removal without the use of excessive force or unusual techniques, such as with the use of bolt cutters or other metal cutting tools.
B. Tagout devices and their means of attachment will be substantial enough to prevent their unintended or accidental removal. To meet this requirement,

_____
(COMPANY NAME)

will require that the means of attachment for the tagout device will be of a nonreusable type, attachable by hand, self-locking, and nonreleasable with a minimum unlocking strength of at least 50 pounds and having the general design and basic characteristics of being at least equivalent to a one-piece, all-environment-tolerant nylon cable tie.

IV. Energy Control Identification System

Lockout and tagout devices will indicate the identity of the employee authorized to apply and to remove the device. Tagout devices will warn against hazardous conditions if the machine or equipment is energized and will include a legend such as the following:

A. Do not start
B. Do not open
C. Do not close
D. Do not energize
E. Do not operate

STANDARD LOCKOUT/TAGOUT PROCEDURE

1. All affected employees are to be notified that a lockout or tagout system is going to be used and told the reasons why. The authorized employee will review and clarify the type and magnitude of energy that the machine or equipment uses and shall understand all the hazards associated with it.
2. If the machine is operating, the employee must shut it down using standard operating procedures. Examples of this include such things as pressing the stop button, opening toggle switches and closing auto valves.
3. _____'s policies
(COMPANY NAME)

dictate that stored energy must be released or restrained by methods such as repositioning, blocking, bleeding down, or other methods. The authorized employee will maneuver the switch, valve, or other energy isolating device so the equipment is isolated from its energy source. Stored energy could be in springs; elevated

Table 5.4. Energy Sources

ELECTRICAL
There are two basic types of electrical energy sources. The first is generated electrical power. This type of electrical energy is what is commonly thought of when describing lockout/tagout procedures. Generated electrical energy is the type of energy that is found in electric lines that run lights and saws. This type of energy can be turned on or turned off.

The other basic type of electricity is static electricity. A common example of static electricity is the spark a person gets from a doorknob after walking across a carpet. Static electricity cannot be turned on or off. It has to dissipate or be controlled.

MECHANICAL
Mechanical energy can be mechanical motion such as a rotating saw blade or a PTO shaft. Mechanical energy can also produce work which in turn produces changes in temperature. Mechanical energy can be turned on or turned off.

POTENTIAL
Potential energy can be due to pressure. Hydraulic energy which is liquid, most commonly oil, under pressure is one type of potential energy. An example of hydraulic energy would be a front end loader. Another type of potential energy would be pneumatic energy, which is air or some other gas under pressure. An example of pneumatic energy would be an air compressor. A third type of potential energy would be the negative pressure present in a vacuum system. Potential energy can also be due to springs or gravity. A falling log or breaking spring are examples of these types of potential energies. Potential energy cannot be turned off or on. It has to be controlled or dissipated.

THERMAL
Thermal energy is displayed by high and low temperature. Thermal energy is the result of mechanical work, radiation, chemical reactions, or electrical resistance. An example of thermal energy would be a hot saw tooth that had just been sharpened by being filed. Thermal energy can't be turned off or eliminated; however, it can be dissipated or controlled.

CHEMICAL
Chemical energy refers to chemical reactions. Chemical reactions manifest in exothermic or endothermic effects. Exothermic reactions raise temperatures and may cause a variety of effects such as fires, explosions, and burns. Endothermic reactions lower temperatures and create a need for additional heat. Some elements manufactured by endothermic reactions are used as explosives or have explosive characteristics because of their instability and rapid release of energy. With chemical reactions, the energy-on-energy-off approach does not apply. Any material that could chemically react should be eliminated, dissipated, or controlled.

machine members; rotating flywheels; hydraulic systems; air, gas, steam, or water pressure; as well as from other sources.

4. The energy isolating devices will be locked out and/or tagged out with assigned individual locks or tags. The authorized employee who attaches the lock will be the only person other than _____ to have a key in
(PROGRAM COORDINATOR)
order to remove it.

5. After determining that no personnel are exposed, an authorized employee will operate the push button or the normal operating controls to make certain the equipment will not operate. This is a test to check the equipment to make sure that it is disconnected from the energy source. The authorized employee will return all operating controls to the neutral or off position after the test.
6. The equipment will then be locked or tagged out and ready to be serviced or maintained. Table 5.4 is a checklist regarding lockout/tagout procedures.

RESTORING NORMAL PRODUCTION OPERATIONS TO MACHINES OR EQUIPMENT

1. The authorized employee will check the machine and equipment to make sure all tools have been removed, all guards have been reinstalled properly, and that employees are in the clear.
2. After work on the machine or equipment is finished and it is ready for normal operations, the authorized employee will check the area around the machines and equipment to make sure no one is exposed.
3. The authorized employee will inform the affected employees that the lockout/tagout device is about to be removed so they can prepare for the resumption of normal operations of the machine or equipment.
4. The authorized employee will then remove the lockout or tagout device to restore energy to the machine, equipment, or system. The lockout or tagout device will only be removed by the employee who applied the device.

   If the authorized employee who put on the lock or tag is not available to remove it, the device may be removed under the direction of _____
   (PROGRAM COORDINATOR)

   When a lock or tag must be removed by the program coordinator, he or she must utilize the following specific procedure:

   A. _____ must confirm that the authorized employee
   (PROGRAM COORDINATOR)
   is no longer at the facility.
   B. Every reasonable effort will be made to inform authorized employees that their lock or tag has been removed from the energy-isolating device.
   C. Authorized employees will be informed that their lockout/tagout device was removed before resuming work at the facility.

Procedures for Multiple Lockout

If more than one person is involved in the maintenance or service of the machine or equipment, each individual must place a lockout or tagout device on the energy-isolating device. If the energy-isolating device will not accept multiple locks or tags,

a multiple lockout or tagout device (a hasp) will be used. If the lockout method is used, a single lock may be placed on the energy-isolating device of the machine or equipment and the key to the lock placed in a lockout box or cabinet which will allow the use of multiple locks to secure it. Each authorized employee will then secure the box or cabinet, with his or her own lock. As each person no longer needs to maintain his or her lockout protection, that person will remove his or her lock from the cabinet or box.

Key Components in Lockout/Tagout Procedure

Following are the key components for locking out and restarting machinery and equipment. Steps for locking out machinery and equipment:

1. **KNOW**
   —KNOW all of the energy sources involved.
   —KNOW the hazards the energy sources present.
   —KNOW how to control the energy.
2. **NOTIFY**—NOTIFY affected employees.
3. **TURN OFF—**TURN OFF the machine or equipment.
4. **REMOVE**—REMOVE machine or equipment from its energy source(s).
5. **LOCKOUT**—Use individual lock to LOCKOUT from energy isolating device. Be sure to check lock for defects before using.
6. **RELEASE**—RELEASE any stored energy that may be present in the system.
7. **CHECK**—CHECK lockout by trying the on-off switch on the machine or equipment to be sure that it won't start.
8. **RETURN**—RETURN on-off switch to the "off" position.

Your machine or equipment is now safely locked out.

Steps to return normal production operations to machine or equipment.

1. **CHECK**
   —CHECK machine or equipment for stray tools or other unwanted materials.
   —CHECK to make sure machine or equipment is fully assembled.
2. **REPLACE**—Properly REPLACE all safety guards.
3. **NOTIFY**—NOTIFY affected employees.
4. **RECHECK**—CHECK that no one is exposed to any danger.
5. **REMOVE**—REMOVE locks and tags. Remember, only the person who applied the lock and tag can remove them.

Table 5.5. Lockout/Tagout Procedure Checklist

LOCKOUT/TAGOUT PROCEDURE CHECKLIST Please check all of the following to ensure proper lockout/tagout procedures are being followed:		
STANDARD LOCKOUT PROCEDURE	*Yes*	*No*
1. Have all the locks and tags been examined for defects?		
2. Has an audit been done to identify all potential energy sources?		
3. Have all affected employees been notified and told the reason for lockout/tagout?		
4. Has the machine been shut down?		
5. Has the authorized employee released or restrained all stored energy?		
6. Has the authorized employee locked and tagged the energy isolating device with his/her individual lock or tag?		
7. Has machine or equipment been tested to see if it will operate in order to make sure it is properly disconnected from its power source?		
8. Has the power switch been returned to the off position after testing?		
9. The machine or equipment is now properly locked out.		
RETURNING TO NORMAL PRODUCTION OPERATIONS		
1. Has the authorized employee checked the machinery and equipment for mislaid tools?		
2. Has the authorized employee checked the machinery and equipment to ensure that all guards have been replaced properly?		
3. Have affected employees been notified that machines are about to resume operations?		
4. Has the authorized employee checked the area to ensure all employees are in the clear and no one is exposed to danger?		
5. The authorized employee may now remove his/her individual lock and tag.		
POSITIONING AND TESTING OF EQUIPMENT		
1. Is the work area clear of tools and materials?		
2. Are all machine and equipment components intact?		
3. Have affected employees been notified testing or positioning of the machine or equipment is about to start?		
4. Have the employees left the area?		
5. Have the locks and tags been removed?		
6. The machine or equipment is now ready to test or position.		
7. Did the authorized employee follow the standard lockout/tagout procedure when de-energizing the machine or equipment?		

Table 5.5. (*continued*)

LOCKOUT/TAGOUT PROCEDURE CHECKLIST Please check all of the following to ensure proper lockout/tagout procedures are being followed:		
GROUP LOCKOUT/TAGOUT	*Yes*	*No*
1. Is the set number of people involved in the group lockout/tagout the primary responsibility of an authorized employee?		
2. Are provisions made for the authorized employee to ascertain the exposure status of individual group members?		
3. If more than one crew is involved, is responsibility for the overall lockout/tagout procedure given to an authorized employee who will coordinate affected work forces and ensure continuity of protection?		
4. Has each authorized employee attached a personal lockout and tagout device to the group lockout device when beginning work?		
5. Has each authorized employee removed his or her personal lockout and tagout device when stopping work on the machine or equipment being serviced or maintained?		

TESTING AND POSITIONING OF MACHINES AND EQUIPMENT

If the machine or equipment must be temporarily energized to test or position a component, machine, or equipment, the locks or tags may be temporarily removed from the energy isolating device if the following procedures are obeyed:

1. The work area will be cleared of tools and materials and the machine and equipment components will be operationally intact.
2. Employees will be removed from the machine or equipment area and affected employers will be notified that lockout/tagout devices have been removed.
3. Each lock or tag will be removed by the employee who installed the device.
4. The machine or equipment will be energized and the testing or positioning will proceed.
5. All systems will de-energize and the energy control measures will be reapplied in the manner described in the specific lockout procedure. Servicing and maintenance will then continue.

Outside Personnel

Whenever outside personnel are engaged in activities that are covered by the scope and application of the control of hazardous energy source standard (lockout/tagout), the on-site employer and the outside employer will inform each other of their respective

lockout or tagout procedures. The on-site employer will ensure that his/her personnel understand and comply with the restrictions and restraints of the outside employer's energy control procedures.

Shift and Personnel Changes

When shift or personnel changes occur, the following procedure will be followed to ensure the continuity of lockout or tagout protection:

1. The personnel that are leaving will meet the oncoming personnel at the lockout device.
2. The oncoming personnel will place their locks on the energy control device before the exiting employees remove their locks.
3. If the energy-isolating device will not accept any more locks, the leaving employee will remove his/her lock and the arriving employee will immediately place his/her lock to ensure minimal exposure to hazards from the unexpected energization or start up of the machine or equipment or release of stored energy.
4. The personnel leaving the shift will communicate any potential problems or concerns and any special precautions necessary to oncoming employees.

Periodic Inspection Program

_____ will conduct an inspection of the energy control
(PROGRAM COORDINATOR)
procedures at least once a year to make sure that the proper procedures and requirements of the lockout/tagout standard are being followed.

1. The inspection will be conducted by _____
(PROGRAM COORDINATOR)
and an authorized employee other than the ones who use the energy control procedure being inspected.
2. Any flaws or deviations observed during the inspection will be corrected.
3. When the lockout is used as an energy control, the inspection shall include a review between the inspector and the authorized employee regarding that employee's responsibilities under the energy control procedure being inspected.
4. When the tagout system is being used, the inspector will review with each authorized and affected employee, the employee's responsibilities under the energy control procedure being inspected. The inspector will also review the tag training procedure.

_____ will certify that periodic inspections have been performed.
(NAME OF COMPANY)

The certification will include:

1. The identity of the machine or equipment on which the energy control procedure was used.
2. The date of the inspection.
3. The employees included in the inspection.
4. The person performing the inspection.

Training Program

_____ will provide training to make sure the purpose
(NAME OF COMPANY)
and function of the energy control program are understood by the employees. The required knowledge and skill necessary for the safe application, usage, and removal of energy controls will be taught to the employees by _____,
(PROGRAM COORDINATOR)
or those authorized by _____ management.
(NAME OF COMPANY)

This training program will take place when the lockout/tagout program is implemented. The training program shall include the following:

1. Each authorized employee will receive training to recognize all applicable hazardous energy sources, the type and magnitude of energy available in the workplace, and the methods and means necessary for energy isolation and control. It will be made clear to all employees that locks or tags belonging to other employees will not be removed from an energy control device.
2. Every affected employee will be taught the purpose and use of the energy control procedure.
3. All other employees whose work operations are or may be in the area where energy control procedures may be used, will be instructed about the procedure, and about the prohibition relating to attempts to restart or re-energize machines or equipment that have been locked or tagged out.

When the tagout system is used, employees will be trained in the following limitations of tags:

1. Tags are warning devices attached to energy isolating devices, and do not provide any physical restraint on those devices like that which is provided by a lock.
2. When a tag is attached to an energy isolating device, it is not to be removed without the permission of the authorized person responsible for it, and is never to be bypassed, ignored, or otherwise defeated.
3. Tags must be readable and understandable by authorized, affected, and other employees whose work operations are or may be in the area, in order to be effective.

4. Tags and their means of attachment must be made of materials that will withstand the workplace's environmental conditions.
5. Tags may evoke a false sense of security and their meaning needs to be understood in order to be effective as part of the overall energy control program.
6. Tags must be securely attached to energy isolating devices so they do not accidentally or inadvertently detach during use.

Employee Retraining

Retraining will be provided to all affected and authorized employees whenever there is a change in their job assignments, a change in machinery, equipment, or processes that presents a new hazard, or when there is a change in their energy control procedures. Additional retraining will also occur whenever a periodic inspection takes place or whenever _____ has a reason to believe
(NAME OF COMPANY)
that there are deviations from or inadequacies in the employee's knowledge or use of the energy control procedure. The retraining will re-establish employee proficiency and introduce new or revised control procedures and methods, as necessary. When training is completed, _____ will document that
(NAME OF COMPANY)
each employee has been trained and understands the lockout/tagout system. The documentation will include the instructor's name, employee's name, the date of training, and his or her evaluation sheet.

Summary

Lockout/tagout remains one of the violations most often cited by OSHA compliance officers. The purpose of the standard is to reduce the chance of worker injuries and fatalities during servicing or maintenance operations. When OSHA compliance officers inspect workplaces, they evaluate the potential for employee exposure to the unexpected release of hazardous energy during the servicing or maintenance of equipment. If violations are discovered, then the compliance officers should make recommendations for abatement based on the requirements of the lockout/tagout standard.

Organizations should make concerted efforts to comply with the requirements of the lockout/tagout standard—not to avoid OSHA citations, but rather to protect the well-being of their employees. A 10 percent reduction in injuries for many organizations can be considerable. Therefore, compliance with the lockout/tagout standard may result in a reduction of injuries and medical costs for the organization.

Perhaps the best method of instituting lockout/tagout procedures is to involve the employees in writing the procedures. They are the ones that deal firsthand with the hazards of energized equipment and machinery. Their expertise will produce great benefits for the lockout/tagout program. In addition, employee involvement will create a sense of ownership for the program that will result in better compliance among the workforce.

Reference A

CONTROL OF HAZARDOUS ENERGY SOURCE

29 CFR PART 1910.147

Federal Register / Vol. 54 No. 169 / Friday, September 1, 1989 / Rules and Regulations

Accordingly, pursuant to sections 4, 8(b), 8(c) and 8(g) of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657), Secretary of Labor's Order No. 9-83 (48 FR 35736), and 29 CFR Part 1911, 29 CFR Part 1910 is hereby amended as set forth below.

Signed at Washington, D.C. this 20th day of August 1989.

Alan C. McMillan, Acting Assistant Secretary of Labor.

29 CFR Part 1910 is amended as follows:

PART 1910—OCCUPATIONAL SAFETY AND HEALTH STANDARDS

1. The authority citation for subpart j of Part 1910 is revised to read as follows:

Authority: Section 4, 6, and 8, Occupational Safety and Health Act of 1970, 29 U.S.C. 653, 655, 657; Secretary of Labor's Order No. 12-71 (36 FR 8754) 8-76 (41 FR 25059) or 9-83 (48 FR 35736), as applicable. Sections 1910.141, 1910.142, and 1910.147 also issued under 29 CFR Part 1911.

1910.150 [Re-designated from 1910.147]

2. Section 1910.147 is re-designated as 1910.150

3. A new 1910.147 and appendix to 1910.147 are added as follows:

1910.147 The control of hazardous energy (lockout/tagout).

(a) Scope, application and purpose—

(1) Scope.

(i) This standard covers the servicing and maintenance of machines and equipment in which the unexpected energization or start-up of the machine or equipment, or release of stored energy could cause injury to employees. This standard establishes minimum performance requirements for the control of such hazardous energy.

