COURSE SPONSORS

Three Federal agencies have contributed to the development of this home study course: the Federal Emergency Management Agency (FEMA), the Environmental Protection Agency (EPA), and the Department of Transportation (DOT). All three agencies have responsibilities related to the *protection of the public from hazards* posed by the manufacture, transportation, and disposal of hazardous materials.

The DOT is charged with the development and oversight of the Nation's transportation policy, including the regulation of interstate hazardous materials transportation. The EPA is the primary agency responsible for protecting our environment, including funding cleanup operations at thousands of abandoned hazardous waste disposal sites and oversight of programs to regulate disposal of hazardous wastes identified by certain legislation. The FEMA is the central point of contact within the Federal government for a wide range of emergency management activities in both peace and war. That responsibility includes the design, delivery, coordination, and monitoring of hazardous materials training in cooperation with the members of the National Response Team (NRT).

On March 1, 2003, the Federal Emergency Management Agency became part of the U.S. Department of Homeland Security (DHS). FEMA's continuing mission within the DHS is to lead the effort to prepare the Nation for all hazards and effectively manage Federal response and recovery efforts following any national incident. FEMA also initiates proactive mitigation activities, trains first responders, and manages the National Flood Insurance Program and the U.S. Fire Administration. FEMA has ten regional offices, and two area offices. Each region serves several States, and regional staff work directly with the States to help plan for disasters, develop mitigation programs, and meet needs when major disasters occur. They have Technical Hazard Specialists to deliver hazardous materials training. Regions also have State training partners to assist in the delivery of other emergency preparedness training courses throughout their regions. You should become familiar with these individuals and attend hazardous materials training programs when they are offered within your State. Such programs will increase your emergency preparedness and professional development in identifying and reporting hazardous materials incidents to appropriate authorities within your community.

Independent Study Courses

The independent study program is one of the delivery channels the Emergency Management Institute (EMI) uses to deploy emergency management training to the general public and to select emergency management audiences.

Go to *http://training.fema.gov/is/* for information on these courses.

These independent study courses are geared toward both the general public and persons who have local government responsibilities for emergency management. All courses are available at no charge. Courses include a final examination, and persons who score 75% or better on the examination are issued a certificate of completion by EMI.

If you have questions about these courses, you may call (301) 447-1200; e-mail independent.study@fema.dhs.gov; or write to:

FEMA Independent Study Program
Administration Office
Emergency Management Institute
16825 S. Seton Avenue
Emmitsburg, MD 21727

INTRODUCTION

As hazardous materials and hazardous wastes become more and more commonplace, accumulating in our earth, air, and water, it is vitally important that citizens are well informed about the challenges posed by these substances. American communities are facing policy decisions that can dramatically affect their population's well being: Should hazardous materials traffic be regulated? What is the community's role in preparing for the possibility of a serious hazardous materials accident? What should be done with household hazardous wastes? Concerned community members willing to take the time to learn more about such issues can help protect their own health and contribute to their community—for just as surely as there are thorny problems associated with hazardous materials, there are creative minds at work seeking and testing solutions.

This home study course is intended to provide interested members of the general public with a basic introduction to hazardous materials that can serve as a foundation for more specific research. No prior knowledge of the subject is assumed. At the end of the course, the reader should be able to:

- Recognize the dangers posed by hazardous materials;
- List places where hazardous materials are likely to be encountered;
- Identify when a hazard may exist;
- Contact the appropriate persons or agencies to give or receive specific hazardous materials information; and
- Identify procedures to minimize personal and community exposure to hazardous materials.

The course has five units:

Unit 1: Health and Environmental Regulations explains the roles of Federal, State, and local governments in reducing hazardous materials risks, and reviews the key provisions of critical Federal legislation.

Unit 2: Hazardous Materials Identification Systems discusses the two major hazardous materials identification systems currently being used in the United States. It also outlines how communities identify possible targets of opportunity in a terrorist's use of toxic industrial chemicals (TICs) as Weapons of Mass Destruction (WMD).

Unit 3: Identifying Hazardous Materials provides an overview of locations in which these materials are commonly found and discusses ways of determining what particular chemicals, with what health effects, exist in these locations.

Unit 4: Hazardous Materials and Human Health introduces many of the basic terms used to discuss hazardous materials problems, and explains how hazardous materials enter and move through the body and the environment.

Unit 5: Preparing for Hazardous Materials Incidents shows what local communities can do to increase their preparedness to respond to hazardous materials accidents of any size. It also identifies steps individuals can take to protect themselves in an incident.

How to Complete the Course

You will remember the material best if you do not rush through it. Often there is white space next to the text where you can make notes. (The more you interact with the material, the better you will remember it!) Take a break at the end of each unit and give yourself time to think about the material. Then, go back and take the quiz at the end of the unit, reviewing the relevant material if you missed any questions.

Besides the five units, there is a glossary, a resource section to help you continue learning, and a final examination. The components of each are listed below.

The *glossary*, located after the final unit, contains definitions of terms related to hazardous materials. The glossary may be consulted while you are reading the units, or may be read separately.