(ii) This standard does not cover the following:

(A) Construction, agriculture, and maritime employment;

(B) Installations under the exclusive control of electric utilities for the purpose of power generation, transmission, and distribution, including related equipment for the communication and metering; and

(C) Exposure to electrical hazards from work on, near, or with conductors or equipment in electric utilization installations, which is covered by subpart S of this part; and

(D) Oil and gas well drilling and servicing.

(2) Application. (i) This standard applies to the control of energy during servicing and/or maintenance of machines and equipment.

(ii) Normal production operations are not covered by this standard (See Subpart 0 of this Part). Servicing and/or maintenance which takes place during normal production

operations is covered by this standard only if;

(A) An employee is required to remove or bypass a guard or other safety device; or

(B) An employee is required to place any part of his or her body into an area on a machine or piece of equipment where work is actually performed upon the material being processed (point of operation) or where an associated danger zone exists during machine operating cycle.

Note: Exception to paragraph (a)(2)(ii): Minor tool changes and adjustments, and other minor servicing activities, which take place during normal production operations, are not covered by this standard if they are routine, repetitive, and integral to the use of the equipment for production, provided that the work is performed using alternative measures which provide effective protection (See Subpart 0 of this part).

(iii) This standard does not apply to the following.

(A) Work on cord and plug connected electric equipment for which the exposure to the hazards of unexpected energization or start-up of the equipment is controlled by the unplugging of the equipment from the energy source and by the plug being under the exclusive control of the employee performing the servicing or maintenance.

(B) Hot tap operations involving transmission and distribution systems for substances such as gas, steam, water, or petroleum products when they are performed on pressurized pipelines, provided that the employer demonstrates that (1) continuity of service is essential; (2) shutdown of the system is impractical; and (3) documented procedures are followed, and special equipment is used which will provide proven effective protection for employees.

(3) Purpose. (i) This section requires employers to establish a program and utilize procedures for affixing appropriate lockout devices or tagout devices to energy isolating devices, and to otherwise disable machines or equipment to prevent unexpected energization, start-up, or release of stored energy in order to prevent injury to employees.

(ii) When other standards in this part require the use of lockout or tagout, they shall be used and supplemented by the procedural and training requirements of the section.

(b) Definitions applicable to this section.

Affected employee. An employee whose job requires him/her to operate or use a machine or equipment on which servicing or maintenance is being performed under lockout or tagout, or whose job requires him/her to work in an area in which such servicing or maintenance is being performed.

Authorized employee. A person who locks or implements a tagout system procedure on machines or equipment to perform the servicing or maintenance on that machine or equipment. An authorized employee and an affected employee may be the same person when the affected employee's duties also include performing maintenance or service on a machine or equipment that must be locked or a tagout system implemented.

"Capable of being locked out." An energy isolating device will be considered to be capable of being locked out either if it is designed with a hasp or other attachment of integral part to which, or through which, a lock can be affixed, or if it has a locking mechanism

built into it. Other energy isolating devices will also be considered to be capable of being locked out, if lockout can be achieved without the need to dismantle, rebuild, or replace the energy isolating device or permanently alter its energy control capability.

Energized. Connected to an energy source or containing residual or stored energy.

Energy isolating device. A mechanical device that physically prevents the transmission or release of energy, including but not limited to the following: A manually operated electrical circuit breaker; a disconnect switch; a manually operated switch by which the conductors of a circuit can be disconnected from all ungrounded supply conductors and, in addition, no pole can be operated independently; a slide gate; a slip blind; a line valve; a block; and any similar device used to block or isolate energy. The term does not include a push button, selector switch, and other control circuit type devices.

Energy source. Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy.

Hot tap. A procedure used in the repair, maintenance and services activities which involves welding on a piece of equipment (pipelines, vessels, or tanks) under pressure, in order to install connections or appurtenances. It is commonly used to replace or add sections of pipeline without the interruption of service for air, gas, water, steam, and petrochemical distribution systems.

Lockout. The placement of a lockout device on an energy isolating device, in accordance with an established procedure, ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

Lockout device. A device that utilizes a positive means such as a lock, either key or combination type, to hold an energy isolating device in the safe position and to prevent the energizing of a machine and/or equipment.

Normal production operations. The utilization of a machine or equipment to perform its intended production function.

Servicing and/or maintenance. Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities include lubrication, cleaning or un-jamming of machines or equipment and making adjustments or tool changes, where the employee may be exposed to the unexpected energization or startup of the equipment or release of hazardous energy.

Setting up. Any work performed to prepare a machine or equipment to perform its normal production operation.

Tagout. The placement of a tagout device on an energy isolating device, in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

Tagout device. A prominent warning device, such as a tag and a means of attachment, which can be securely fastened to an energy isolating device in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

(c) General-(1) Energy control program. The employer shall establish a program consisting of an energy control procedure and employee training to ensure that before any employee performs any servicing or maintenance on a machine or equipment where the unexpected energizing, start up, or release of stored energy could occur and cause injury, the machine or equipment shall be isolated, and rendered inoperative, in accordance with paragraph (c)(4) of this section.

(2) Lockout/tagout. (i) If an energy isolating device is not capable of being locked out, the employer's energy control program under paragraph (c)(1) of this section shall utilize a tagout system.

(ii) If an energy isolating device is capable of being locked out, the employer's energy control program under paragraph (c)(1) of this section shall utilize lock out, unless the employer can demonstrate that the utilization of a tagout system will provide full employee protection as set forth in paragraph (c)(3) of this section.

(iii) After October 31, 1989, whenever major replacement, repair, renovation, or modification of machines or equipment are installed, energy isolating devices for such machines or equipment shall be designed to accept a lockout device.

(3) Full employee protection. (i) When a tagout device is used on an energy isolating device which is capable of being locked out, the tagout device shall be attached at the same location that the lockout device would have been attached, and the employer shall demonstrate that the tagout program will provide a level of safety equivalent to that obtained by using a lockout program.

(ii) In demonstrating that a level of safety is achieved in the tagout program which is equivalent to the level of safety obtained by using a lockout program, the employer shall demonstrate full compliance with all tagout-related provisions of this standard together with such additional elements as are necessary to provide the equivalent safety available from the use of a lockout device. Additional means to be considered as part of the demonstration of full employee protection shall include the implementation of additional safety measures such as the removal of an isolating circuit element, blocking of a controlling switch, opening of an extra disconnecting device, or the removal of a valve handle to reduce the likelihood of inadvertent energization.

Energy control procedure. (i) Procedures shall be developed, documented and utilized for the control of potentially hazardous energy when employees are engaged in the activities covered by this section.

Note: exception: The employer need not document the required procedure for a particular machine or equipment, when all of the following elements exist: (1) The machine or equipment has no potential for stored or residual energy or reaccumulation of stored energy after shut down which could endanger employees; (2) the machine or equipment has a single energy source which can readily be identified and isolated; (3) the isolation and locking out of the energy source will completely de-energize and deactivate the machine or equipment; (4) the machine or equipment is isolated from that energy source and locked

out during servicing or maintenance; (5) a single lockout device will achieve a lockout condition; (6) the lockout device is under the exclusive control of the authorized employee performing the servicing or maintenance; (7) the servicing or maintenance does not create hazards for other employees; and (8) the employer, in utilizing this exception, has had no accidents involving the unexpected activation or re-energization of the machine or equipment during servicing or maintenance.

(iii) The procedures shall clearly and specifically outline the scope, purpose, authorization, rules, and techniques to be utilized for the control of hazardous energy, and the means to enforce compliance including, but not limited to, the following:

(A) A specific statement of the intended use of the procedure;

(B) Specific procedural steps for shutting down, isolating, blocking and securing machines or equipment to control hazardous energy;

(C) Specific procedural steps for the placement, removal and transfer of lockout devices or tagout devices and the responsibility for them; and

(D) Specific requirements for testing a machine or equipment to determine and verify the effectiveness of lockout devices, and other energy control measures.

(5) Protective materials and hardware. (i) Locks, tags, chains, wedges, key blocks, adapter pins, self-locking fasteners, or other hardware shall be provided by the employer for isolating, securing, or blocking of machines or equipment from energy sources.

(ii) Lockout devices and tagout devices shall be singularly identified; shall be the only device(s) used for controlling energy; shall not be used for other purposes; and shall meet the following requirements:

(A) Durable. (1) Lockout and tagout devices shall be capable of withstanding the environment to which they are exposed for the maximum period of time that exposure is expected.

(2) Tagout devices shall be constructed and printed so that exposure to weather conditions or wet and damp locations will not cause the tag to deteriorate or the message on the tag to become illegible.

(3) Tags shall not deteriorate when used in corrosive environments such as areas where acid and alkali chemicals are handled and stored.

(B) Standardized. Lockout and tagout devices shall be standardized within the facility in at least one of the following criteria: color; shape; or size; and additionally, in the case of tagout devices, print and format shall be standardized.

(C) Substantial-(1) Lockout devices. Lockout devices shall be substantial enough to prevent removal without the use of excessive force or unusual techniques, such as with the use of bolt cutters or other metal cutting tools.

(2) Tagout devices. Tagout devices, including their means of attachment, shall be substantial enough to prevent inadvertent or accidental removal. Tagout device attachment means shall be of a non-reusable type, attachable by hand, self-locking, and non-releasable with a minimum unlocking strength of no less than 50 pounds and having the general design and basic characteristics of being at least equivalent to a one-piece, all-environment-tolerant nylon cable tie.

(D) Identifiable. Lockout devices and tagout devices shall indicate the

identity of the employee applying the device(s).

(iii) Tagout devices shall warn against hazardous conditions if the machine or equipment is energized and shall include a legend such as the following: **Do not start, Do not open, Do not close, Do not energize, Do not operate**.

(6) Periodic inspection. (i) The employer shall conduct a periodic inspection of the energy control procedure at least annually to ensure that the procedure and the requirements of this standard are being followed.

(A) The periodic inspection shall be performed by an authorized employee other than the one(s) utilizing the energy control procedure being inspected.

(B) The periodic inspection shall be designed to correct any deviations or inadequacies observed.

(C) Where lockout is used for energy control, the periodic inspection shall include a review, between the inspector and each authorized employee, of that employee's responsibilities under the energy control procedure being inspected.

(D) Where tagout is used for energy control, the periodic inspection shall include a review, between the inspector and each authorized and affected employee, of the employee's responsibilities under the energy control procedure being inspected, and the elements set forth in paragraph (c)(7)(ii) of this section.

(ii) The employer shall certify that the periodic inspections have been performed. The certification shall identify the machine or equipment on which the energy control procedure was being utilized, the date of the inspection, the employees included in the inspection, and the person performing the inspection.

(7) Training and communication. (i) The employer shall provide training to ensure that the purpose and function of the energy control program are understood by the employees and that the knowledge and skills required for the safe application, usage, and removal of energy controls are required by the employees. The training shall include the following:

(A) Each authorized employee shall receive training in the recognition of applicable hazardous energy sources, the type and magnitude of the energy available in the workplace, and the methods and means necessary for energy isolation and control.

(B) Each affected employee shall be instructed in the purpose and use of the energy control procedure.

(C) All other employees whose work operations are or may be in the area where energy control procedures may be utilized, shall be instructed about the procedure, and about the prohibition relating to attempts to reenergize or start machines or equipment which are locked out or tagged out.

(ii) When tagout systems are used, employees shall also be trained in the following limitations of tags:

(A) Tags are essentially warning devices affixed to energy isolating devices, and do not provide the physical restraint on those devices that is provided by a lock.

(B) When a tag is attached to an energy isolating means, it is not to be removed without the permission of the authorized person responsible for it, and it is never to be bypassed, ignored, or otherwise defeated.

(C) Tags must be legible and understandable by all authorized employees,

affected employees, and all other employees whose work operations are or may be in the area, in order to be effective.

(D) Tags and their means of attachment must be made of materials which will withstand the environmental conditions encountered in the workplace.

(E) Tags may evoke a false sense of security, and their meaning needs to be understood as part of the overall energy control program.

(F) Tags may be securely attached to energy isolating devices so that they cannot be inadvertently or accidentally detached during use.

(iii) Employee retraining.

(A) Retraining shall be provided for all authorized and affected employees whenever there is a change in their job assignments, a change in machines, equipment or processes that present a new hazard, or when there is a change in the energy control procedures.

(B) Additional retraining shall also be conducted whenever periodic inspection under paragraph (c)(6) of this section reveals, or whenever the employer has reason to believe, that there are deviations from or inadequacies in the employee's knowledge or use of the energy control procedures.

(C) The retraining shall reestablish employee proficiency and introduce new or revised control methods and procedures, as necessary.

(iv) The employer shall certify that employee training has been accomplished and is being kept up to date. The certification shall contain each employee's name and dates of training.

(8) Energy isolation. Implementation of lockout or the tagout system shall be performed only by authorized employees.

(9) Notification of employees. Affected employees shall be notified by the employer or authorized employee of the application and removal of lockout or tagout devices. Notification shall be given before the controls are applied, and after they are removed from the machine or equipment.

(d) Application of control. The established procedure for the application of energy control (implementation of lockout or tagout system procedures) shall cover the following elements and actions and shall be done in the following sequence:

(1) Preparation for shutdown. Before an authorized or affected employee turns off the machine or equipment, the authorized employee shall have knowledge of the type and magnitude of the energy, the hazards of the energy to be controlled, and the method or means to control the energy.

(2) Machine or equipment shutdown. The machine or equipment shall be turned off or shutdown using the procedures required by this standard. An orderly shutdown must be utilized to avoid any additional or increased hazard(s) to employees as a result of equipment deenergization.

(3) Machine or equipment isolation. All energy isolating devices that are needed to control the energy to the machine or equipment shall be physically located and operated in such a manner as to isolate the machine or equipment from the energy source(s).

(4) Lockout or tagout device application. (i) Lockout or tagout devices shall be affixed to each energy isolating device by authorized employees.

(ii) Lockout devices, where used, shall be affixed in a manner so that will hold the energy iso-

lating devices in a "safe" or "off" position.

(iii) Tagout devices where used, shall be affixed in such a manner as will clearly indicate that the operation or movement of energy isolating devices from the "safe" or "off" operating position is prohibited.

(A) Where tagout devices are used with energy isolating devices designed with the capability of being locked, the tag attachment shall be fastened at the same point at which the lock would have been attached.

(B) Where a tag cannot be affixed directly to the energy isolating device, the tag shall be located as close as safely possible to the device, in a position that will be immediately obvious to anyone attempting to operate the device.

(5) Stored energy. (i) Following the application of lockout or tagout devices to energy isolating devices, all potentially hazardous stored or residual energy shall be relieved, disconnected, restrained, or otherwise rendered safe.

(ii) If there is a possibility of re-accumulation of stored energy to a hazardous level, verification of isolation shall be continued until the servicing or maintenance is completed, or until the possibility of such accumulation no longer exists.

(6) Verification of isolation. Prior to starting work on machines or equipment that have locked out or tagged out, the authorized employee shall verify the isolation and de-energization of the machine or equipment have been accomplished.

(e) Release from lockout or tagout. Before lockout or tagout devices are removed and energy is restored to the machine or equipment, procedures shall be followed and actions taken by the authorized employee to ensure the following:

(1) The machine or equipment. The work area shall be inspected to ensure that nonessential items have been removed and to ensure that machine or equipment components are operationally intact.

(2) Employees. (i) The work area shall be checked to ensure that all employees have been safely positioned or removed.

(ii) Before lockout or tagout devices are removed and before machines or equipment are energized, affected employees shall be notified that the lockout or tagout devices have been removed.

(3) Lockout or tagout devices removal. Each lockout or tagout device shall be removed from each energy isolating device by the employee who applied the device. **Exception to paragraph-** (e)(3): When the authorized employee who applied the lockout or tagout device is not available to remove it, the device may be removed under the direction of the employer, provided that specific procedures and training for such removal has been developed, documented and incorporated into the employer's energy control program. The employer shall demonstrate that the specific procedure provides equivalent safety to the device by the authorized employee who applied it. The specific procedure shall include at least the following elements:

(i) Verification by the employer that the authorized employee who applied the device is not at the facility;

(ii) Making all reasonable efforts to contact the authorized employee to inform his/her lockout or tagout device has been removed; and

(iii) Ensuring that the authorized employee has

this knowledge before he/she resumes work at the facility.

(F) Additional requirements. (1) Testing or positioning of machines, equipment or components thereof. In situations in which lockout or tagout devices must be temporarily removed from the energy isolating device and the machine or equipment energized to test or position the machine, equipment or component thereof, the following sequence of actions must be followed:

(i) Clear the machine or equipment of tools and materials in accordance with paragraph (e)(1) of this section;

(ii) Remove employees from the machine or equipment area in accordance with paragraph (e)(2) of this section;

(iii) Remove the lockout or tagout devices as specified in paragraph (e)(3) of this section;

(iv) Energize and proceed with testing or positioning;

(v) De-energize all systems and reapply energy control measures in accordance with paragraph (d) of this section to continue the servicing and/or maintenance.

(2) Outside personnel (contractors, etc.). (i) Whenever outside servicing personnel are to be engaged in activities covered by the scope and application of this standard, the on-site employer and the outside employer shall inform each other of their respective lockout or tagout procedures.

(ii) The on-site employer shall ensure that his/her personnel understand and comply with restrictions and prohibitions of the outside employer's energy control procedures.

(3) Group lockout or tagout. (i) When servicing and or maintenance is performed by a crew, craft, department or other group, they shall utilize a procedure which affords the employees a level of protection equivalent to that provided by the implementation of a personal lockout or tagout device.

(ii) Group lockout or tagout devices shall be used in accordance with the procedures required by paragraph (c)(4) of this section including, but not necessarily limited to, the following specific requirements:

(A) Primary responsibility is vested in an authorized employee for a set number of employees working under the protection of a group lockout or tagout device (such as a operations lock);

(B) Provision for the authorized employee to ascertain the exposure status of individual group members with regard to the lockout or tagout of the machine or equipment; and

(C) When more than one crew, craft, department, etc. is involved, assignment of overall job-associated lockout or tagout control responsibility to an authorized employee designated to coordinate affected work forces and ensure continuity of protection; and

(D) Each authorized employee shall affix a personal lockout device, group lockbox, or comparable mechanism when he/she begins work, and shall remove those devices when he or she stops working on the machine or equipment being serviced or maintained.

(4) Shift or personnel changes. Specific precautions shall be utilized during shift or personnel changes to ensure the continuity of lockout or tagout protection, including provision for the orderly transfer of lockout or tagout devices between off-going and oncoming employees, to minimize exposure to hazards from the unexpected energization, start-up of the machine or equipment, or release of stored energy.

Reference B

STANDARDS FOR VARIOUS INDUSTRIES

PULP, PAPER AND PAPERBOARD MILLS

1910.261(B)(4) Lockout. Devices such as padlocks shall be provided for locking out the source of power at the main disconnect switch. Before any maintenance, inspection, cleaning, adjusting, or servicing of equipment (electrical, mechanical, or other) that required entrance into or close contact with the machinery or equipment, the main power disconnect switch or valve, or both controlling its source of power or flow of materials, shall be locked out or blocked off with padlock, blank flange, or similar device.

(5) Vessel entering. Lifelines and safety harness shall be worn by anyone entering closed vessels, tanks, ship bins, and similar equipment, and a person shall be stationed outside in a position to handle the line and to summon assistance in case of emergency. The air in the vessels shall be tested for oxygen deficiency and the presence of both toxic and explosive gases and vapors, before entry into the closed vessels, tanks, etc., is permitted. Self-contained air or oxygen supply masks shall be readily available in case of emergency. Work shall not be done on equipment under conditions where an injury would result if a valve were unexpectedly opened or closed unless the valve has been locked in a safe position.

1910.261 (e)(2) Slasher tables. Saws shall be stopped and power switches shall be locked out and tagged whenever it is necessary for any person to be on the slasher table.

(10)Stops. All control devices shall be locked out and tagged when knives are being changed.

1910.261 (e)(12)(iii) Whenever it becomes necessary for a workman to go within a drum, the driving mechanism shall be locked out and tagged, at the main disconnect switch, in accordance with paragraph (b)(4) of this section.

1910.261 (e)(13) Intermittent barking drums. In addition to motor switch, clutch, belt shifter, or other power disconnecting device, intermittent barking drums shall be equipped with a device that may be locked out to prevent the drum from moving while it is being emptied or filled.

1910.261 (f)(6)(i) When cleaning, inspection, or other work requires that person enter rag cookers, all steam and water valves or other control devices, shall be locked or tagged in the closed or "off" position. Blank flanging of pipelines is acceptable in place of closed and locked valves.

1910.261 (g)(4)(ii) A man shall be stationed outside to summon assistance if necessary. All intake valves to a tank shall be blanked off or disconnected.

1910.261 (g)(15)(i) Valves controlling lines leading into a digester shall be locked out and tagged. The keys to the locks shall be in the possession of a person or persons doing the inspecting or making repairs.

1910.261 (g)(16)(i) Safety regulations governing inspection and repairing of pressure tanks accumulators (acid) shall be the same as those specified in subparagraph (15) of this paragraph.

1910.261 (g)(19)(iii) When blow lines form more than one digester lead into one pipe. The cock or valve of the blow line from the tank being inspected or repaired shall be locked out, or the line shall be disconnected and blocked off.

1910.261 (g)(21) Inspection and repair of tanks. All piping leading to tanks shall be blanked off or valved and locked or tagged. Any lines to sewers shall be blanked off to protect worker from air contaminants.

1910.261 (j)(1)(iii) Repairs for cleaning of blockage shall be done only when the shredder is shutdown and control devices locked.

1910.261 (j)(4)(iii) When cleaning, inspecting, or other work requires that persons enter the beaters, all control devices shall be locked or tagged out, in accordance with paragraph (b)(4) of this section.

1910.261 (j)(5)(iii) When cleaning, inspection, or other work requires that person enter pulpers, all steam, water, or control devices shall be locked or tagged out. Blank flanging and tagging of pipelines are acceptable in place of closed and locked or tagged valves. Blank flanging of steam and water lines shall be acceptable in place of valve locks.

1910.261 (j)(6)(i) All control devices shall be locked or tagged out when a person enters stock chests, in accordance with paragraph (b)(4) of this section.

1910.261 (k)(2)(ii) All drives shall be provided with lockout devices at the power switch that interrupt the flow of current to the unit.

TEXTILES

1910.262 (C)(1) Means of stopping machines. Every machine shall be provided with individual mechanical or electrical mean for stopping such machines. On machines driven by belts and shafting, a locking type shafter or an equivalent positive device shall be used. On operations where injury to the operator might result if motors were to restart after failures, provision shall be made to prevent machines from automatically restarting upon restoration of power.

1910.262 (n)(2) Protection for loom fixer. Provision shall be made so that every loom fixer can prevent the loom from being started while he is at work on the loom. This may be accomplished by means of a lock, the key to which is retained in the possession of the loom fixer or by other effective means to prevent the starting of the loom.

1910.262 (p)(1) J-box protection. Each valve controlling the flow of steam, injurious gases, or liquids into a J-box shall be equipped with a chain, lock, and key, so that any worker who enters the J-box can lock the valve and retain the key in his possession. Any other method that will prevent steam, injurious gases, or liquids from entering the J-box while the worker is in it will be acceptable.

1910.262 (q)(2) Kier valve protection. Each valve controlling the flow of steam, injurious gases, or liquid into a kier shall be equipped with a chain, lock, and key, so that any worker who enters the kier can lock the valve and retain the key in his

possession. Any other method that will prevent steam, injurious gases, or liquids from entering the kier while the worker is in it will be acceptable.

BAKERY EQUIPMENT

1910.263 (k)(12)(i) Where pan cooling towers extend to two or more floors, a lockout switch shall be provided on each floor in order that mechanics working on the tower may positively lock the mechanism against starting. Only one start switch shall be used in motor control circuit.

1910.263 (1)(3)(iii)(b) Main shutoff valves shall be locked in the closed position when men must enter the oven or when the oven is not in service.

1910.263(1)(8)(iii) A main disconnect switch or circuit breaker shall be provided. This switch or circuit breaker shall be located such that it can be reached quickly and safely. The main switch or circuit breaker shall have provisions for locking it in the open position if any work on the electrical equipment or inside the oven must be performed.

SAWMILLS

1910.265 (c)(12)(v) Open switches. Before working on electrical equipment, switches shall be opened and shall be tagged, blocked, or locked out.

1910.265 (c)(13) Hydraulic systems. Means shall be provided to block, chain, or otherwise secure equipment normally supported by hydraulic pressure so as to provide for safe maintenance.

1910.265 (c)(26)(iii) Blocking hoisting platform. Means shall be provided to positively block the hoisting platform when employees must go beneath the stacker or unstacker hoist.

(v) Locking main control switches. Main control switches shall be so designed that they can be locked in the open position.

1910.265 (e)(1)(iv) Carriage control. A positive means shall be provided to prevent unintended movement of the carriage. This may involve a control locking device, a carriage tie-down, or both.

1910.268 (1)(2) Before the voltage is applied, cable conductors shall be isolated to the extent practicable. Employees shall be warned, by such techniques as briefing and tagging at all affected locations, to stay clear while the voltage is applied.

1910.268 (m)(7)(i) Prior to grounding a radio transmitting station antenna, the employer shall ensure that the rigger in charge (A) prepares a danger tag signed with his signature, (B) requests the transmitting technician to shutdown the transmitter and to ground the antenna with its grounding switch, (C) is notified by the transmitting technician that the transmitter has been shutdown, and (D) tags the antenna ground switch personally in the presence of the transmitting technician after the antenna has been grounded by the transmitting technician.

Reference C

STANDARD PRINT AND FORMAT OF TAGS

The following are some examples of tags that could be used in a lockout/tagout situation. It is recommended that tags are used in combination with locks to ensure maximum employee protection. All authorized employees should have personalized locks and tags. For training, the program coordinator should use the specific tags that the company will be using in order to familiarize the trainees with the equipment they will be using. It is important to remember that locks and tags must be durable, standardized, substantial, and include the identity of the employee applying the device. Refer to pages seven through ten of the written program for details.

DO NOT OPERATE THIS EQUIPMENT

Signed by _____ Dept. _____ Date _____

FRONT
DO NOT REMOVE THIS TAG

THIS LOCK AND TAG TO BE REMOVED ONLY BY PERSON SHOWN

ON BACK

SEE OTHER SIDE

Questions

1. What is the main purpose for establishing a lockout or tagout program?

2. How is a pinch point distinguished from a squeeze point?

3. What is the definition of an energy source?

4. Why should only authorized personnel be responsible for removing their own tags?

5. Why is it important that all lockout/tagout devices be standardized within a facility?

6. Explain the procedures for multiple lockouts.

7. Which is more important to human safety, the amount of current or the voltage? Does the other have any importance especially when locking out equipment?

8. True or false: Buttons, switches, and other controls should be designed and located so that the machine is not likely to be started accidentally.

9. List the four procedures that should be followed to ensure the continuity of lockout or tagout protection when there is a shift and personnel change.

10. There are two basic types of electrical energy sources, generated electrical energy and static electricity. Which of the two cannot be turned on or off? Why?

Case Study

LOCKOUT/TAGOUT INCIDENT REPORT

Date of Accident: September 22, 1993
Time of Accident: 9:22 a.m.
Location of Accident: Wepka Machine Shop
Supervisor: Bob Left
Losses Incurred: Fatality

Summary Description of Event

Carl Krate and Joel Chancel are machinists at Wepka Machine Shop. On September 22, 1993, at 9:22 a.m., they were preparing a press brake as they did each morning. They positioned a metal bar in a notch on the outer flywheel casing so the flywheel could be turned manually. Although they had turned off the power 10 minutes earlier, they had not stopped the flywheel completely. The rotating flywheel caused Carl and Joel to lose control of the metal bar. The force of the moving flywheel pulled the bar from their hands, and it went flying across the shop floor. The bar struck and killed one of their supervisors, Bob Left, who was observing the operation.

Post-response Assessment

After completing the accident report, the plant president and other supervisors discovered the following:

—Carl and Joel failed to guard against inadvertent equipment action;
—they failed to protect the worker from the hazards posed by residual energy, which persists even when primary electrical power to the equipment has been isolated;
—they failed to lock and tag the main power supply source;
—they failed to ensure that all power to the brake press was isolated, locked, or blocked, according to OSHA regulation 29CFR§1910.147.

List any recommendations that should be included on your post-response assessment.

Resources

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CHAPTER 6

Ergonomics

Contents of Chapter

Introduction
Ergonomic Workplace Analysis
Ergonomic Task Analysis
Preventing Ergonomic Hazards
Medical Management
Setting Up an Ergonomics Program
Working Together
Review and Evaluation of the Program
Summary
Questions
Case Study
Resources

Introduction

Ergonomics comes from the Greek words "ergon," meaning work, and "nomos," meaning law. Ergonomics means the laws of work. The discipline of ergonomics involves studying how employees relate, physically and psychologically, to their working environment. Over the last decade, the field of ergonomics has gained a widespread emphasis in the United States. In fact, OSHA is attempting to finalize a fully enforceable ergonomics standard. Until this standard is finalized and phased in over a period of time, OSHA will continue to investigate ergonomic hazards and cite employers using section 5(a)(1) of the Occupational Health and Safety Act.

Repetitive motion injuries are a fundamental reason for the current OSHA efforts toward developing a standard. The increase in reports of repetitive motion injuries has created great concern about the long-term effects of cumulative trauma disorders. A cumulative trauma injury results when workers perform the same tasks

time after time. Adding to the problem is the fact that many workers perform the tasks while in an awkward position or with an inordinate amount of stress placed on the affected body part. A study of injury records can help determine where a problem exists. A better method of identifying a problem task is the surveillance method. This method requires the safety professional to observe the task being performed or to ask the employees what tasks cause pain. The best method of surveillance combines observation with interviews.

The effective interviewer will use this opportunity to not only find out what causes the individual to experience pain, but also to find out if the individual has any suggestions on how to correct the problems.

Employee involvement will facilitate an effective means of identifying problem areas. The workers are the ones with the firsthand experience of what is causing the problems. Management must explain to the workers that an investment of their time will result in fewer injuries in the future. Employees must realize that the ergonomics program is meant to benefit them.

Top management should take this opportunity to increase employee involvement and develop a mutual goal of eliminating cumulative trauma injuries in the workplace. Commitment from management includes providing the organizational resources necessary to have a successful ergonomics program. Perhaps the most important aspect of management commitment is the need to assign responsibilities to individuals so that employees know what is expected of them. Along with the responsibilities, management must be willing to commit adequate authority to individuals so they can get the job done. Each superintendent, manager, and employee must be subject to some prescribed form of accountability for carrying out their assigned responsibilities. Without management commitment, the effort to control ergonomic hazards in the workplace will fail.

Both management and employees must see the benefits of instituting an ergonomics program. If either group is not committed to the prospective program, then it will be a certain failure. Ideally, the two groups should work together in an effort to eliminate repetitive motion injuries in the workplace. A joint-effort ergonomics program will work best in a participative management environment. If the work environment is not of a participative management nature, then working toward a common goal such as an ergonomics program may be the first step in developing a participative management environment.

A smoothly functioning ergonomics program can reduce the risk of both cumulative trauma injuries and serious injuries such as amputations, lacerations, or broken bones. Logically, a lower risk will lead to a lower rate of injuries, thus reducing workers' compensation costs.

Rising workers' compensation costs resulting from cumulative trauma injuries has led to a newfound awareness that ergonomic disorders may result directly from actions in the workplace. Developments in technologies and automation have created an increase in specialization, thus resulting in a multitude of tasks that require increased repetition and higher speeds. Workers are being exposed to an inordinate amount of ergonomic stressors in the workplace.

An effective program designed to eliminate ergonomic hazards in the workplace includes the following program elements:

- Ergonomic Workplace Analysis
- Ergonomic Task Analysis
- Hazard Prevention and Control
- Medical Management Aspects
- Training and Education

Ergonomic Workplace Analysis

A workplace analysis identifies the problem jobs and the risks involved. The prevailing method of determining the jobs and workstations that are problem areas is an in-depth analysis of the injury and illness records.

The first step is to analyze all OSHA 200 logs, safety records, medical records, nurse station visits, insurance records, and workers' compensation records. The problem areas will be the highest areas of injury frequency or severity. Key injuries to look at are back injuries and cumulative trauma injuries. The names of the injured should be kept confidential as the information is not pertinent to the information desired. The second step is to analyze the trends relevant to ergonomic problems occurring in specific departments, on certain tasks, within individual job classifications, or on particular production lines.

It is critical to accurately record information relevant to occupational injuries and illnesses associated with ergonomic hazards. Other methods of analysis include employee questionnaires and surveys. An ergonomist should analyze the questionnaires and surveys. Trained engineers, health care providers, or safety professionals aided by affected employees work as a substitute for an ergonomist.

Ergonomic Task Analysis

The ergonomic approach to task analysis focuses on four factors involved in every task.

1. Human operator
2. Task to be performed
3. Machine and/or equipment
4. Work environment factors

The first three factors are self-explanatory. The fourth factor, work environment, is more complex. It includes company culture, labor relations, lighting, noise, temperature, and other environmental aspects.

To illustrate ergonomic task analysis, this section will present an analysis of the task of riding a bicycle. Components of this task include the bicycle (machine), the

rider (human operator), riding the bicycle down the street (task to be performed), and the road and its immediate surroundings.

The task requires riding the bicycle from point A to point B. The demands placed on the rider include physical exertion and mental effort to control the bike. To accomplish this task, the rider must do the following items in order:

- grab the handle bars firmly;
- straddle the bike, placing one foot on each side of the bike;
- place one foot on the pedal while maintaining balance with the other foot on the ground;
- gently apply pressure to the foot on the pedal while at the same time pushing off with the foot on the ground;
- maintain balance while pedaling with both feet;
- steer the bike by turning the handle bars and leaning into the direction of the turns; and
- stop the bike by applying pressure to the brakes and using both feet to balance the bike once it is stopped.

The element to be ergonomically analyzed is the interaction of the human operator with the bike, the surrounding environment, and the task to be performed. The rider must react to the changing environmental factors encountered during task performance.

This simplistic example provides us with a framework for developing an ergonomic task analysis procedure to be used in the work environment. The first step in developing an ergonomic task analysis is to define the task. To accomplish this, a formal task description involves breaking the task down into subtasks. The human capabilities and limitations and the task demands should be described for each subtask.

Six to ten subtask statements are usually enough to sufficiently describe job tasks. Keep these statements brief. However, be certain that enough attention is given to detail to assure that steps or demands are not neglected.

Preventing Ergonomic Hazards

The primary method of preventing ergonomic injuries is to engineer the hazards out of the workplace. Workstations should be ergonomically designed with the workers' needs in mind. Properly designed workstations will accommodate all employees. Workstations should be designed to meet the needs of 95 percent of the workforce.