A *resource section* is included to help you continue learning after you have completed the course. This section features listings of organizations that can supply additional information relevant to course objectives,

recommended reading, computer networks accessible to the public, and telephone services that supply information on specific hazardous materials issues.

The *final examination* will test the knowledge you have gained from the course. You may take the examination online at http://training.fema.gov/is/. Search for the course, and then click on the link for the exam. If your score is 75% or above, a certificate of completion will be emailed to you.

MEMBER AGENCIES OF THE NATIONAL RESPONSE TEAM

Federal Emergency Management Agency
Federal Center Plaza
500 C Street, S.W.
Washington, DC 20472
(202) 646-4542

U.S. Environmental Protection Agency
OSWER Preparedness Staff
401 M Street, S.W.
Washington, DC 20460
(202) 475-8600
(479-2449 in Washington, DC, area)

U.S. Environmental Protection Agency
OERR Emergency Response Division
401 M Street, S.W.
Washington, DC 20460
(202) 475-8720

Agency for Toxic Substances and Disease Registry
Department of Health and Human Services
Chamblee Building 30S
Atlanta, GA 30333
(404) 452-4100

U.S. Department of Energy
1000 Independence Avenue, S.W.
Washington, DC 20585
(202) 252-5000

Department of Agriculture
Forest Service
P.O. Box 96090
Washington, DC 20013-6090
(703) 235-8019

Department of Labor
Occupational Safety and Health Administration
Directorate of Field Operations
200 Constitution Avenue, N.W.
Washington, DC 20210
(202) 523-7741

U.S. Department of Transportation
Research and Special Programs Administration
Office of Hazardous Materials Transportation
(Attention: DHM-50)
400 7th Street, S.W.
Washington, DC 20590
(202) 366-4000

Department of Justice
Environmental Enforcement Section
Room 7313
10th and Constitution, N.W.
Washington, DC 20530
(202) 633-3646

Department of the Interior
18th and C Streets, N.W.
Washington, DC 20240
(202) 343-3891

Department of Commerce
NOAA—Superfund Program Coordinator
11400 Rockville Pike
Rockville, MD 20852
(301) 443-8465

Department of Defense
OASD (A+L)E
Room 3D 833
The Pentagon
Washington, DC 20301-8000
(202) 695-7820

Department of State
Office of Oceans and Polar Affairs
Room 5801
2201 C Street, N.W.
Washington, DC 20520
(202) 647-3263

Nuclear Regulatory Commission
Washington, DC 20555
(301) 492-7000

U.S. Coast Guard (G-MER)
Marine Environmental Response Division
2100 2nd Street, S.W.
Washington, DC 20593
(202) 267-2010

PIPELINE AND HAZARDOUS MATERIALS SAFETY ADMINISTRATION

HAZARDOUS MATERIALS
INFORMATION CENTER

1-800-HMR-4922
1-800-467- 4922
(202) 366-4488 (*Washington, DC***)**

PHMSA (Pipeline and Hazardous Materials Safety Administration) operates the Hazardous Materials Information Center (HMIC) for help on use of the Hazardous Materials Regulations 49 CFR Parts 100-185. The phone number is menu driven when calling from a touch tone phone. Non-touch tone phone callers must use the telephone number (202) 366-8553. Callers will be directed through an automated menu that provides options to:

1. Obtain answers to questions on the Hazardous Materials Regulations 49 CFR Parts 100-185;
2. Receive recent copies of Federal Register publications, copies of DOT exemptions or letters of interpretation
3. Receive copies of training material, such as Chart 12 or information packages;
4. Report violations of the HMR;
5. Leave a voice mail message concerning a question on the HMR (messages will be returned within 24 hours).
6. OHMS **Fax On Demand**. Now you can access Hazardous Materials Information quickly and easily! A menu of options lets you choose documents to be faxed to your machine (e.g., final rules, DOT forms, letters of clarification, safety notices and more). To reach the Fax On Demand system dial **1-800-467-4922** and select **Option 2**.

Callers needing assistance on questions relating to the HMR will be forwarded to the HMIC after selecting the correct menu item. Calls to the center are handled on a first call first answered manner through an automatic stacking system. The HMIC is open for direct calls from 9:00 am to 5:00 pm EST, however you may leave a message at any time, or you may email your question to the HMIC. Or you may write to:

Director, Office of Hazardous Materials Standards
U.S. DOT/PHMSA (DHM-10)
400 7th Street S.W.
Washington, D.C. 20590-0001

TRANSPORTATION SAFETY INSTITUTE

Transportation Safety Institute
P.O. Box 25082
Oklahoma City, OK 73125-5050

Director's Office
Frank Tupper, Director - DTI-1: (405) 954-3153
E-Mail: Director@tsi.jccbi.gov
Linda Gulley, Associate Director - DTI-2: (405) 954-3153

E-Mail: AssociateDirector@tsi.jccbi.gov
Diana Lopez Story, Executive Officer - DTI-10: (405) 954-6441
E-mail: OperationSupport@tsi.jccbi.gov

Aviation Safety
Christine Lawrence, Manager - DTI-20: (405) 954-9740
E-Mail: AviationSafety@tsi.jccbi.gov

Special Programs
Dee Smith, Manager - DTI-100: (405) 949-0036 x367
E-Mail: SpecialPrograms@tsi.jccbi.gov

Hazardous Materials
Mike Nolan, Manager - DTI-30: (405) 954-4512
E-Mail: HazardousMaterials@tsi.jccbi.gov

Pipeline Safety
Richard Sanders, Manager - DTI-60: (405) 954-7219
E-Mail: PipelineSafety@tsi.jccbi.gov

Highway Safety
Mike Baldwin, Manager - DTI-70: (405) 954-3112
E-Mail: HighwaySafety@tsi.jccbi.gov

National Automotive Sampling System
Bob Romberg Team Coordinator: (405) 954-7212
E-Mail: NASS@tsi.jccbi.gov

Transit Safety & Security
Vacant, Manager - DTI-80: (405) 954-3682
E-Mail: Transit@tsi.jccbi.gov

Coast Guard Container Inspection Training and Assistance Team (CITAT)
Gerard Achenbach, Commander - DTI-120: (405) 954-8983
E-Mail: CITAT@tsi.jccbi.gov

ENVIRONMENTAL PROTECTION AGENCY

EPA Headquarters
Ariel Rios Building
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460
(202) 272-0167, TTY (202) 272-0165

EPA Regional Offices

Region 1 (CT, MA, ME, NH, RI, VT)
Environmental Protection Agency
1 Congress St. Suite 1100
Boston, MA 02114-2023
http://www.epa.gov/region01/
Phone: (617) 918-1111
Fax: (617) 565-3660
Toll free within Region 1: (888) 372-7341

Region 6 (AR, LA, NM, OK, TX)
Environmental Protection Agency
Fountain Place 12th Floor, Suite 1200
1445 Ross Avenue
Dallas, TX 75202-2733
http://www.epa.gov/region06/
Phone: (214) 665-2200

Region 2 (NJ, NY, PR, VI)
Environmental Protection Agency
290 Broadway
New York, NY 10007-1866
http://www.epa.gov/region02/
Phone: (212) 637-3000
Fax: (212) 637-3526

Region 3 (DC, DE, MD, PA, VA, WV)
Environmental Protection Agency
1650 Arch Street
Philadelphia, PA 19103-2029
http://www.epa.gov/region03/
Phone: (215) 814-5000
Fax: (215) 814-5103
Toll free: (800) 438-2474
Email: r3public@epa.gov

Region 4 (AL, FL, GA, KY, MS, NC, SC, TN)
Environmental Protection Agency
Atlanta Federal Center
61 Forsyth Street, SW
Atlanta, GA 30303-3104
http://www.epa.gov/region04/
Phone: (404) 562-9900
Fax: (404) 562-8174
Toll free: (800) 241-1754

Region 5 (IL, IN, MI, MN, OH, WI)
Environmental Protection Agency
77 West Jackson Boulevard
Chicago, IL 60604-3507
http://www.epa.gov/region5/
Phone: (312) 353-2000
Fax: (312) 353-4135
Toll free: (800) 223-0425 toll free within Region 5: (800) 621-8431
Fax: (214) 665-7113
Toll free within Region 6: (800) 887-6063

Region 7 (IA, KS, MO, NE)
Environmental Protection Agency
901 North 5th Street
Kansas City, KS 66101
http://www.epa.gov/region07/
Phone: (913) 551-7003

Region 8 (CO, MT, ND, SD, UT, WY)
Environmental Protection Agency
999 18th Street Suite 500
Denver, CO 80202-2466
http://www.epa.gov/region08/
Phone: (303) 312-6312
Fax: (303) 312-6339
Toll free: (800) 227-8917
Email: r8eisc@epa.gov

Region 9 (AZ, CA, HI, NV)
Environmental Protection Agency
75 Hawthorne Street
San Francisco, CA 94105
http://www.epa.gov/region09/
Phone: (415) 947-8000
(866) EPA-WEST (toll free in Region 9)
Fax: (415) 947-3553
Email: r9.info@epa.gov

Region 10 (AK, ID, OR, WA)
Environmental Protection Agency
1200 Sixth Avenue
Seattle, WA 98101
http://www.epa.gov/region10/
Phone: (206) 553-1200
Fax: (206) 553-0149
Toll free: (800) 424-4372

U.S. DEPARTMENT OF LABOR
OCCUPATIONAL SAFETY & HEALTH ADMINISTRATION

IF YOU HAVE WORKPLACE SAFETY AND HEALTH RELATED QUESTIONS:

[By Phone]:
1-800-321-OSHA (6742) {Toll Free U.S.}

[**Write To: (required for an Official Agency Response*)**]

[**DOMESTIC ONLY**]	[**INTERNATIONAL**]
U.S. Department of Labor Occupational Safety & Health Administration 200 Constitution Avenue Washington, D.C. 20210	U.S. Department of Labor OSHA Coordinator for International Affairs Occupational Safety & Health Administration - Room N3641 200 Constitution Avenue Washington, D.C. 20210