Each workstation should be designed for optimal performance of the workers as they execute their assigned tasks. For example, if the employees are forced to reach too far or in an awkward manner, then the chance of ergonomic injuries increases. When designing a workstation, the engineer should be made aware of the full range of motions that the employee will use in the normal performance of the assigned tasks.

Employee posture is a major factor in the types and severities of injuries reported. It is crucial that the workstation is designed to provide a range of comfortable yet correct postures. Important issues in this area include adequate space for knees, height ad-

justments on chairs, proper leg support and back support (including lumbar supports), and ample room for the employees' feet. Tables and desks in the work area should be adjustable to allow for differences in workers' heights. In the case of an office workstation, the top of the video display screen should be slightly below eye level. If a document holder is used, it should be the same height as the display screen and the same distance from the employee.

A difficult issue when designing a workstation is making it equally favorable to both right- and left-handed employees. This remains a problem issue for checkout clerks. The registers are typically designed for right-handed operators. Left-handed operators are forced to use their right hand to run the register while using their left hand to move the items through the line. An example of an ergonomic solution to this problem is the use of optical scanners to read the bar coding on the items.

In the case of production operations, tools are an essential element. Tool selection is crucial to maintaining a healthy working environment. Great care must be taken in the selection and design of tools to ensure that they do not contribute to cumulative trauma disorders. Before purchasing new tools, it is a good idea to allow the workers to test tools in the workplace where they will be used over the long term. The workers performing the test should be informed that they have more than one choice. They should be made aware that the final decision will be theirs. Points tested should include the following:

- Is the grip designed to reduce the amount of strength required to operate the tool?
- Does the task that the tool will be used for require repetitive motion?
- Does the tool vibrate under normal operating conditions?
- Does the grip have an ergonomically correct handle?
- Is the grip padded to improve the employee's comfort?
- Do the grips come in different sizes to facilitate use by all employees?

All of the above factors will contribute to selection of the proper tool. After the selection is made and the tools are placed in service, it is crucial that the employees use the correct tool for the job. If any of the previously used tools are still in operation, they should be replaced with the new selection. It is also important for the employees to use the proper tool for the job. For example, they should not try to take shortcuts by using a screwdriver as a chisel simply because the chisel was out of reach.

This last point is a direct reflection of the work atmosphere and past practices in the workplace. It is management's responsibility to train workers in proper work practices and to condition them to use safe work practices at all times. If the workers are observed using improper techniques, their supervisors should stop them and refresh their memory on the proper techniques to be used. Feedback is essential to maintain employee awareness of safe work practices. Supervisors should be encouraged to positively reinforce employees' correct actions.

In addition to positive reinforcement, numerous other administrative controls may be used in the effort to reduce workplace hazards. For example, job rotation is a method used to reduce stress and fatigue placed on certain muscle groups by a particular task. The basic premise of job rotation is to rotate the worker to jobs where the

different tasks performed will use different sets of muscles. This will permit one group of muscles to rest while the other group of muscles is being worked. The overall result should be a reduction in the amount of cumulative trauma injuries.

As a last resort, companies have been forced to use personal protective equipment in an effort to reduce the negative effects of certain jobs. Attention to detail is needed in the selection of personal protective equipment. If the wrong equipment is chosen, it may actually add to the problem instead of alleviating it.

Training and education will reinforce the efforts of first-line supervisors in getting the employees to comply with proper work practices. A well-educated workforce will lead to a healthier workforce. The employees are the ones experiencing firsthand the effects of repetitive motions or heavy lifting. Therefore, training sessions often result in suggestions from employees that present more ergonomically correct methods of performing tasks.

It is not uncommon for employees to be experiencing health problems resulting from workplace problems without realizing what is causing their discomfort. A major training need is the education of workers. A better educated workforce will recognize the early symptoms of cumulative trauma disorders, thus reducing the amount of future lost-time injuries and workers' compensation claims. A corporation may see a short-term increase in the frequency of cumulative trauma disorder cases, but will ultimately realize the decrease in the dollar cost of cumulative trauma injuries.

Medical Management

A medical management program can help reduce the incidence of ergonomically related injuries. The medical management program's goal should be to accomplish this by early identification and treatment of cumulative trauma disorder symptoms.

Perhaps the best method of early detection is one that starts with a baseline health assessment of every worker. The workers are then examined on a periodic basis to determine if any signs or symptoms of ergonomic injury are apparent in individuals. All signs or symptoms should be recorded. An analysis of overall trends according to job, task, or department should be completed in order to isolate problem areas.

Injured employees or those who are suffering from signs or symptoms of future injury should be treated immediately. Records should be kept of the treatments and follow-up exams should be given to assess levels of improvement. Effective treatments should be noted for future use.

The results of these studies should be used to develop an ergonomics program aimed at effectively preventing future occurrences of ergonomically related injuries.

Setting Up an Ergonomics Program

(This sample program will focus on back injuries)

The first step is to designate an ergonomics contact, or, better yet, an ergonomics committee. The committee should include a couple of the affected employees, a mem-

ber of the safety and health staff, the human resource director, and another member of top management.

The committee's first job is to develop awareness training. At a minimum, training should cover the following points:

- spine anatomy (basic)
- disc pressure
- posture correction and control
- practical applications and practice of body mechanics
- effects of obesity
- benefits and demonstrations of physical exercise
- on-the-job stretching exercises
- use of leverage as a lifting tool
- available mechanical advantages
- first aid for back pain

The underlying theme of this training must be individual, personal accountability. The ultimate responsibility for preventing back injury is in the individual's hands.

Proactive ergonomic training programs can help employers prevent some back pain problems, but they will provide only a minimal impact unless they are combined with employee involvement in decision making and a genuine concern for employees' well being. The ergonomics program can only help employees reach the continuous improvement level if employees are involved in workplace analysis and solution development.

The ergonomics program must be developed with realistic, measurable expectations. If the expectations for results are too high or too low, there is a chance that the program will never be implemented. Implementation is a crucial element in any ergonomics program. Once a training program is initiated, a job task analysis should be conducted. Knowing exactly how the task is performed may lead to answers about why people are being injured—it may be the nature of the task, or improper technique.

The next step is to prioritize the hazards. Addressing both the risks in the job (lifting and twisting) as well as risks to the person (health and attitude) are the two major steps in beginning a program for back injury prevention. Using these measures, the tasks should be organized in order of the hazards they present.

Once the tasks are prioritized, the next step is to start addressing the most severe hazards, based on injury severity, frequency of occurrence, and cost to the organization. The amount of time lost to an injury is the major cost to an organization. When the high-risk tasks have been addressed to management's and the employees' satisfaction, it is time to move on to the lower-risk tasks.

The most effective control is to eliminate manual lifting and handling altogether. The next consideration in task redesign is to modify the task to make it easier to accomplish through improved task layout or through the use of mechanical equipment and devices. The other alternative is to optimize the manual handling method by applying task redesign and ergonomic workplace design principles.

The last steps involved in an ergonomics program are administrative in nature. Maintaining proper recordkeeping and establishing company guidelines for medical treatment of back injuries are necessary elements in any ergonomics program.

Recordkeeping is essential to determine the risks and hazards involved with particular tasks. The frequency and severity of injuries can be located from the OSHA 200 forms maintained by the company. The other aspect of recordkeeping is maintaining a detailed list of action taken after an injury occurs, as well as actions taken to prevent future injuries.

Establishing company guidelines for the medical treatment of back injuries provides a sense of organization and cooperation. Management should work directly with the employees in establishing the guidelines. By doing so, the management says, "We care about you and value you." Workers tend to gain a sense of ownership in guidelines they help develop. They are less likely to abuse or take advantage of something they own.

A properly designed and implemented ergonomics program will preserve property, protect human resources, preserve capital, and promote efficacy. It will maximize factors that promote efficacy while minimizing factors that hinder performance.

For an ergonomics program to be effective, top management must completely support it. This support must be passed down through the corporate chain all the way to the line worker. An effective program will be the result of a combination of engineering, training, and behavioral changes.

Procedures should be developed to evaluate the ergonomics program during implementation. Another set of procedures and guidelines should be developed to measure the status and effectiveness of the program. The standards used to measure the effectiveness should be quantifiable in nature. For example, analysis of the trends in injury and illness rates since the program's institution is a quantifiable standard.

Top management must be involved in the review of the ergonomics program. By conducting semiannual reviews, top management is showing its support. The results of the review should be placed in writing and distributed to all the interested parties, including members of the ergonomics committee, line management, and line workers.

The program needs to be evaluated on a frequent basis by supervisors and employees. Any minor changes needed in the program's goals and objectives should be accomplished at this level. Any changes of a higher caliber will be taken to a committee meeting to be held on a quarterly basis.

The activities of the group must be evaluated to determine the interest and enthusiasm levels of the group members. If the enthusiasm level has declined from what it was at the start of the program, then chances are good that the interest level has also declined. Continued success of the program will depend on management's efforts in keeping interest and enthusiasm levels high.

It is common for group members to become frustrated with unresolved issues or lack of cooperation from line workers or management. Management must be perceptive enough to realize that frustration is natural in a program such as this one. The key for management is to detect the frustration early enough to prevent members from dropping out of the committee. The primary means by which management can mollify disgruntled group members is to provide visible support for the program. Know-

ing that management fully supports the program will provide a sense of pride for the committee members.

Committee members must be trained in communication skills. If the committee members cannot properly communicate orally and in writing, then the program will not produce the desired results. The committee members are dealing with management and employees, therefore they need to understand how to effectively communicate on both levels.

Further training is needed to educate the workforce about cumulative trauma disorders. The training should be provided through oral, written, and visual means. A better educated workforce will result in earlier detection of injuries and illnesses. This may cause the initial rate of reported symptoms to increase, but a dramatic decrease in medical treatment for long-term effects should accompany this increase. This training should be a basic part of the committee's duties.

Training committee members in the prioritization of tasks is essential. Every member of the committee will think that the issues in their departments are the most important. They will also feel pressure from employees in their departments to get things done. It is for this reason that they must be trained to look at the entire picture. Items posing immediate or imminent threats to the employees' health and well-being will be handled first. Committee members must be able to communicate to the employees the reasons behind their prioritization decisions. A good committee member will include input from employees into the prioritization process.

A frequent and consistent schedule for training the workforce will provide needed exposure for the ergonomics program to function. The training should focus on getting every employee involved in making the workplace a better place to work. Suggestions from the workers should be welcomed by all committee members and management. These suggestions should be evaluated and the action taken on them should be reported to the employee(s) making them. If the suggestion is not used, the employee should be informed of the reason why and at the same time encouraged to submit any other suggestions that he or she may have in the future. If the suggestion is used, then the employee should be made aware of the target date for completion. Also, keep the employee informed of the status of completion of the tasks required by the suggestion. Feedback must be frequent and positive in order to be effective.

Working Together

Once trained, management and employees are faced with the decision of choosing which jobs and tasks should be evaluated first. Generally speaking, items should be prioritized in the following manner:

- Priority 1: The probability of injury is HIGH and the resultant injury will be SEVERE.
- Priority 2: The probability of injury is HIGH and the resultant injury will likely be MINOR.

- Priority 3: The probability of injury is LOW but the resultant injury will be SEVERE.
- Priority 4: The probability of injury is LOW and the resultant injury will be MINOR.

This is only a suggested method; an organization may need to alter this method to suit its specific situation. Keep in mind that it is necessary to perform an ergonomics task analysis on all jobs in order to effectively prioritize them. After the jobs and tasks are prioritized, it is time to implement the ergonomics program. Start with the job or task that requires the most urgent effort—the Priority 1 job or task.

Review and Evaluation of the Program

Procedures should be developed to monitor the program's effectiveness. These procedures should provide a means to evaluate the program's implementation. Beyond the implementation phase, the procedures should provide for development of periodic progress reports of the program's accomplishments.

The progress reports should be provided to top management. On at least a semiannual basis, top management should evaluate the program's effectiveness relating to its goals and objectives. Evaluation methods include the following:

1. Analysis of trends in injury/illness rates
2. Employee surveys
3. Before-and-after surveys/evaluations of job or worksite changes
4. Review of the results of plant evaluations
5. Up-to-date records or logs of tried or implemented job improvements

The results of top management's review should be presented in writing to all responsible parties and communicated to the employees. The written report should include a progress report and program update. Often, at this point, it is necessary for goals and objectives to be revised or new goals and objectives to be developed. If either is the case, then the new goals and objectives must be shared with all workers involved in the program.

Line management and employees should review the program's goals and objectives on a continuing basis. Quarterly meetings involving employees, managers, and supervisors should be held to identify and discuss possible changes to the program or revisions of goals and objectives. Items of change, agreed on in the quarterly meeting, should be submitted to top management for its semiannual review. If the matter is urgent, then an emergency meeting of top management, managers, supervisors, and involved employees should be called.

It is important to maintain interest in improving the ergonomics program. It is not unusual for a corporation to develop the program until results are noticed, and then any progress stops. For a program to be successful, it must be continuously improved.

Summary

Ergonomic injuries such as soft tissue strains and sprains still remain a significant problem in many organizations. Companies have found that while they have been able to reduce these injuries through a variety of task- and workstation-specific interventions, their performance has reached a plateau. A systematic leadership approach that develops ergonomic behavior on the part of line staff, supervisors and executives is critical to breaking through this plateau.

These ergonomics programs are only as good as management will permit. In other words, with management's commitment the programs will be effective, but without management's commitment the program is destined for failure. Implementation of an effective ergonomics program can be an enormous task. Therefore, commitment is needed from both management and the employees.

Ergonomics is a term commonly used to incorporate many issues. An organization must determine exactly what it needs ergonomically before designing a program. If an organization decides to use a "canned," already prepared ergonomics program, it must be careful to ensure that the program will cost-effectively facilitate changes that will tailor the program to the organization's specific needs. For example, an effective program for a meat packing plant may vary greatly from an effective program for a steel producing plant.

Questions

1. What is the key to any proper lifting technique?

2. True or false: The term ergonomics comes from two words that mean "work" and "law."

3. True or false: A smooth and functioning ergonomics program can reduce both cumulative trauma injuries and the risk of serious injuries, such as amputations, lacerations, or broken bones. Why?

4. List the four factors involved in the ergonomic approach to the task analysis.

5. True or false: The primary method of preventing ergonomic injuries is to engineer the hazards out of the workplace.

6. True or false: Workstations should be designed to meet the needs of 50 percent of the workforce.

7. True or false: Ergonomic programs are only as good as management will permit. Explain.

8. Explain why it is difficult to design a workstation that is equally favorable to both right- and left-handed employees.

9. Explain why workstations must be designed to eliminate unnecessary reaching, bending, and stretching.

10. True or false: Before purchasing new tools, it is a good idea to allow the workers to test tools in the workplace where they will be used over the long term. Explain.

Case Study

ERGONOMICS INCIDENT EVENT

Date of Accident:	November 4, 1994
Time of Accident:	10:30 a.m.
Location of Accident:	Melroe Meat Packing
Supervisor:	Kevin Kurp
Losses Incurred:	Scathed thigh, cumulative trauma of the wrist and shoulder

Summary Description of Event

Ken Cole is a line slaughter worker at the front of a meat packing plant. He works 5 days a week, 10 hours a day. His job is to saw off the hindquarters of beef as they pass in front of him. He uses a chainsaw-type tool and is required to extend his arms out in front of him and slightly above shoulder height. During an average day, Ken saws between 200 and 300 hindquarters.

Ken arrives at work at 5:00 a.m., and by 5:30 a.m. he is on the line. For the first five to six hours, Ken feels fine. For the remaining hours, Ken experiences numbness in his wrists and needles in his right shoulder. Ken has discussed this with his supervisor, Kevin Kurp, on several occasions; Kevin's remedy was one additional 15-minute break.

At 10:30 a.m. on November 4, 1994, Ken was in his fifth hour on the job. His symptoms were severe, but his supervisor would not permit him to take a break until the quota was met. Ken continued to saw, but the pain got so bad he dropped the saw. Ken suffered only a scathed thigh in addition to cumulative trauma to his wrist and shoulder.

Post-response Assessment

This incident reflects a serious deficiency, willfully ignoring a serious health hazard that is potentially dangerous to the hundreds of people working at the plant.

Findings show that Ken, along with others, had the ability to perform when overloaded but only when job rotation was permitted. The precise, repetitive operations of sawing hindquarters while stretching out the arms is not a natural position for such long periods of time.

In this case, job rotation, sufficient resting periods, and a more ergonomically designed line would help increase worker health and productivity.

What other decisions could be included to make this environment safer?

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CHAPTER 7

Confined Spaces

Contents of Chapter

Introduction
Permit-Required Confined Space Program
Discussion of Written Program Elements
The Permit System
Training
Rescue and Emergency Services
Summary
Questions
Case Study
Resources
Additional Information

Introduction

The deadly nature of confined spaces leaves little room for error and even less of an opportunity to learn on the job. Learning from practical, real-world experiences often requires learning from one's own mistakes. Understanding the type of hazards that may be present at your job site involves familiarity with the OSHA standards and recommendations. Confined spaces are enclosures that have limited means of access and egress. Some confined spaces include tanker cars, storage tanks, boilers, silos, bins, and similar areas that have access through a door or manhole. Other places include underground utility tunnels, pipelines, septic tanks, and storm sewers that reduce the concentration of the normal 21 percent of oxygen in the atmosphere, or where oxygen deficiencies arise and heavier-than-air gases settle in closed containers where there is no opening at the bottom of the enclosure. There are three

specific hazards of confined spaces: (1) oxygen deficient atmosphere (less than 18 percent oxygen), (2) confined spaces of flammable and combustible gases, vapors, dusts, and other substances, and (3) toxicity. The only way to safely detect a hazardous atmosphere is with a "calibrated direct reading instrument" as described in OSHA's Federal Register, 29 CFR 1910.146. More information on specific hazards will be covered later in this chapter.