Region 1
JFK Federal Building, Room E340
Boston, Massachusetts 02203
(617) 565-9860
(617) 565-9827 FAX

Region 2
201 Varick Street, Room 670
New York, New York 10014
(212) 337-2378
(212) 337-2371 FAX

Region 3
U.S. Department of Labor/OSHA
The Curtis Center-Suite 740 West
170 S. Independence Mall West
Philadelphia, PA 19106-3309
TELE: (215) 861-4900
FAX: (215) 861-4904

Region 4
61 Forsyth Street, SW
Atlanta, Georgia 30303
(404) 562-2300
(404) 562-2295 FAX

Region 5
230 South Dearborn Street, Room 3244
Chicago, Illinois 60604
(312) 353-2220
(312) 353-7774 FAX

Region 6
525 Griffin Street, Room 602
Dallas, Texas 75202
(214) 767-4731
(214) 767-4693 FAX

Region 7
City Center Square
1100 Main Street, Suite 800
Kansas City, Missouri 64105
(816) 426-5861
(816) 426-2750 FAX

Region 8
1999 Broadway, Suite 1690
P.O. Box 46550
Denver, Colorado 80201-6550
(303) 844-1600
(303) 844-1616 FAX

Region 9
71 Stevenson Street, Room 420
San Francisco, California 94105
(800) 475-4019 (For Technical Assistance)
(800) 475-4020 (For Complaints - Accidents/Fatalities)
(800) 475-4022 (For Publication Requests)
(415) 975-4319 FAX

Region 10
1111 Third Avenue, Suite 715
Seattle, Washington 98101-3212
(206) 553-5930
(206) 553-6499 FAX

FEDERAL EMERGENCY MANAGEMENT AGENCY

FEMA HEADQUARTERS
500 C Street S.W.
Washington, D.C. 20472
1-800-621-FEMA

Emergency Management Institute	National Fire Academy
16825 South Seton Avenue Emmitsburg, Maryland 21727 Phone: 301-447-1000 • 800-238-3358 Fax: 301-447-1658 (Admissions) http://training.fema.gov/emiweb/emicourses/	16825 South Seton Avenue Emmitsburg, Maryland 21727 Phone: 301-447-1000 • 1-800-238-3358 Fax: 301-447-1441 (Admissions) http://www.usfa.fema.gov

Region I
99 High Street, 6th Floor
Boston, Massachusetts 02110
(617) 956-7506
(617) 956-7550 (Training Office)
FSN: 551-9550
Fax: (617) 956-7519 or 956-7538

Region II
26 Federal Plaza, Room 1307
New York, New York 10278-0002
(212) 680-3609
(212) 225-7018 (Training Office)
Fax: (212) 680-3681

Region III
One Independence Mall Building
615 Chestnut Street, 6th Floor
Philadelphia, Pennsylvania 19106-4404
(215) 931-5500
(215) 931-5569 (Training Office)
FSN: 553-5569
Fax: (215) 931-5714

Region IV
3003 Chamblee Tucker Road
Atlanta, Georgia 30341
(770) 220-5200
(770) 220-5218 (Training Office)
FSN: 554-5218
Fax: (770) 220-5275

Region V
536 South Clark Street, 6th Floor
Chicago, Illinois 60605
(312) 408-5500
(312) 408-5377 (Training Office)
FSN: 555-5377
Fax: (312) 408-5222

Region VI
Federal Regional Center
800 North Loop 288
Denton, Texas 76201-3698
(940) 898-5399
(940) 898-5457 (Training Office)
FSN: 536-5399
Fax: (940) 898-5263

Region VII
2323 Grand Boulevard, Suite 900
Kansas City, Missouri 64108-2670
(816) 283-7061
(816) 283-7093 (Training Office)
FSN: 537-7093
Fax: (816) 283-7093

Region VIII
Federal Regional Center
Building 710, Box 25267
Denver, Colorado 80225-0267
(303) 235-4800
(303) 235-4929 (Training Office)
FSN: 538-4929
Fax: (303) 235-4857

Region IX
111 Broadway, Suite 1200
Oakland, CA 94607-4052
(510) 627-7100
(510) 627-7106 (Training Office)
FSN: 539-7106
Fax: (510) 627-7126 or 627-7117

Region X
Federal Regional Center
130 228th Street SW
Bothell, Washington 98021-9796
(425) 487-4600
(425) 487-4603 (Training Office) or
(425) 487-4684
FSN: 530-4603
Fax: (425) 487-4777

NATIONAL RESPONSE CENTER

National Response Center
c/o United States Coast Guard (G-OPF) - Room 2611
2100 2nd Street, Southwest
Washington, DC 20593-0001

Toll Free: 800-424-8802
Direct: 202-267-2675
FAX: 202-267-2165
TDD: 202-267-4477 (Telecommunications Device for the Deaf)

TERRORISM/SUSPICIOUS ACTIVITY

TERRORISM: Any incident related to terrorism or possible terrorist activity requires telephonic notification to the National Response Center. **DO NOT SEND AN ON-LINE REPORT!** This would include bombings, bomb threats, suspicious letters or packages, and incidents related to the intentional release of chemical/biological/radioactive agents. Our Watch Standers have been trained to ask specific questions for such reports and will immediately pass the information to the proper agencies for response.

SUSPICIOUS ACTIVITY: Any incident, activity or behavior that you deem to be activity of a suspicious nature should be reported to the NRC by calling **1-877-24-W**ATCH or **1-800-424-8802**. Email reports are not an acceptable method for making suspicious activity reports. Examples of suspicious activity would be:

- people appearing to be engaged in surveillance of any kind (picture taking, note taking, shooting video, asking strange questions, etc)
- recovering or tossing items into the water
- unattended vessels or vehicles in unusual locations
- light signals between boats
- unusual diving, night operations
- operations in an area that usually does not have such activity
- fishing or hunting in locations not typically used for those activities
- anchoring in areas not typically used for anchoring
- transfer of people or things between ships or shore that seems unusual
- small planes flying over critical areas
- people attempting to buy or rent fishing or recreational boats/vehicles with cash for short term, undefined use
- anyone operating a vessel in an aggressive manner
- missing fencing or lighting near sensitive locations

Remember-it is the activity or behavior that is suspicious, not a person's ethnicity.

RECOMMENDED READING

Center for Environmental Toxicology, TOXICOLOGY FOR THE CITIZEN. Available from the Center for Environmental Toxicology, C-231 Holden Hall, Michigan State University, East Lansing, Michigan 48824, (517) 353-6469. Single copies free; inquire about quantity prices.

NIOSH/OSHA, POCKET GUIDE TO CHEMICAL HAZARDS (017-033-00426-9). Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402, (202) 783-3238. Cost: $11.00.

U.S. Department of Labor, Occupational Safety and Health Administration. HOW TO PREPARE FOR WORKPLACE EMERGENCIES. (1988 Revised) OSHA 3088. Available from Occupational Safety and Health Administration Publications Office, Room N3101, Washington, DC 20210, (202) 523-9667.

Cohen, Gary, executive ed. THE CITIZENS TOXICS PROTECTION MANUAL. (1988). Available from the National Campaign Against Toxic Hazards, 29 Temple Place, 5th Floor, Boston, MA 02111, (617) 482-1477. Cost: $30.00 for nonprofits, $50.00 for business, industry, and government.

U.S. Department of Labor, Occupational Safety and Health Administration. CHEMICAL HAZARD COMMUNICATION. (1988 Revised) OSHA 3084. Available from Occupational Safety and Health Administration Publications Office, Room N3101, Washington, DC 20210, (202) 523-9667.

Musselman, Victoria Cooper. EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW: AN IMPLEMENTER'S GUIDE TO SARA TITLE III. (1988). Van Nostrand Reinhold, New York. Available from Public Information Center, U.S. Environmental Protection Agency, Mail Code PM-21 1 B, 401 M Street, S.W., Washington, DC 20460.

National Response Team. HAZARDOUS MATERIALS EMERGENCY PLANNING GUIDE. (March 1987) NRT-1. Available from Hazardous Materials Emergency Planning Guide, WH-562A, U.S. Environmental Protection Agency, 401 M Street, S.W., Washington, DC 20460.

U.S. Environmental Protection Agency. CHEMICALS IN YOUR COMMUNITY. A GUIDE TO THE EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT. (September 1988) OS-120. Available from Emergency Planning and Community Right-to-Know Information Service, OS-120, U.S. Environmental Protection Agency, Washington, DC 20460.

U.S. Environmental Protection Agency, Office of Pesticides and Toxic Substances. THE EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT. SECTION 313 RELEASE REPORTING REQUIREMENTS. (February 1988) EPA 560/4-88-001. Available from Emergency Planning and Community Right-to-Know Information Service, OS-120, U.S. Environmental Protection Agency, Washington, DC 20460.

)04 EMERGENCY RESPONSE GUIDEBOOK. U.S. Department of Transportation, Research and Special Program Administration, Office of Hazardous Materials Initiatives and Training (DHM-50) Washington, DC 20590-001.

Glossary

Absorption

The passing of a substance into the circulatory system of the body. Also used specifically to refer to entry of toxicants through the skin.

Glossary

ACGIH

American Conference of Governmental Industrial Hygienist

Glossary

Acute Exposure

An exposure to a toxic substance which occurs in a short or single time period.

Glossary

Acute Toxicity

Any poisonous effect produced by a single short-term exposure. The LD_{50} of a substance (the lethal dose at which 50 percent of test animals succumb to the toxicity of the chemicals) is typically used as a measure of its acute toxicity.

Glossary

Additive Effect

A biological response to exposure to multiple chemicals which is equal to the *sum* of the effects of the individual agents.

Adsorption

Glossary The bonding of chemicals to soil particles or other surfaces.

Aerosol

Glossary A solid particle or liquid droplet suspended in air. An aerosol is larger than a molecule and can be filtered from the air.