OSHA expects the Confined Space Standard (effective April 15, 1993) to prevent 85 percent of the fatalities annually associated with confined space entry in general industry. Agriculture, construction, and shipyard employment are not covered by the standard, as it applies only to general industry. According to OSHA Standard 29 CFR 1910.146, a confined space is one that is all of the following:

1. Large enough and so configured that an employee can bodily enter and perform assigned work;
2. Has limited or restricted means for entry or exit (e.g., tanks, vessels, silos, storage bins, hoppers, vaults, pits, and spaces that may have limited means of entry); and
3. Is not designed for continuous employee occupancy.

29 CFR 1910.146 also states that a non-permit-required confined space is a confined space that does not contain or (with respect to atmospheric hazards) does not have the potential to contain any hazard capable of causing death or serious physical harm.

The standard defines a permit-required confined space as a confined space that has one or more of the following characteristics:

1. Contains or has the potential to contain a hazardous atmosphere;
2. Contains a material that has the potential for engulfing an entrant;
3. Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross section; or
4. Contains any other recognized serious safety or health hazard.

The standard is intended to protect workers from hazards of entry into permit-required confined spaces. It requires all employers to evaluate their workplaces to determine if any permit-required confined spaces are present. If the workplace does contain permit-required confined spaces, then the employer must warn exposed employees of the existence and location of permit-required confined spaces. The most common method to warn employees is by posting "Danger: Permit-Required Confined Space—Do Not Enter" signs.

The employer must determine if any employees will be permitted to enter the permit-required confined space. If the employer decides to allow certain employees to enter the confined space, the employer shall train the employees on proper entry procedure and develop and implement a written permit-required confined-space entry program. The written program shall be available for employees to examine.

Permit-Required Confined Space Program

Once the employer has determined that confined spaces do exist on the premises and that some are permit-required confined spaces, the development of a written permit-required confined space program is required. The written program is to be designed to safeguard the employees from hazards associated with permit-required confined spaces. Each permit-required confined space is unique; therefore the written program should provide regulations and procedures for the worst-case scenario. The idea is that the authorized workers will become accustomed to using a stringent set of procedures for all entries.

Paragraph (c)(4) of the standard requires employers to provide a written program for permit-required confined-space entry. OSHA outlines 14 specific areas that must be covered by the written program. In accordance with paragraph (d) of the standard the items in Table 7.1 must be addressed in the written program.

Discussion of Written Program Elements

The method for complying with the employer's responsibility to prevent unauthorized entry is up to the employer's discretion. OSHA is only concerned with the accomplishment of the desired goal.

Table 7.1. Permit-Required Confined-Space Program Mandatory Elements

- Implement the measures necessary to prevent unauthorized entry;
- Identify and evaluate the hazards of permit spaces before employees enter them;
- Develop and implement the means, procedures, and practices necessary for safe permit space entry operations;
- Provide, maintain, and ensure proper use of equipment;
- Evaluate permit-required space conditions for acceptable entry conditions;
- Provide at least one attendant outside the permit space into which entry is authorized for the duration of entry operations;
- Include emergency response procedures to be followed by an attendant who monitors more than one space at a time;
- Designate persons to have active roles in the entry operations, identify their duties, and train them;
- Develop and implement procedures for summoning rescue and emergency services to the scene;
- Develop and implement a system for the preparation, issuance, use, and cancellation of entry permits;
- Develop and implement procedures to coordinate entry when employees of more than one employer are working in a permit space simultaneously;
- Develop and implement procedures for concluding entry upon completion of operations;
- Review entry operations and revise any deficiencies in the program;
- Review program and cancelled permits annually for compliance with the standard.

The most effective method of preventing unauthorized entry is a combination of training, warning signs, barriers, and locks. Of course, any method is only effective if it is enforced. Having a written program does not constitute full compliance with the standard. Procedures and work practices provided in the written program must be explained and demonstrated to all authorized entrants. All unauthorized employees need to know not to enter the permit-required space.

Unauthorized entrants to a confined space often place their lives and the lives of the authorized entrants in danger. For this reason, signs must be posted warning of the dangers associated with entry into this area.

Developing and implementing the means, procedures and practices necessary for safe permit space entry operations includes, but is not limited to, the following:

- Specifying acceptable entry conditions;
- Isolating the permit space;
- Purging, inerting, flushing, or ventilating the permit space as necessary to eliminate or control atmospheric hazards;
- Providing pedestrian, vehicle, or other necessary barriers to protect entrants from external hazards; and
- Verifying that conditions in the permit space are acceptable for entry throughout the duration of an authorized entry.

Employers must provide, at no cost to employees, the following equipment for safe entry, maintain such equipment, and ensure its proper use by employees:

- Testing and monitoring equipment
- Ventilating equipment needed to ensure acceptable entry conditions
- Communications equipment necessary for safety of entrants in case of emergency
- Personal protective equipment, insofar as feasible engineering and work practice controls do not adequately protect employees
- Lighting equipment for safe work and efficient exit in case of emergency
- Barriers and shields
- Equipment (such as ladders) needed for safe entry and exit by authorized entrants
- Rescue and emergency equipment
- Any other equipment necessary for safe entry into and rescue from permit spaces

The permit systems must address specifically the equipment to be kept on hand, its proper maintenance, tests to determine the condition for its use, and the person(s) responsible for these areas of the program.

Before authorizing entry, the conditions in the permit space must be tested to determine if acceptable entry conditions exist. In addition to the initial testing, it is necessary to test or monitor the permit space as necessary to determine if acceptable entry conditions are being maintained during the entire course of entry operations.

The standard requires that testing for atmospheric hazards be conducted in the following sequence: first, test for oxygen; second, test for combustible gases and vapors; and finally, test for toxic gases and vapors.

For details on atmospheric testing of permit spaces see Appendix B to 29 CFR 1910.146, Procedures for Atmospheric Testing, as supplemented by the Standard's Appendix E, Sewer System Entry.

In addition, an attendant must be stationed outside the permit space(s) for the duration of the entry. If an attendant is required to monitor more than one permit space, then the standard requires that the permit program include the means and procedures that will provide the attendant means to respond to an emergency affecting one or more of the permit spaces being monitored without compromising his/her responsibilities of monitoring the other space(s).

The written program must also designate the persons who are to have active roles in entry operations (i.e., authorized entrants, attendants, entry supervisors, or persons who test or monitor the atmosphere in a permit space), identify the duties of each employee, and provide each employee with the appropriate training required by the standard.

The standard further requires development and implementation of procedures for summoning rescue and emergency services to the scene, for rescuing entrants from permit spaces, for providing necessary emergency services to rescued employees, and for preventing unauthorized personnel from attempting a rescue. In addition, the standard requires development and implementation of a system for the preparation, issuance, use, and cancellation of entry permits. Also required is the development and implementation of procedures to coordinate entry when employees of more than one employer are working in a permit space simultaneously, thus preventing employees of one employer from endangering the employees of another employer. The last step required in any entry operation is conclusion of entry upon completion of operations; this will include closing off a permit space and canceling the permit.

It will become necessary to review entry operations and revise the program to correct any deficiencies before subsequent entries are authorized. (Examples of circumstances requiring the review of the permit space program include any unauthorized entry of a permit space, the detection of a permit space hazard not covered by the permit, the detection of condition prohibited by the permit, the occurrence of an injury or near-miss during entry, a change in the use or configuration of a permit space, and employee complaints about the effectiveness of the program.)

As a final step to ensure compliance with the standard, the written program should provide for a procedure to review the program and cancelled permits annually for compliance with the standard. If no entry is made within a 12-month period, then no review is necessary.

The Permit System

Before entry is authorized, the employer shall document the completion of measures required to prepare a space for entry by completing an entry permit. The examples

Table 7.2. Duties of Involved Employees

Duties of authorized entrants—The employer must ensure that each entrant:

- Knows the hazards he or she may face;
- Is able to recognize signs or symptoms of exposure and understand the consequences of exposure to hazards;
- Knows how to use any needed equipment;
- Communicates with the attendant as necessary to enable the attendant to monitor entrant status and to enable the attendant to alert entrants of the need to evacuate the space if necessary;
- Alerts attendants when a warning symptom or other hazardous condition exists; and
- Exits as quickly as possible whenever ordered or alerted (by alarm, warning sign, or prohibited condition) to do so.

Duties of attendants—The employer must ensure that each attendant:

- Knows the hazards that may be faced during exposure;
- Is aware of behavioral effects of hazard exposure;
- Continuously maintains an accurate count of authorized entrants in the permit space and ensures that the means used to identify authorized entrants accurately identifies who is in the permit space;
- Remains outside the permit space during entry operations until relieved by another attendant;
- Communicates with authorized entrants to monitor entrant status and to alert entrants of the need to evacuate the area;
- Monitors activities inside and outside the space to determine if it is safe for entrants to remain in the space and orders evacuation of the permit space if any of the following conditions exist:
  - Attendant detects a prohibited condition;
  - Attendant detects the behavioral effects of hazard exposure;
  - Attendant detects a situation outside the space that could endanger the authorized entrants;
  - Attendant cannot effectively and safely perform all assigned duties;
- Summons rescuers when necessary;
- Prevents unauthorized entry into the permit spaces;
- Performs nonentry rescues if needed; and
- Does not perform any duties that interfere with his or her primary duty to monitor and protect the safety of authorized entry.

Duties of entry supervisors—The employer must ensure that entry supervisors:

- Know the hazards of confined spaces;
- Verify that all tests have been conducted and all procedures and equipment are in place before endorsing the permit;
- Terminate entry and cancel permits;
- Verify that rescue services are available and the means for summoning them are available;
- Remove unauthorized individuals who enter or attempt to enter the permit space during entry operations; and
- Determine—at least when shifts and entry supervisors change—that acceptable conditions as specified in the permit are maintained.

Table 7.3. Confined Space Pre-entry Checklist

Date and Time Issued: Date and Time Expires:
Job site/Space I.D.: Job Supervisor:
Equipment to be worked on: Work to be performed:
Stand-by Personnel:

1. Atmospheric Checks: Time:
   Oxygen%
   Explosive% L.F.L.
   Toxic PPM
2. Tester's signature:
3. Source isolation (No Entry):

	N/A	Yes	No
Pumps or lines	blinded ( )	disconnected ( )	blocked ( )

4. Ventilation modification:

	N/A	Yes	No
Mechanical	( )	( )	( )
Natural ventilation only	( )	( )	( )

5. Atmospheric check after isolation and ventilation:
   Oxygen %>19.5%
   Explosive % L.F.L.<10%
   Toxic PPM<10PPM H (2) S
   Time:
   Tester's Signature:
6. Communication procedures:
7. Rescue procedures: ____
8. Entry, standby, and back-up persons:

	Yes	No
Successfully completed required training?	( )	( )
Is it current?	( )	( )

9. Equipment:

	N/A	Yes	No
Direct reading gas monitor tested	( )	( )	( )
Safety harness and lifelines for entry and standby persons	( )	( )	( )
Hoisting equipment	( )	( )	( )
Powered communications	( )	( )	( )
SCBAs for entry and standby persons	( )	( )	( )
Protective clothing	( )	( )	( )
All electric equipment listed Class I, Division I, Group D and nonsparking tools	( )	( )	( )

10. Periodic atmospheric tests:

Oxygen%	Time	Oxygen%	Time
Oxygen%	Time	Oxygen%	Time
Explosive%	Time	Explosive%	Time
Explosive%	Time	Explosive%	Time
Toxic%	Time	Toxic%	Time

We have reviewed the work authorized by this permit and the information contained herein. Written instructions and safety procedures have been received and are understood. Entry cannot be approved if any squares are marked in the "No" column. This permit is not valid unless all appropriate items are completed.

(*continued*)

Table 7.3. (*continued*)

Permit prepared by: (Supervisor)
Approved by: (Unit Supervisor)
Reviewed by: (C-S Operations personnel):
Printed Name Signature

This permit to be kept at job site. Return job site copy to safety office following job completion.

Copies White (Original (Safety Office))
Yellow (Unit Supervisor)
Hard (Job Site)

of permits (Tables 7.3 and 7.4) whose elements are considered to comply with the requirements of this section are taken from Appendix D to 29 CFR 1910.146.

The entry supervisor must authorize entry, prepare and sign written permits, order corrective measures if required, and cancel permits when work is completed. The completed permit must be made available to all authorized entrants. The best method of complying with this requirement is to post the permit at the entrance to the confined space. After the job is complete, the permit should be removed and retained for a minimum of one year.

Training

Initial training must provide the employees with the understanding and skills needed to perform the entry safely. Employers must train entrants before their first entry and give refresher training any time the duties change or hazards within the confined space change.

The standard requires that a record must be kept to prove that the training has taken place, consisting of a sign-in sheet with the employees' names, the trainer's signature or initials, and the date of the training. Upon the employees' request, the record of the training must be made available for inspection by the employees or their authorized representatives.

Rescue and Emergency Services

Personal protective equipment and rescue equipment must be provided to all rescue personnel. It is the employer's responsibility to ensure that all rescue personnel are trained in the proper use of the personal protective equipment. In addition, each member of the rescue service shall also receive the same training that is provided to the authorized entrants.

Each member of the rescue service team shall be trained to perform assigned rescue duties. This training shall include practice making permit space rescues at least

Table 7.4. Entry Permit

PERMIT VALID FOR EIGHT (8) HOURS ONLY. ALL COPIES OF PERMIT WILL REMAIN AT JOB SITE UNTIL JOB IS COMPLETED. DATE: _ _/_ _/_ _.

SITE LOCATION AND DESCRIPTION: _____
PURPOSE OF ENTRY: _____
SUPERVISOR(s) in charge of crews, type of crew, and phone #: _____
COMMUNICATION PROCEDURES: _____
RESCUE PROCEDURES (PHONE NUMBERS AT BOTTOM): _____
REQUIREMENTS COMPLETED (DATE/TIME):

Lock Out/De-energize/Try-out _____
Line(s) Broken-Capped-Blanked _____
Purge-Flush and Vent _____
Ventilation _____
Secure Area (Post and Flag) _____
Breathing Apparatus _____
Resuscitator Inhalator _____
Standby Safety Personnel _____
Full Body Harness w/"D" ring _____
Emergency Escape Retrieval Equipment _____
Lifelines _____
Fire Extinguishers _____
Lighting (explosive-proof) _____
Protective Clothing _____
Respirator(s) (Air Purifying) _____
Burning and Welding Permit _____

NOTE: For items that do not apply, enter "N/A" in the blank.

RECORD CONTINUOUS MONITORING RESULTS EVERY TWO (2) HOURS

Continuous Monitoring**	Permissible Test(s) to be taken at Entry Level				
Percent of Oxygen	19.5%–23.5%	___	___	___	___	___
Lower Flammable Limit	Under 10%	___	___	___	___	___
Carbon Monoxide	+35 PPM	___	___	___	___	___
Aromatic Hydrocarbon	+1 PPM * 5PPM	___	___	___	___	___
Hydrogen Cyanide(Skin)	* 4PPM	___	___	___	___	___
Hydrogen Sulfide	+10 PPM *15PPM	___	___	___	___	___
Sulfur Dioxide	+2 PPM * 5PPM	___	___	___	___	___
Ammonia	*35PPM	___	___	___	___	___

* Short-term exposure limit: Employee can work in the area up to 15 minutes.
+ 8-hour Time Weighted Average: Employee can work in area for eight hours (longer with appropriate respiratory protection).

REMARKS:

GAS TESTER NAME, INSTRUMENT(S), MODEL, SERIAL AND/OR CHECK # USED (OR TYPE UNIT #)

SAFETY STANDBY PERSON IS REQUIRED FOR ALL CONFINED-SPACE WORK

SAFETY STANDBY CHECK# / CONFINED CHECK # / CONFINED CHECK #

PERSON(S)
ENTRANT(S)

_____
_____

SUPERVISOR AUTHORIZING—ALL CONDITIONS SATISFIED
DEPARTMENT/PHONE #

AMBULANCE 2800 FIRE 2900 SAFETY 4901 GAS COORDINATOR 4529/5387

(58 FR 4549, Jan. 14, 1993; 58 FR 34836, June 29, 1993)

once every 12 months. A hands-on style of training is to be used for this aspect—for example, simulated rescue operations in which they remove manikins or actual persons from the actual permit spaces or from representative spaces.

Summary

Adherence to the rules and procedures included in the confined-space standard will lead to safe and effective entry into confined spaces. The standard provides a good foundation for a thorough confined-space entry program. Instituting a confined-space program using the confined-space standard as a guide will result in safe entry and possibly prevent industrial deaths from occurring.

By the nature of the act, confined-space entry is a dangerous proposition, but with proper training and equipment workers can safely enter confined spaces. Proper equipment is essential for maintaining a safe atmosphere to facilitate a confined-space entry. If a space cannot be made safe for entry, then it is necessary to postpone the entry until it can be assured that the space's atmosphere is stable enough to permit entry. The best confined-space program and procedures mean nothing if an injury or death occurs because employees bypassed procedures.

If entry into confined spaces becomes necessary, then it is mandatory that only trained and authorized entrants enter into the space. Attendants posted at the entrance to the confined space are required. It is important for the attendant to maintain contact with the entrant; attendants should not be assigned any other tasks that may distract their attention from the confined-space entrant.