Antagonism

Glossary The situation in which two chemicals interfere with each other's actions, or one chemical interferes with the action of the other.

Aquifer

Glossary An underground bed, or layer, of earth, gravel, or porous storage that contains water.

Asphyxiants

Glossary Chemicals that starve the cells of an individual from the life-giving oxygen needed to sustain metabolism.

Biodegradable

Glossary Capable of decomposing quickly through the action of microorganisms.

Biomagnification

Glossary The tendency of certain chemicals to become concentrated as they move into and up the food chain.

Boiling Point

Glossary The temperature at which a liquid will start to become a gas, and boil. A chemical with a low boiling point can boil and evaporate quickly. If a material that is flammable also has a low boiling point, a special fire hazard exists.

Carcinogen

Glossary A chemical or physical agent that encourages cells to develop cancer.

Central Nervous System Depressants

Glossary

Toxicants that deaden the central nervous system (CNS), diminishing sensation.

CERCLA

Glossary

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980—the Federal statute that authorized “Superfund.” Administered by EPA, the law provides funding for cleanups and emergency response actions for hazardous substances at the worst hazardous waste sites in the United States. CERCLA is also significant because it set the first criteria for notification of emergencies involving hazardous substances. Superfund regulates abandoned waste disposal sites; for *active* disposal site regulation, see RCRA.

CHEMTREC

Glossary

Chemical Transportation Emergency Center, a service operated by the Chemical Manufacturers Association to provide information and other assistance to emergency responders.

Chronic Exposure

Glossary

Process by which small amounts of toxic substances are taken into the body over an extended period.

Command Post

Glossary

A centralized base of operations established near the site of a hazardous materials incident.

Corrosive

Glossary

A chemical that destroys or irreversibly alters living tissue by direct chemical action at the site of contact.

Decontamination

Glossary

The process of removing or neutralizing contaminants that have accumulated on personnel and equipment. This process is critical to health and safety at hazardous waste incidents.

Dermal Exposure

Glossary

Exposure to toxic substances by entry though the skin.

Dose

The quantity of a chemical absorbed and available for interaction with metabolic processes.

Glossary

Epidemiology Studies

Glossary

Investigation of factors contributing to disease or toxic effects in the general population.

Evaporation Rate

Glossary

The rate at which a chemical changes into a vapor. A chemical that evaporates quickly can be a more dangerous fire or health hazard.

Exercise

Glossary

A simulated emergency condition carried out for the purpose of testing and evaluating the readiness of a community or organization to handle a particular type of emergency.

Explosive

Glossary

A chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperatures.

Extremely Hazardous Substance (EHS)

Glossary

Any one of more than 300 hazardous chemicals on a list compiled by EPA to provide a focus for State and local emergency planning activities.

Hazard Class

Glossary

A group of materials, as designated by the Department of Transportation, that share a common major hazardous property such as radioactivity or flammability.

Hazardous Materials Response Team (HMRT)

Glossary

A team of specially trained personnel who respond to a hazardous materials incident. The team performs various response actions including assessment, firefighting, rescue, and containment; they are *not* responsible for cleanup operations following the incident.

Incident Commander

Glossary

The person in charge of on-scene coordination of a response to an incident, usually a senior officer in a fire department.

Inversion

Glossary

An atmospheric condition caused by a layer of warm air preventing cool air trapped beneath it from rising, thus holding down pollutants that could otherwise be dispersed.

Irritant

Glossary

Chemicals which inflame living tissue by chemical action at the site of contact, causing pain or swelling.

LD_{50}

Glossary

The calculated dosage of a material that would be fatal to 50% of an exposed population (Lethal Dose 50%).

Leachate

Glossary

Material that pollutes water as it seeps through solid waste.

Leaching

Glossary

The process by which water dissolves nutrient chemicals or contaminants and carries them away, or moves them to a lower layer.

LEPC

Glossary

Local Emergency Planning Committee.

LOAEL

Glossary

The Lowest Observed Adverse Effect Level, i.e., the lowest dose which produces an observable adverse effect.

Medium

Glossary

The environmental vehicle by which a pollutant is carried to the receptor (e.g., air, surface water, soil, or groundwater).

Melting Point

Glossary

The temperature at which a solid material changes to a liquid. Solid materials with low melting points should not be stored in hot areas.

Mg

Glossary

Milligram, a metric unit of mass, one thousandth of a gram: 1 mg = 0.001 g = 1000 µg.

Mm^3

Glossary

Milligrams per cubic meter. The mass in micrograms of a substance contained within a cubic meter of another substance or vacuum. This is the standard unit of measure for the mass density (concentration) of particles suspended in air; also sometimes used for the concentration of gases in air.

MSDS (Material Safety Data Sheet)

Glossary

A worksheet required by the U.S. Occupational Safety and Health Administration (OSHA) containing information about hazardous chemicals in the workplace. MSDSs are used to fulfill part of the hazardous chemical inventory reporting requirements under the Emergency Planning and Community Right-to-Know Act.

Mutagen

Glossary

A chemical or physical agent that induces a permanent change in the genetic material.