Questions

1. Why must there be an accurate count kept of all workers in a confined space?

2. Explain all potential hazards associated with a confined space.

3. What are the correct procedures for securing a confined space area?

4. Why must entrants be identified and accurately counted as they enter and exit the confined space?

5. Explain the benefits of identification and keeping an accurate count of all entrants in an emergency rescue situation in any confined space area.

6. How is the activity monitored inside and outside of a confined-space area? Describe the correct technique.

7. List and describe hazard conditions that result in the evacuation of a confined space.

8. What are the proper communication-monitoring techniques used with entrants in a confined space?

9. Describe the correct communication techniques to order entrants out of a confined-space area.

10. What procedure is followed (for notification) when unauthorized personnel actually enter a confined space?

11. How are rescue and emergency services summoned? Explain the correct procedure.

12. List and describe the equipment used in confined spaces.

Case Study

CONFINED SPACE INCIDENT

Date of Accident: October 13, 1993
Time of Accident: 9:30 a.m.
Location of Accident: Seventh Chemical Plant, #3 Toxaphene Stripper Tank
Supervisor: Kenneth Ludy
Losses Incurred: Bodily injury, two fatalities

Summary Description of Event

Two men were injured and two men were killed in a confined space incident triggered by the improper use of an air-line respirator. On October 13, 1993, maintenance worker John Joe arrived at work at 7:30 a.m. and was discussing his daily tasks with his supervisor, Ken Ludy. His task for this day was to remove built-up residue from the #3 Toxaphene Stripper Tank, which was 13 feet in diameter and 12 feet deep.

At 8:40 a.m., John donned a full-faced air-line respirator and entered the tank through the 18-inch manhole. Once he was in the tank, his assistant removed the ladder so the sludge bucket could pass through the manhole. After emptying several buckets, John asked his assistant to replace the ladder so he could climb out with the last bucket. As he was climbing out, the air line got caught and separated at a quick-connect fitting. While John was trying to reconnect it, the ladder slipped and he attempted to hold on but fell to the bottom of the tank.

His assistant placed another ladder in the space and attempted to enter, but was unable to do so because of the overpowering odor. A nearby maintenance mechanic entered to attempt the rescue, but suffocated. Supervisor Ken Ludy also entered the tank but escaped before becoming overcome.

Rescue squads were called in to assist. They ventilated the space with a blower and were able to remove the two men. Both men were pronounced dead on arrival at the hospital. The assistant and supervisor were treated and released.

Post-response Assessment

This incident suggests there was a serious deficiency with the employer's confined-space entry program. OSHA's permit-required confined-space entry standard (29 CFR 1910.146 (d)(4)(iv)) requires entrants to be provided with proper personal protection equipment, presuming that the equipment is the correct type and is properly maintained and working.

In this case, the air-line should have had a double-action connector preventing it from being accidentally disconnected. The entrant should have also been equipped with an emergency cylinder to facilitate self-rescue in the event of a problem. Analysis also suggests other OSHA violations, such as failure to conduct a thorough assessment, inadequate ventilation, inadequate rescue plans, the absence of retrieval harness and mechanical lifting devices, and the absence of an attendant and entry supervisor.

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U.S. Department of Health and Human Services, NIOSH, Division of Safety Research, Morgantown, WV. Report No. FACE-93-17. *FACE Report: Two Men Die in Well-Cleaning Operation-Maryland, May 1, 1993*.

Additional Information

Confined-space entry requires special equipment and special training. Films, computer programs, literature, and other media instruct the confined-space worker in the proper use of special equipment for work in such places as manholes, tanks, silos, mine shafts, and towers.

COMPUTER PROGRAMS—CONFINED-SPACE ENTRY

WorkSmart Software Inc., 10 Ames Rd., Ste. 110, Morristown, NJ 07960. 1-201-539-4280. FAX:1-201-439-4280.

AUDIOVISUAL PROGRAMS—CONFINED-SPACE ENTRY

BNA Communications Inc., 9434 Key West Ave., Rockville, MD 20850. 1-800-233-6067. FAX: 1-301-948-2085.

Brown & Root Environmental (a division of Halliburton NUS Corporation), Foster Plaza 7, 661 Anderson Dr., Pittsburgh, PA 15220. 1-412-921-7090. FAX:1-412-921-4040.

Coastal Video Communications Corp., 3083 Brickhouse Court, Virginia Beach, VA 23452. 1-804-498-9014. FAX: 1-804-498-3657.

Conney Safety Products, 3202 Latham Drive, Madison, WI 53713. 1-800-356-9100. FAX: 1-800-845-9095.

Emergency Film Group, 225 Water St., Plymouth, MA 02360. 1-800-842-9100. FAX: 1-800-845-9095.

Enmet Corporation, 680 Fairfield Ct., P.O. Box 979, Ann Arbor, MI 48106. 1-313-761-1270. FAX: 1-313-761-3220.

Global Occupational Safety, 22 Harbor Park Drive, Port Washington, NY 11050. 1-800-433-4848. FAX:1-800-336-3818.

Labelmaster, An American Labelmark Co., 5724 N. Pulaski Road, Chicago, IL 60646. 1-800-621-5808. FAX: 1-800-478-6054.

Marcum Group, Ltd., #4 Denny Rd., Wilmington, DE 19809. 1-800-654-2448. 1-302-764-3400.

Matheson Gas Products, 166 Keystone Dr., Montgomery, PA 18936. 1-800-828-4313. FAX: 1-215-641-2714.

National Safety Council, 1121 Spring Lake Drive, Itasca, IL 60143. 1-800-621-7619. FAX: 1-703-285-0797.

Ray Jewell Productions, 139 Loma Media Rd., Santa Barbara, CA 93103. 1-805-568-1184. FAX: 1-805-899-2199.

LITERATURE AND TRAINING MANUALS—CONFINED-SPACE ENTRY

BNA Communications Inc., 9434 Key West Ave., Rockville, MD 20850. 1-800-233-6067. FAX: 1-301-948-2085.

Coastal Video Communications Corp., 3083 Brickhouse Court, Virginia Beach, VA 23452. 1-804-498-9014. FAX: 1-804-498-3657.

Conney Safety Products, 3202 Latham Drive, Madison, WI 53713. 1-800-356-9100. FAX: 1-800-845-9095.

ELB & Associates, Inc., 605 Eastowne Dr., Chapel Hill, NC 27514. 1-800-334-5478. FAX: 1-919-493-2263.

Enmet Corporation, 680 Fairfield Ct., P.O. Box 979, Ann Arbor, MI 48106. 1-313-761-1270. FAX: 1-313-761-3220.

Global Occupational Safety, 22 Harbor Park Drive, Port Washington, NY 11050. 1-800-433-4848. FAX:1-800-336-3818.

Labelmaster, An American Labelmark Co., 5724 N. Pulaski Road, Chicago, IL 60646. 1-800-621-5808. FAX: 1-800-478-6054.

Marcum Group, Ltd., #4 Denny Rd., Wilmington, DE 19809. 1-800-654-2448. 1-302-764-3400.

National Safety Council, 1121 Spring Lake Drive, Itasca, IL 60143. 1-800-621-7619. FAX: 1-703-285-0797.

Orr Safety Corporation, P.O. Box 16326, 2360 Millers Ln., Louisville, KY 40256. 1-800-669-1677. FAX: 1-800-800-6774.

SLIDES, FILMSTRIPS, AND FILMS—CONFINED-SPACE ENTRY

BNA Communications Inc., 9434 Key West Ave., Rockville, MD 20850. 1-800-233-6067. FAX: 1-301-948-2085.

Enmet Corporation, 680 Fairfield Ct., P.O. Box 979, Ann Arbor, MI 48106. 1-313-761-1270. FAX: 1-313-761-3220.

Marcum Group, Ltd., #4 Denny Rd., Wilmington, DE 19809. 1-800-654-2448. 1-302-764-3400.

Texas Safety Association, P.O. Box 9345, Austin, TX 78766. 1-512-343-6525. FAX: 1-512-343-0746.

CHAPTER 8

Putting It All Together

Contents of Chapter

Introduction
Management Styles
Summary
Resources

Introduction

Management is the process of reaching organizational goals by working with and through people and other organizational resources—property and efficacy. Safety management is the process of protecting human resources, preserving property resources, and promoting efficacy resources on an organizational level. The programs in this publication lay the foundation for the success of the safety function. Implementing safety programs starts with integration of safety management and management in general. Examining the common elements within both definitions, it is evident that the integration process is already initiated. The common elements are the following:

Human resources, including line-workers, line-supervisors, middle managers, and top management
Property resources, including plants, facilities, equipment, vehicles, and monetary assets
Efficacy resources, including efficient and effective use of resources

The programs in this publication are essential building blocks in the preservation, protection, and promotion of organizational resources. By implementing these programs, the safety manager is taking the first step in developing a link between the safety

function and management in general. By definition, accomplishment of organizational goals relies heavily on all organizational resources. Therefore, organizational resources must be protected from subjection to risk danger and loss. Without the protection, preservation, and promotion provided by the safety function, resources may not be available when needed for accomplishment of organizational goals.

Management Styles

PARTICIPATIVE MANAGEMENT

In its purest sense, participative management is a method of involving every member of the organization in the decision-making process. Top management retains the right of final decision-making authority. However, line-workers' opinions are welcomed and valued.

The type of information and access to the information available to each level of the organization is important. Filtering the appropriate information on a timely basis to people who need it is crucial. Every decision does not necessarily involve every level of the organizational chain. Sending all information to each level of the organization will prove overwhelming to every employee. For this reason, it is important to route the information to the proper organizational levels (i.e., do not send routine decisions to members of top management).

Participative management in the safety realm is a wonderful idea. The intent of participative management in the safety arena is to have the employees who are most affected by the dangers suggest corrective measures. The line-workers are exposed to the most risk and danger, and therefore they should be able to best describe what the hazards are and how they will best be abated. Involving the line-workers in the decision-making process will develop in these individuals a sense of ownership for the system. They will take pride in knowing that what they have suggested is now being placed into action. In addition, they will experience a definite satisfaction in understanding that what they helped develop will prevent others from being injured or killed.

It may be necessary to educate the employees as to whom and what will be affected by their decisions. For instance, a decision to institute a slowdown in an assembly line to allow clearing of obstructions will affect every worker before and after the slowdown point. A critical element to look at before making this decision is an alternative that would clear the obstructions while allowing the assembly line to run at the normal speed. Clearly, if the latter alternative exists, it will be superior to slowing down the line. Management will be receptive any time they are presented with an alternative that will improve safety without a loss in production.

Participative management presents a number of potential advantages. Some of the major advantages include less resistance to proposed changes, improved motivation, and a higher degree of satisfaction. Perhaps the greatest advantage is the higher quality of decisions. The decisions are a result of a culmination of the line-workers' firsthand exposure to the situation and management's long-term view of the organization's goals.

Educating line-workers will facilitate better quality decisions that are in the organization's best interest. Individuals may need to be trained in decision-making skills and problem analysis. Other areas in which the individuals may need training include interpersonal skills, education about the entire production process (including areas outside their departments), and possibly how the organization functions as a business unit. The time spent educating the employees will be repaid tenfold by the increase in the quality of the decisions.

In order for participative management to succeed, the information within the organization must flow two ways between every level of the organization. Without the needed information, it is useless to provide line-workers with input into the decision-making process. In other words, participative management can only succeed when the lines of communication within an organization are completely open.

QUALITY CIRCLES

Quality circles are part of a style of participative management that can provide the groundwork to reduce or replace the adversarial relationship between labor and management. Quality circles are responsible for increasing employee morale, reducing stress levels, increasing safety awareness, changing safety management from a focus on protection (reactive management) to a focus on prevention (proactive management), and a host of other positive results.

A typical quality circle is a small group of six to twelve employees that meet on a regular basis to solve problems concerning their work environment. This group of employees generally receives training in areas such as group processes, communications, and problem solving. On completion of this training, the group meets on company time with a facilitator to evaluate situations and make recommendations for improvement or corrections. The membership of most quality circles is strictly on a volunteer basis. The group members' wages are usually their only compensation for their efforts. In many cases, highly successful groups may receive noncash recognition awards.

Quality circles are rarely granted spending authority. However, they are generally expected to evaluate the financial implications of their proposed recommendations. The purpose of this evaluation process is to encourage the groups to search for long-term solutions instead of costly quick fixes.

In America, quality circles' training focuses primarily on group processes, communication, and problem solving with little emphasis being placed on statistical quality control methods. The agenda for most quality circle sessions is usually so narrowly defined that they are almost programmed. However, an important point to remember is that safety is a natural part of every production process. Therefore, safety-related issues should be discussed at every quality circle meeting.

Safety circles are an offspring of quality circles and focus primarily on personal and environmental safety issues. Safety circles are an effective method of engaging worker participation because all employees are concerned with their safety. Involving first-line supervisors from the very beginning will help overcome any resistance to quality or safety circles.

The first-line supervisors' visible support for the programs is an essential element for the continued success of the quality or safety circles. In fact, all levels of management must visibly show support for the program if it is to be successful. Line-workers will not become involved without the visible support of all levels of management.

Management must also provide recognition of and support for changes in worker behavior to achieve the desired safe work behaviors. Management support in this area will motivate the workers to take responsibility for initiating and instituting change. When workers are involved in establishing safety-related norms for the group, they will be more motivated to help sustain the desired behaviors. Rewards such as gainsharing, recognition programs, and other noncash rewards will aid in changing behaviors.

Quality and safety circles are most effective when representatives from all levels of employees are included from the outset. More involvement will lead to a greater level of commitment to following through on the ideas and solutions generated by the group. After witnessing the commitment made by top management, representatives from every other level in the organization will be more apt to support the project. In turn, the representatives will develop an ownership for the group's decisions. This will lead to representatives from each level in the organization encouraging those on their level to institute the group's decisions.

MANAGEMENT BY OBJECTIVES (MBO)

This is a method of management that starts with the company's overall mission statement, the highest level of achievement for the organization. The mission statement is the highest objective for the organization. All other organizational objectives must relate to the mission statement. In a traditional MBO system, the overall organizational objective, the mission statement, can be accomplished by accomplishing divisional, departmental, and individual objectives. Superiors throughout the organization establish goals and measures for their subordinates. The subordinates propose goals and measures for their particular positions. The superiors have meetings with their subordinates to reach mutual agreement on the subordinate's goals. Subordinates should be informed of where their individual objectives fit in the scheme of the organization's mission statement, the divisional objectives, and departmental objectives.

Feedback is essential for the continuing success of the MBO system of management. Feedback should be frequent, positive, and detailed. The subordinate's results to date should be measured against milestones. Feedback should include the superior and the subordinate sitting down together and discussing ways to improve the current methods of accomplishing the objectives, the appropriateness of the current objectives, and how the objectives can be improved.

It is necessary for management to review what is being accomplished by the organization as a whole. All goals and objectives should be analyzed with any inappropriate goals and objectives eliminated. Methods of accomplishing the remaining goals and objectives should be studied to determine if they can be improved.

The long-term goals and objectives should be broken into quickly achievable minor steps, so the overall long-term goals and objectives are not viewed as being beyond reach. Each minor accomplishment will lead to achievement of the major goals or ob-

jectives. If practical, it is imperative to send a status report to the workers each time a minor step is accomplished. The status report should state what has been accomplished, what will be accomplished as the next step, and what is the overall progress related to the long-term goals and objectives.

A crucial element in the MBO system is the need for a definite time frame within which the objectives will be accomplished. Arriving at the culmination of a desired goal or objective will be rare unless a time frame is established for its completion. The time frame for the process should be mutually agreed on in advance by management and labor. The best time to establish the time frame is during the meeting, held by the superiors and their subordinates, that determines the substance of the joint goals and objectives. The subordinate's performance is reviewed periodically during the time allotted to encourage the subordinate to reach the goals and objectives on a timely basis. It may become apparent during the process that the established time frame may need to be extended.

Many American corporations are using MBO in all categories of production, service, and retail operations. The capacity for MBO to contribute to an organization's well-being is yet to be determined. If instituted properly, MBO is an effective method for increasing employee involvement, employee morale, and production.

SAFETY COMMITTEES

Safety committees allow participation by employees from all levels within an organization and increase total employee safety awareness. A well-organized safety committee can play a vital role in reducing and controlling workplace hazards.

Responsibilities and Procedures

- The safety committee's role can include periodic site and area inspections, assistance in accident investigations, and facilitation of employee hazard notifications.
- Safety committee meetings are usually held monthly, at a minimum, to coordinate, integrate, assess, and implement safety activities.
- Committee members are selected or appointed in a number of ways, such as appointment by members of management, election, volunteers, and other ways. Length of term may vary from twelve months to two years or more. The company philosophy will determine the structure of any committee.
- In forming a safety committee, it is essential to structure it to foster employee participation and develop clear-cut goals and expectations. Additional rationale for employee participation is discussed below, as well as typical employee safety and health roles and responsibilities. Neither federal nor state safety health regulations require companies to form safety committees. However, they are widely recognized as an effective tool in generating employee involvement, raising employee awareness, and strengthening a company's overall safety, health, and environmental programs. One source that covers safety and health committees is contained in twenty-nine CFR, Federal Employee Safety and Health, Subpart F—Occupational Safety and Health Committees.

The usual purpose of a safety committee is to:

- Inspect and report on a regular basis any unsafe conditions and practices, hazardous materials, and environmental factors.
- Review and update existing work practices and hazard controls.
- Plan improvements for existing safety and health rules, procedures, and regulations.
- Provide an effective way to communicate the safety and health information between and among all employees at every level within the organization.

Employee involvement and participation in the structure and operation of safety and health programs will foster increased and potentially lasting awareness, responsibility and support for safety and health concerns and solutions that are discussed by the safety committees. In order for employees to become involved with their safety and health program, they must know about it and understand how it works for them. Several components of safety and health programs require direct, committed employee participation if the program is to succeed and help provide a safe and healthy work environment.

Safety committee members need to have a broad understanding of the different roles, rights, and responsibilities traditionally attributed or assigned to upper management, managers and supervisors, safety and loss control personnel, and line-workers. Improving a hazard prevention or employee program for safety and health depends on the proper use of the information provided through various sources and channels that are available for communicating concerns. All employees should contribute to ensuring that the reporting policy is known and understood by everyone to be discussed with the safety committee. Based on the reports, copies of these high-priority issues should also be delivered to the safety department so that ensuing corrective action can be tracked in concert with the safety committee.

SAFETY MANAGEMENT BY OBJECTIVES (SMBO)

Safety Management by Objectives is a direct offspring of MBO, with an emphasis placed on safety issues. The ideas of employee involvement, mutually agreed on goals and objectives, defined time frames, and frequent feedback are all present in the SMBO system.

An SMBO system will only succeed in companies with the right climate. SMBO requires a joint effort between management and employees. A work environment that currently enjoys a cooperative relationship between management and employees is the best candidate for implementation of an SMBO system.

Whatever the environment is, an SMBO system will only be successful if the implementation process is flexible enough to deal with any unsteadiness that may occur along the way. Top management commitment is another key element for program success. In fact, all levels of management must be committed to the program and encourage the support of the workers.

Encouraging the workers' support and commitment involves management and employees arriving at mutually agreed on short-term and long-term goals. These goals must be attainable (in the minds of the workers), quantifiable (capable of being measured), and in writing (to reference at a later date). In addition, these goals must be challenging enough to motivate the workforce, yet not so challenging as to be unrealistic goals that will prove to be a major discouragement for employees.

The methods for arriving at the proper goals vary from organization to organization. Some organizations give supervisors and employees complete latitude in goal setting and accomplishment. On the other hand, some organizations' top management will establish guidelines within which supervisors and employees must develop goals.

The method of goal setting used is only a part of the entire system needed to develop a successful SMBO program. All of the items mentioned in this section can work together to function as a well-tuned SMBO system. If any of the elements in this section are not present, then the SMBO system is in danger of becoming unsuccessful. If all of these elements are functioning properly together, then the system will be successful.

TOTAL QUALITY MANAGEMENT (TQM)

TQM is a concept that involves building quality into every phase of production versus inspecting quality at the end of the production process. This concept has been around for many years, but has only recently gained widespread implementation in U.S. organizations.

Following World War II, the United States government assigned W. Edwards Deming to the task of assisting Japan in its economic redevelopment. Dr. Deming's methods helped the Japanese develop into a world power industrially and technologically. Dr. Deming's methods of continuous improvements and statistical process control measures continue to be a driving force in TQM systems.

In addition to the work of Dr. Deming, one needs to become familiar with the efforts of Joseph M. Juran (team problem-solving techniques) and Philip Crosby (zero defects). The philosophies of Deming, Juran, and Crosby have been combined into numerous variations of the TQM system.

How TQM systems interrelate with safety and health management differs at every company. However, a common bond for TQM to succeed in any safety and health management system is the absolute need for top-management commitment. Top management must take a visible leadership role to encourage overall commitment.

Another task to be accomplished by top management is assisting various departments in determining the needs of numerous customers. The customer is the person, department, or company benefiting form the product or service generated. For example, the safety and health department generally provides services to internal customers.

Each person, all departments, and the organization as a whole must strive to continuously improve the product or service that is being produced. A key element in accomplishing continuous improvement is a good communication system. The producer of the product or the provider of the service must understand what the customer needs. Complete customer satisfaction is a goal of any TQM system.

Communication must be timely and consistent. Information must flow freely within an organization and to external customers. Good communication is a tool that will develop a greater sense of trust within the organization and with external customers. This trust will provide the atmosphere necessary for moving from a reactive management style to a proactive approach.

Being proactive in nature involves developing educational and retraining programs. These programs will cover areas dealing with the new knowledge and skills needed to function efficiently in performance of new production methods that may require current employees to learn new skills. Organizations must commit to retention programs for experienced employees. Workers should not feel threatened by the changing production system. The workers should view change as opportunities to further their knowledge, skills, and careers. Employees must understand that the changes are not being made in an effort to eliminate jobs, but that they are being made to make existing jobs safer and to improve product quality.

Improvements created by TQM methods may not be immediately noticeable. The TQM process is not a quick fix. TQM requires complete long-term commitment by employees and management. Short-term costs must be viewed in terms of the overall long-term benefits.

INTERNATIONAL ORGANIZATION FOR STANDARDS (ISO) 9000

The ISO 9000 standards are a set of standards representing a level of measurement for Total Quality Management. They pose a challenge for all safety professionals to strive toward four strategic goals: universal acceptance, current compatibility, forward compatibility, and forward flexibility. ISO provides tests that are intended to act as indicators to determine when a strategic goal is satisfied. (The details of these tests are not provided, because the intent of this section is to provide an overview of how ISO 9000 relates to safety professionals.)

These documents all contain information relevant to safety, health, and environmental concerns. The safety issues in ISO 9000 involve a wide array of concerns that may make it difficult for many organizations to reach compliance. Adding to the complexity of compliance is the need to ensure repeatability while managing continual change.

Documenting compliance can be a monumental task. However, efficient computerization will reduce the time that safety professionals spend doing paperwork. Fur-

Table 8.1. ISO 9000 Components

ISO 9000 is organized into the following four documents:
9001: Quality Systems—Model for Assurance in Design/Development, Production, Installation, and Servicing
9002: Quality Systems—Model for Assurance in Production and Installation
9003: Quality Systems—Model for Assurance Final Inspection and Test
9004: Quality Management and Quality System Elements—Guidelines

thermore, complete integration of ISO 9000 into planning, engineering, and production processes will alleviate time constraints imposed on safety professionals by ISO 9000 documentation requirements. Automation and integration will afford the safety professional an opportunity to spend more time implementing safety programs and meeting with the workforce.

Many forms required for ISO 9000 can be scanned into the computer using a document scanner. The scanned document becomes the original, thus reducing the amount of storage room devoted to the original paperwork. A good example of utilization of scanned documents is a system that uses scanned MSDSs. Once the image of an MSDS is scanned into a database, the MSDS may be accessed from any network computer terminal as the need arises. A hard copy can be printed at the terminal and provided to any emergency personnel on scene. The time saved in an emergency situation could save lives.

ISO 9000 compliance is best accomplished with the aid of computerization. Complete compliance with ISO 9000 will ensure a more efficient, better-focused safety program.

Summary

Every management style discussed is appropriate in specific situations. Products, services, and people differ greatly from organization to organization, thus numerous variations of each management style are being successfully used throughout the world.

The atmosphere created from past management and union relationships will somewhat guide the approach management must take in its efforts to become more proactive in nature. Relationships that consisted of turmoil in the past cannot be expected to change overnight. A gradual approach to becoming proactive will assist management in accomplishing long-range goals.

In certain organizations, safety professionals are assisted by human resource and industrial relation specialists in the development of safety programs. Safety is one item that is of mutual importance to labor and management, and therefore it is used as a catapult for an organization to develop a win-win environment.

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Index

accident causal factor analysis: analytical techniques, 108–9; failure sources and, 110–11; report preparation and, 111; types of, 109–10
accident fact acquirement: employee reluctance to, 87, 91–92; interviewing styles and, 87–90; methods of, 91; reporting of, 96–100
accident investigation, ix; accident causation and, 99; accident recurrence/prevention and, 100; actual accident occurrence and, 98–99; analysis/reporting of, 108–11; case study for, 112–13; employee position involved and, 98; eyewitnesses and, 92; fact acquirement during, 87–90; HAZCOM and, x; information established by, 96–97; investigator characteristics in, 93–96; investigator role in, 92–93; job performance and, 98; plan, 84–87, 96–100; questions regarding, 111–12; responsibility for, 100–101; substandard acts/conditions and, 83–84; videotaping and, 87; WC and, 85, 106; where accident occurred, 97–98; who experienced accident and, 97; why accident occurred and, 97
accident investigation forms, completion procedures for, 102–5
accident investigation plan, 84–87; fact reporting and, 96–100; incident/accident report and, 85; investigative methods and, 86–87; investigative responsibility and, 85–86; notifications and, 85
ACGIH. *See* American Conference of Governmental Industrial Hygienist
alarm systems: alarm panel, *165*; for fire emergency mitigation, 165–66; functions of, 166; horn/strobe, *166*; pull box, *166*; smoke detector, *165*
American Conference of Governmental Industrial Hygienist (ACGIH), 6, 38
American Heart Association, CPR by, 122
American Red Cross, CPR/First Aid by, 122
analytical interviewing style, 87; characteristics/tendencies of, *94*, 94–95; effectiveness increase of, 89; qualities of, 88, 90
animal data, for hazard determination, 51–52
Annual Report on Carcinogens (NTP), 6, 39, 42, 49

bakery equipment, lockout/tagout of, 214–15
bomb threats: call checklist for, *133*; Explosive Ordinance Disposal team and, 140; Homeland Security and, 139–40

CAA. *See* Clean Air Act
CAAA. *See* Clean Air Act Amendments
Cardiopulmonary Resuscitation (CPR), by American Red Cross/American Heart Association, 122
CAS. *See* Chemical Abstract Service Registry
case study(ies): for accident investigation, 112–13; for confined spaces, 243–44; for

emergency response, 151–52; for ergonomics, 230–31; for fire safety, 181–84; for HAZCOM Standard, 78–80; for lockout/tagout, 217
centrifugal pumps, positive placement pumps *v.*, 175–76
CERCLA. *See* Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CERT. *See* Community Emergency Response Team Program
CFR. *See* Code of Federal Regulations
Chemical Abstract Service (CAS) Registry, 9
chemical information audit, *30–31*
chemical inventory sheet, 31
chemicals. *See* hazardous chemicals
civil disturbances. *See* public demonstrations/civil disturbances
Clean Air Act (CAA), 3
Clean Air Act Amendments (CAAA), 3
Clean Water Act Amendments to FWPCA (CWA), 3
Code of Federal Regulations (CFR), 2
communication: during emergency response, 118; EOC and, 142–43; ergonomics program and, 227; for fire safety, 160; internal/external, 118; TQM and, 256
community awareness, of fire safety, 163
Community Emergency Response Team (CERT) Program, 139
company, disaster prevention plans and, 125–26
Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 2
confined spaces, ix, 15, 233; atmospheric testing for, 237; audiovisual programs for, 245–46; case study for, 243–44; computer programs for, 245; emergency services and, 240, 242; employee duties and, *238*; entry conditions for, 236–37, 242; entry permit for, *241*; equipment for, 236; hazards of, 234, 242; literature/training manuals for, 246; permits for, 234–35; permit system for, 237, 240; pre-entry checklist for, *239–40*; questions regarding, 242–43; slides/filmstrips/films for, 247; training for, 240; unauthorized entry to, 236. *See also* Permit-Required Confined Space Program
Confined Space Standard, by OSHA, 234
control banding: benefits of, 12; HAZCOM and, 12–14; ILO and, 13; stages of, 13; for workplace safety, 11–12
Control of Hazardous Energy Source: affected/authorized employee, 205; employee notification and, 210–12; general energy control program and, 207–8; lockout and, 205–6; OSHA on, 188, 204; protective material/hardware, 208–9; scope of, 204–5; training and, 209
Control of Substances Hazardous to Health (COSHH-Essentials), 13
COSHH-Essentials. *See* Control of Substances Hazardous to Health
CPR. *See* Cardiopulmonary Resuscitation
cumulative trauma injury: decrease of, 220; education on, 227; ergonomics and, 219–20, 229
CWA. *See* Clean Water Act Amendments to FWPCA

deluge sprinkler system, 170
Department of Energy (DOE), industrial radiological accidents and, 140
Department of Homeland Security (DHS). *See* Homeland Security
Department of Transportation (DOT): Emergency Response Guidebook by, 135; hazardous materials and, 134; Hazardous Materials Transportation Act by, 2
DHS. *See* Department of Homeland Security; Homeland Security
disaster drills, 15; frequency of, 124; for general emergency plan, 122
disaster management authority, 142
disaster prevention plans: companies and, 125–26; OSHA standards and, 121
disaster recovery, 148–50; alternate headquarters for, 148–49; emergency lines of executive succession and, 148; emergency response and, 148–50; management continuity for, 148–49; production continuity for, 149–50; records and, 149–50

disasters: at home, planning for, 138–39; manmade, 130–35; natural, 126–30; recovery from, 148–50; secondary, 141; teams, 141–42; vulnerability for, 125–26
DOE. *See* Department of Energy
DOT. *See* Department of Transportation
drills. *See* disaster drills; fire drill report
dry sprinkler system, wet *v.,* 169–70

earthquakes, precautions for, 130
education: on cumulative trauma injury, 227; for fire safety, 159, 164; for general emergency plan, 122
efficacy resources, management and, 249
Electrical Preventive Maintenance (EPM) Program, 177
electrical safety: fire safety and, 160–61; NFPA National Electrical Code 70 E and, 160–61
Elevators, 123
emergency funds, EOC and, 147
emergency information: EOC and, 146; maps/charts/lists/resources/agreements/glossary, 147
emergency kit: content suggestion for, 138; for home disasters, 138
emergency medical services (EMS), 122
emergency operation center (EOC): administration/logistics and, 146; alerting/warnings and, 143; communications and, 142–43; direction/control and, 141–42; emergency information and, 146; emergency services and, 145–46; evacuation and, 144; facility shutdown by, 143; functions of, 142; funds provision and, 147; shelters and, 144–45; supporting materials of, 147
emergency phone numbers, for emergency response, 119–20
emergency plan, general: CPR/First Aid and, 122; education/training/drills for, 122; shelters for, 122; special duties for, 122–23; warnings from within/outside agencies and, 121
Emergency Planning & Community Right-to-Know Act (EPCRA), 3
emergency response, ix, 117; case studies for, 151–52; communications during, 118; disaster recovery and, 148–50; emergency phone numbers for, 119–20; evacuation procedure for, 123–25; Homeland Security and, 135–41; manmade disasters and, 130–35; natural disasters and, 126–30; planning of, x; questions regarding, 150–51
emergency response team (ERT), hazardous materials and, 134
emergency services: confined spaces and, 240, 242; EOC and, 145–46; for fire safety, 159–60. *See also* emergency medical services
employee evaluation, Hazard Communication Program Lesson Plan and, 24, 29
employee handling requirements, for hazardous chemicals, 17
employee notification: Control of Hazardous Energy Source and, 210–12; of Hazard Communication Program Lesson Plan, 20; of hazardous chemicals, 10; HAZCOM and, 10
employee training: Hazard Communication Program Lesson Plan and, 20–21; on hazardous chemicals, 14; HAZCOM and, 44–45; lockout/tagout and, 202–3; new hazard/special, 15; for nonroutine tasks, 14–15
EMS. *See* emergency medical services
energy sources, electrical/mechanical/potential/thermal/chemical, *196*
Environmental Protection Agency (EPA), 2
EOC. *See* emergency operation center
EPA. *See* Environmental Protection Agency
EPCRA. *See* Emergency Planning & Community Right-to-Know Act
EPM. *See* Electrical Preventive Maintenance Program
ergonomics, ix; case study for, 230–31; cumulative trauma injury and, 219–20, 229; example of, 222; feedback for, 223–24; hazard prevention of, 222–24; human error/task/equipment/environment and, 221–22; medical management and, 224; OSHA on, 219–20; posture and, 222–23; questions regarding, 229–30; task analysis

and, 221–22; tools and, 223; training and, 224, 227; WC and, 220; workplace analysis, 221
ergonomics program: benefits of, 220–21; communication and, 227; company guidelines and, 226; employee awareness and, 225; hazard prioritization and, 225, 227–28; management and, 226–27; procedural development by, 226; progress of, 228; recordkeeping and, 226; review/evaluation of, 228; setting up, 224–25; support for, 226; training/task redesign and, 225
ERT. *See* emergency response team
evacuation procedures: duty delegation and, 124–25; elevators and, 123; for emergency response, 123–25; EOC and, 144; fire extinguishers and, 124; general, 123–24; SERP and, 124
exit routes, for fire safety, 17–18
Explosive Ordinance Disposal team, bomb threats and, 140
eyewitnesses: accident investigation and, 92; illiterate/injured/prejudiced, 93; suspicious/talkative/boasting/timid, 93