NOAEL

Glossary

No Observable Adverse Effect Level.

NECP Suit

Glossary

Non-encapsulating chemical protective suit. Not gas or vapor tight.

Organic Compound

Glossary

Chemicals that contain carbon. Volatile organic compounds vaporize at room temperature and pressure. They are found in many indoor sources, including many common household products and building materials.

OSHA

Glossary

The Occupational Safety and Health Administration, part of the Department of Labor.

Pathway

Glossary

A history of the flow of a pollutant from source to receptor, including qualitative descriptions of emission type, transport, medium, and exposure route.

PEL

Glossary Permissible Exposure Limits set by OSHA as a guide to acceptable levels of chemical exposure.

Percent Volatile

Glossary The percentage of a chemical that will evaporate at ordinary temperatures. A high volatile percentage may mean there is more risk of explosion, or that dangerous fumes can be released. Evaporation rates are a better measure of the danger than the percent volatile measure.

PH

Glossary The pH is a measure of how acidic or caustic a chemical is, based on a scale of 1 to 14. A pH of 1 means the chemical is very acidic. Pure water has a pH of 7. A pH of 14 means the chemical is very caustic. Both acidic and caustic substances are dangerous to skin and other valuable surfaces.

Poison

Glossary A chemical that, in relatively small amounts, is able to produce injury by chemical action when it comes in contact with a susceptible tissue.

RCRA

Glossary The Resource Conservation and Recovery Act (of 1976). A Federal statute which establishes a framework for proper management and disposal of all wastes. Generation, transportation, storage, treatment, and disposal of hazardous wastes are all regulated under this Act.

Risk Assessment

Glossary Broadly defined as the scientific activity of evaluating the toxic properties of a chemical and the conditions of human exposure to it, with the objective of determining the probability that exposed humans will be adversely affected. Its four main components are:

1. *Hazard Identification*—Does the agent cause the effect?
2. *Dose-Response Assessment*—What is the relationship between the dose and its incidence in human beings?
3. *Exposure Assessment*—What exposures are experienced or anticipated, and under what conditions?
4. *Risk Characterization*—The total analysis producing an estimate of the incidence of the adverse effect in a given population.

Runoff

Glossary Water from rain, snow melt, or irrigation that flows over the ground surface and returns to streams.

SARA

Superfund Amendments and Reauthorization Act of 1986.

Glossary

SERC

Glossary State Emergency Response Commission.

Solubility in Water

Glossary An indicator of the amount of a chemical that can be dissolved in water, shown as a percentage or as a description. A low percent of solubility (or a description of “slight” solubility or “low” solubility) means that only a small amount will dissolve in water. Knowing this may help firefighters or personnel cleaning a spill.

Specific Gravity

Glossary A comparison of the weight of the chemical to the weight of an equal volume of water. Chemicals with a specific gravity of less than 1 are lighter than water, while a specific gravity of more than 1 means the chemical is heavier than water. Most flammable liquids are lighter than water.

Synergistic Effect

Glossary A biological response to exposure to multiple chemicals which is greater than the sum of the effects of the individual agents.

Systemic Toxicants

Glossary Chemical compounds that affect entire organ systems, often operating far from the original site of entry.

Teratogen

Glossary A material that produces a physical defect in a developing embryo.

Threshold

Glossary The lowest dose of a chemical at which a specific measurable effect is observed. Below this dose, the effect is not observed.

Title III

Glossary The third part of SARA, also known as the Emergency Planning and Community Right-to-Know Act of 1986.

TLV

Glossary Threshold Limit Values, which are the calculated airborne concentrations of a substance to which all workers could be repeatedly exposed 8 hours a day without adverse effects.

TECP Suit

Glossary Totally encapsulating chemical protective suit. Special protective suits made of material that prevents toxic or corrosive substances or vapors from coming in contact with the body. Gas and vapor tight suit.

Toxicity

Glossary The degree of danger posed by a substance to animal or plant life.

Toxicology

Glossary The study of the adverse effects of chemicals on biological systems, and the assessment of the probability of their occurrence.

Transformation

Glossary The chemical alteration of a compound by processes such as reaction with other compounds or breakdown into component elements.

Transport

Glossary Hydrological, atmospheric, or other physical processes that convey pollutants through and across media from source to receptor.

Vapor Density

Glossary The measure of the heaviness of a chemical's vapor as compared to the weight of a similar amount of air. A vapor density of 1.0 is equal to air. Vapors that are heavier than air may build up in low-lying areas, such as along floors, in sewers, or in elevator shafts. Vapors that are lighter than air rise and may collect near the ceiling.

Vapor Pressure

Glossary The measure of how quickly a chemical liquid will evaporate. Chemicals with low boiling points have high vapor pressures. If a chemical with a high vapor pressure spills, there is an increased risk of explosion and a greater risk that workers will inhale toxic fumes.