facility fires. *See* fires, facility
FBI. *See* Federal Bureau of Investigation
Federal Bureau of Investigation (FBI), 139
Federal Emergency Management Agency (FEMA): hurricanes and, 127, 128; Nuclear Regulatory Commission and, 140
Federal Insecticide, Fungicide & Rodenticide Act (FIFRA), 3
Federal Water Pollution Control Act (FWPCA), 3
FEMA. *See* Federal Emergency Management Agency
FIFRA. *See* Federal Insecticide, Fungicide & Rodenticide Act
fire brigade: cost/value of, 170; fire emergency mitigation and, 170–71; maintenance of, 171; OSHA standards for, 171; training for, 171
fire departments: fire emergency mitigation and, 173; Hazardous Material Incident Response and, 173; ISO on, 178; types of, 173. *See also* fire brigade
fire drill report, *132*
fire emergency mitigation: alarm systems for, 165–66; fire brigades for, 170–71; fire departments and, 173; fire extinguishers and, 172–73; International Building Code and, 177; ISO on, 177–79; pumps for, 175–76; sprinkler system, 167–69; standpipe suppression system and, 167; water systems and, 173–75
fire emergency, recovery from, 179
fire extinguishers: evacuation procedures and, 124; fire emergency mitigation and, 172–73; NFPA 101 Life Safety Code and, 172; portable, 172; types of, 172–73
fire possibility evaluation, for fire safety, 159, 164
fire prevention, for fire safety, 159
fire safety, ix, 15, 157; case studies for, 181–84; communication for, 160; community awareness of, 163; education/training for, 159, 164; electrical safety and, 160–61; emergency services for, 159–60; exit routes for, 17–18; fire emergency recovery and, 179; fire possibility evaluation for, 159, 164; fire prevention for, 159; fire suppression for, 159; hazardous materials and, 161; inspections for, 159, 180; mitigation and, 165–79; NFPA 101 Life Safety Code and, 161–63; NFPA and, 160; OSHA standards for, 164; policies/procedures for, 163–64; preparation/prevention and, 160–64; process evaluation for, 161; program elements, 159–60; program goals of, 158; questions regarding, 181; records/reports for, 160
fires, facility: drill report for, *132*; management role in, 132; as manmade disaster, 130–33; procedures for, 131–33; response to, 131; warning for, 131
fires, losses from, 157
First Aid, by American Red Cross, 122
floods: precautions for, 129–30; warnings used for, 129
FWPCA. *See* Federal Water Pollution Control Act

hazard communication. *See* communication
Hazard Communication Program Lesson Plan: chemical information audit, *30–31*;

employee evaluation of, 24, 29; employee notification of, 20; employee training and, 20–21; hazard chemical release/spill/exposure, 21; label use and, 20; materials needed for, 18; MSDS and, 20; plan for, 18; teaching-learning activities for, 18; written hazard communication program, 5, 18–19, 39–40. *See also* Hazard Communication Standard
Hazard Communication (HAZCOM) Standard, 3; accident investigation and, x; case study for, 78–80; control banding and, 12–14; definitions in, 34–38; effective dates of, 48; employee notification and, 10; employee training and, 44–45; hazard determination by, 38–39, 51–52; health hazard definitions in, 48–51; information sources for, 52–54; lesson plan for, 18–21; MSDS and, 5, 41–44, 161; multiemployer workplaces and, 40–41; questions regarding, 77–78; requirements of, 4, 12; scope/application of, 32–34; success of, 13; trade secrets and, 45–48, 54–56; written program for, 5, 18–19, 39–40
hazard determination: animal data for, 51–52; carcinogenicity for, 51; data, adequacy/reporting of, 52; by HAZCOM, 38–39, 51–52; human data for, 51
Hazardous and Solid Waste Amendments of 1984 (HSWA), 2
hazardous chemicals: documentation for, 16–17; employee handling requirements for, 17; employee notification of, 10; employee training on, 14; identification of, 8–9, 22–23, 38–39; labels of, 11; list of, 8–9; management role for, 17–18; MSDSs and, 9; release/spill/exposure and, 15–16, 21; sample inventory list for, *8*; target organ effects of, 50–51; in workplace, *10*
hazardous energy control program, 190; authorization for, 191–92; identification system for, 195; implementation of, 188–89, *189*; preparation for, 192–95; procedures for, 188–89, 195–97; production operation restoration and, 197, 198; sample letter for, *191*; sources of, *196*. *See also* Control of Hazardous Energy Source
Hazardous Material Incident Responses, fire departments and, 173
hazardous materials, ix; case study for, 78–80; determination of, 5–6, 8; DOT and, 134; ERT and, 134; fire safety and, 161; as manmade disaster, 133–34; MSDSs and, 134; overview of, 2–4; warning system for, 134. *See also* hazardous chemicals
Hazardous Materials Transportation Act, 2
Hazardous Waste Operations and Emergency Response (HAZWOPER) Standard, 3
hazard prioritization, 225, 227–28
HAZCOM. *See* Hazard Communication Standard
HAZWOPER. *See* Hazardous Waste Operations and Emergency Response Standard
headquarters, alternate, for disaster recovery, 148–49
Health and Safety Executive (HSE), 13
health hazard definitions, in HAZCOM, 48–51
home disasters: emergency kit and, 138; planning for, 138–39
Homeland Security: bomb threats and, 139–40; emergency response and, 135–47; hurricanes and, 128; industrial radiological accidents and, 140; NIMS by, 136; NRP and, 137–38; nuclear power plant incidents and, 140–41; terrorism and, 139
Homeland Security Advisory System, by Department of Homeland Security, 136
horn/strobe alarm systems, *166*
HSE. *See* Health and Safety Executive
HSWA. *See* Hazardous and Solid Waste Amendments of 1984
human data, for hazard determination, 51
human resources department: management and, 249; WC and, 107
hurricanes: DHS/NRP and, 128; FEMA and, 127, 128; precautions for, 127; warnings used for, 126–27

IARC. *See* International Agency for Research on Cancer

ICC. *See* International Code Council
ICS. *See* Incident Command System
ILO. *See* International Labor Organization
Incident Command System (ICS), NIMS and, 136
industrial radiological accidents: DOE and, 140; Homeland Security and, 140
injury, cumulative trauma. *See* cumulative trauma injury
inspections: for fire safety, 159, 180; for lockout/tagout, 201–2
insurance companies, Occupational Safety and Health Act of 1970 and, ix
Insurance Service Office (ISO): EPM by, 177; on fire departments, 178; on fire emergency mitigation, 177–79
integrative interviewing style, 87; characteristics/tendencies of, 96, *96*; effectiveness increase of, 90; qualities of, 88–89, 91
Interagency Radiological Assistance Plan, 140
International Agency for Research on Cancer (IARC), 6, 39, 42
International Building Code: fire emergency mitigation and, 177; by ICC, 177; International Fire Code and, 177
International Code Council (ICC), 177
International Fire Code, 177
International Labor Organization (ILO), 13
International Organization for Standards (ISO) 9000, 256–57; compliance with, 257; components of, *256*; forms required for, 257; TQM and, 256–57
interrogative interviewing style, 87; characteristics/tendencies of, 93–94, *94*; effectiveness increase of, 89; qualities of, 88, 90
interviewing styles: accident fact acquirement and, 87–90; analytical, 87, 88, 89, 90, *94,* 94–95; integrative, 87, 88–89, 90, 91, 96, *96*; interrogative, 87, 88, 89, 90, 93–94, *94*; supportive, 87, 88, 89–90, 91, 95, *95*
interviews, for accident investigation, 86
investigative methods, accident investigative plan and, 86–87
ISO. *See* Insurance Service Office; International Organization for Standards 9000

label use, 11; Hazard Communication Program Lesson Plan and, 20
Life Safety Code. *See* NFPA 101 Life Safety Code
lockout/tag-out, ix, 15, 190; authorization for, 191–92; of bakery equipment, 214–15; case study for, 217; Control of Hazardous Energy Source and, 205–6; durability of, 193–94; employee sheet, *192*; energy control identification system, 195; energy sources for, *196*; equipment and, x, *193*; equipment testing/position for, 200; format/print of tags for, 215–16; hazardous energy, 188–97; implementation of, 188–89, 203; OSHA on, 187–88, 203; outside personnel and, 200–201; periodic inspection program for, 201–2; preparation for, 192–95; procedures for, 188–89, 195–97; procedures for, checklist, *199–200*; procedures for, key components of, 198, 200; procedures for, multiple, 197–98; production operation restoration and, 197, 198; of pulp/paper mills, 213–14; questions regarding, 216; sample letter for, *191*; of sawmills, 215; shift/personnel changes and, 201; standardized, 194; substantial, 195; of textile mills, 214; training for, 202–3. *See also* Control of Hazardous Energy Source; hazardous energy control program

management: ergonomics program and, 226–27; facility fire role of, 132; hazardous chemicals role of, 17–18; human/property/efficacy resources and, 249; MBO, 252–53; participative, 250–51; quality circles and, 251–52; safety committees and, 253–54; SMBO and, 254–55; styles of, 250–57, 257; TQM, 255–56
management by objectives (MBO): characteristics of, 252; employee involvement and, 252; feedback and, 252; goals/objectives and, 252–53; SMBO and, 254; success of, 253
management techniques/styles, ix; accident investigation plan and, 85–86, 100–101
manmade disasters: bomb threat call checklist and, *133*; emergency response

and, 130–35; facility fires as, 130–33; hazardous materials as, 133–34; public demonstrations/civil disturbances as, 135; transportation accidents as, 134–35
Material Safety Data Sheets (MSDSs), 3; accuracy of, 5–6; acronyms/common terms for, 56–77; checklist for, *6*; Hazard Communication Program Lesson Plan and, 20; hazardous chemicals and, 9; hazardous materials and, 134; HAZCOM and, 5, 41–44, 161; lesson plan for, 21–23; location/availability of, 7–8, 14; new/updated, 6; quality assurance of, 8; sample of, *25–29*; sample request letter for, *6*; study guide for, *24*
MBO. *See* management by objectives
medical management, ergonomics and, 224
Medical Waste Tracking Act (MWTA), 3
Monographs (IARC), 6, 39, 42
MSDS Lesson Plan, 21–23; material identification and, 22–23
MSDSs. *See* Material Safety Data Sheets
MWTA. *See* Medical Waste Tracking Act

National Environmental Policy Act (NEPA), 3
National Fire Protection Association (NFPA): fire safety and, 160; standpipe system standards of, 167
National Incident Management System (NIMS): by Department of Homeland Security, 136; ICS and, 136; NIC, 137; preparedness and, 136
National Incident Management System Integration Center (NIMS NIC), 137
National Institute for Occupational Safety and Health (NIOSH), 11, 39
National Response Plan (NRP): Homeland Security and, 137–38; hurricanes and, 128; preparedness by, 138; prevention by, 137–38; recovery by, 138; response by, 138
National Toxicology Program (NTP), 6, 39, 42, 49
National Weather Service, natural disasters and, 126
natural disasters: earthquakes as, 130; emergency response and, 126–30; floods as, 129–30; hurricanes as, 126–28; National Weather Service and, 126; preseason storm preparedness measures for, 126; tornadoes as, 128; winter storms as, 128–29
NEPA. *See* National Environmental Policy Act
NFPA. *See* National Fire Protection Association; NFPA 101 Life Safety Code; NFPA National Electrical Code 70E
NFPA 101 Life Safety Code: fire extinguishers and, 172; fire safety and, 161–63; requirements of, 162
NFPA National Electrical Code 70E, fire/electrical safety and, 160–61
NIC. *See* National Incident Management System Integration Center
NIMS. *See* National Incident Management System
NIMS Integration Center. *See* National Incident Management System Integration Center
NIMS NIC. *See* National Incident Management System Integration Center
NIOSH. *See* National Institute for Occupational Safety and Health
NRP. *See* National Response Plan
NTP. *See* National Toxicology Program
nuclear power plant incidents, Homeland Security and, 140–41
Nuclear Regulatory Commission, FEMA and, 140

Occupational Safety and Health Act of 1970, insurance companies and, ix
Occupational Safety and Health Administration (OSHA), 2; Confined Space Standards by, 234; on Control of Hazardous Energy Source, 188, 204; disaster prevention plans and, 121; on ergonomics, 219–20; on fire brigades, 171; on fire safety, 164; form 300/300A, 102, 103–5, *114*; form 301, 102–3, 105, *115*; HAZCOM investigation by, 4; on lockout/tagout, 187–88, 203
Oil Pollution Act (OPA), 3
OPA. *See* Oil Pollution Act
open stem and yoke valves (OSY valves), as sprinkler system type, 168, *168*
OSHA. *See* Occupational Safety and Health Administration

OSHA form 300, 103–5, *114*; occupational injury/illness log, 102
OSHA form 300A, 103–5, *114*; occupational injury/illness log, 102
OSHA form 301, *115*; completion procedure for, 105; injury/illness incident report, 102–3
OSY valve. *See* open stem and yoke valves

paper mills. *See* pulp/paper mills
participative management: advantages of, 250–51; characteristics of, 250; employee involvement and, 251; success of, 251
PEL. *See* permissible exposure levels
permissible exposure levels (PEL), 6
Permit-Required Confined Space Program: equipment for, 236; procedures for, 236, 237, 242; written elements of, 235, *235*
permits, for confined spaces, 234–35
PIV. *See* post indicator valve
policies: for fire safety, 163–64; regarding trade secrets, 16; for workplace safety, x
positive displacement pumps, centrifugal *v.,* 175–76
post indicator valve (PIV), 168–69
preseason storm preparedness measures: for natural disasters, 126; for winter storms, 129
procedures: for accident investigation forms completion, 102–5; for facility fires, 131–33; for fire extinguishers/ evacuation, 124; for fire safety, 163–64; for hazardous energy control program, 188–89, 195–97; for lockout/tag-out, 188–89, 195–97, 198, 200; for lockout/tag-out checklist, *199–200*; for multiple lockout/tag-out, 197–98; for OSHA form 301 completion, 105; for Permit-Required Confined Space Program, 236, 237, 242; regarding trade secrets, 16; of safety committees, 253; SERP and, 124; for transportation accidents, 134. *See also* evacuation procedures; policies
procedures for, hazardous energy control program, 195–97
property resources, management and, 249
public demonstrations/civil disturbances, as manmade disasters, 135
pull box alarm systems, *166*
pulp/paper mills, lockout/tagout of, 213–14
pumps: positive displacement *v.* centrifugal, 175–76; for water systems, 175–76

quality circles: characteristics of, 251; employee involvement and, 252; recognition of, 252; safety circles and, 251–52

RCRA. *See* Resource Conservation and Recovery Act
records: disaster recovery and, 149–50; ergonomics programs and, 226; for fire safety, 160; preservation of, 149; protection selection of, 149–50
The Registry of Toxic Effects of Chemical Substances (NIOSH), 39
reports. *See* records
rescue services. *See* emergency services
Resource Conservation and Recovery Act (RCRA), 2

sabotage, terrorism and, 140
Safe Drinking Water Act (SDWA), 3
safety committees: employee involvement and, 254; responsibilities/procedures of, 253
safety management by objectives (SMBO): characteristics of, 254; employee involvement in, 255; MBO and, 254
safety policies. *See* policies
SARA. *See* Superfund Amendments & Reauthorization Act
sawmills, lockout/tagout of, 215
scene isolation, for accident investigation, 86
SDWA. *See* Safe Drinking Water Act
SERP. *See* Site Emergency Response Plan
shelters: EOC and, 144–45; for general emergency plan, 122
Site Emergency Response Plan (SERP), evacuation procedure and, 124
SMBO. *See* safety management by objectives
smoke detector, *165*
sprinkler system: components of, 167–68; deluge, 170; for fire emergency mitigation, 167–69; OSY valve, 168, *168*; PIV, 168–69; room 2, *168*; siamese/fire pump connection, *168*; sprinkler head, 169, *169,* 170; wet *v.* dry, 169–70

stairwell, *167*
standpipe suppression system, 167; for fire emergency mitigation, 167; NFPA standards for, 167; stairwell, *167*; types of, 167
storms. *See* hurricanes; tornadoes; winter storms
substandard acts/conditions, accident investigation and, 83–84
Superfund Amendments & Reauthorization Act (SARA), 3
supportive interviewing style, 87; characteristics/tendencies of, 95, *95*; effectiveness increase of, 89–90; qualities of, 88, 91

tag-out. *See* lockout/tag-out
target organ effects, from hazardous chemicals, 50–51
terrorism: FBI and, 139; Homeland Security and, 139; sabotage and, 140; workplace and, ix–x
textile mills, lockout/tagout of, 214
Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment (ACGIH), 5–6, 38
tools: employee choices of, 223; ergonomics and, 223
tornadoes: precautions for, 128; warnings used for, 128
total quality management (TQM): characteristics of, 255; communication and, 256; employee involvement and, 255–56; ISO 9000 and, 256–57
Toxic Substance Control Act (TSCA), 3
TQM. *See* total quality management
trade secrets: HAZCOM and, 45–48, 54–56; policies/procedures regarding, 16
training: for confined spaces, 240; Control of Hazardous Energy Source and, 209–10; ergonomics and, 224, 227; ergonomics program and, 225; for fire brigades, 171; for fire safety, 159, 164; for general emergency plan, 122; for lockout/tagout, 202–3. *See also* employee training
transportation accidents: as manmade disasters, 134–35; procedures for, 134
TSCA. *See* Toxic Substance Control Act

UN. *See* United Nations
United Nations (UN), 13
UORA. *See* Used Oil Recycling Act
Used Oil Recycling Act (UORA), 3

videotaping, accident investigation and, 87

warnings: EOC and, 143; used for floods, 129; used for hurricanes, 126–27; used for tornadoes, 128; used for winter storms, 128–29
water systems: elevated tank, *174*; factors involving, 174; fire emergency mitigation and, 173–75; pumps and, 175–76
WC. *See* workers' compensation
wet sprinkler system, dry *v.,* 169–70
winter storms: preseason storm preparedness measures for, 129; warnings used for, 128–29
workers' compensation (WC): accident investigation and, 85, 106; claim process guidelines for, 105–8; ergonomics and, 220; human resources department and, 107; wage calculation and, 106–7
workplace: CAS/chemical listings in, 9; ergonomic analysis of, 221; potential hazardous chemicals in, *10*; safety policies for, ix; terrorism and, ix–x
workplace safety, control banding for, 11–12
Written Hazard Communication Program, 5, 18–19, 39–40