Volatilization

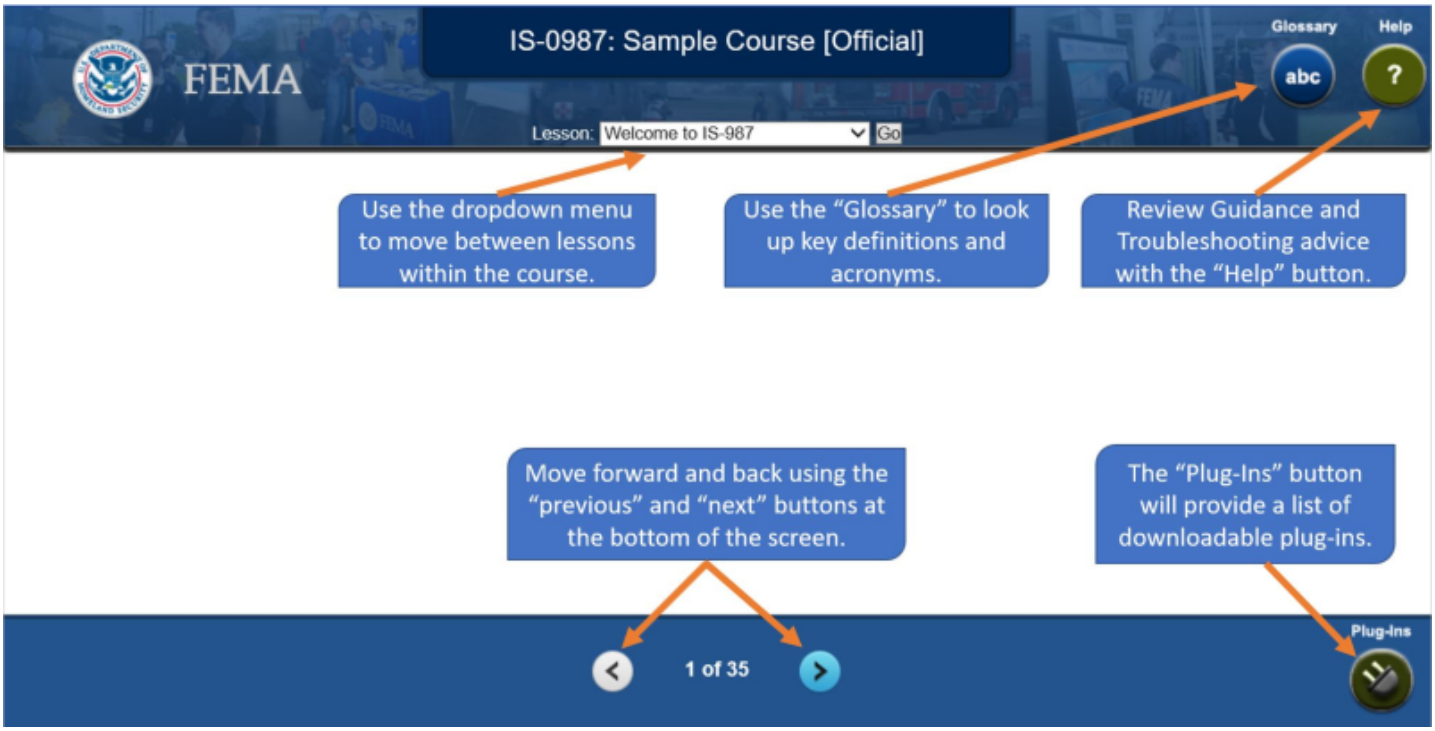
Glossary Entry of contaminants into the atmosphere by evaporation from soil or water.

Glossary

Workers Right-to-Know

Legislation mandating communicating of chemical information to employees. A regulatory initiative by OSHA, and an antecedent to Community Right-to-Know.

Screen Features



Receiving Credit

Students must complete the entire course and pass the final exam to receive credit for the course. Each lesson takes a variable amount of time to complete. If you are unable to complete the course in its entirety, you may close the window and reopen the course at any time. However, depending on the system used to take the course, it is possible you may have to repeat a portion of the last lesson you were studying.

HAZARDOUS MATERIALS LEGISLATION Objectives

In this unit, you will learn about:

- The major U.S. laws pertaining to health and environmental regulations
- Responsibilities of the key Federal agencies
- Title III of the 1986 Superfund Amendments and Reauthorization Act, known as the "Emergency Planning and Community Right-to-Know Act"
- The roles of Federal, State, and local governments, as well as industry
- How to use legislation to protect yourself from hazardous materials

Hazardous Materials Legislation

There are a number of Federal laws that regulate hazardous materials. The following is a brief overview of the major pieces of legislation that comprise our country's hazardous materials management policies and programs.

There are a number of Federal laws that regulate hazardous materials.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

In 1980, Congress passed the Comprehensive Emergency Response, Compensation, and Liability Act, known as CERCLA. The bill's purpose was to fund cleanups and emergency response actions for some of the worst inactive or abandoned hazardous waste sites scattered across the country. A billion dollar revolving trust fund—financed primarily by a tax on certain chemical and petroleum products—was created to pay for Federal and State response actions when hazardous substances pose an existing or potential threat to human health or the environment.

In 1986, this bill was revised and expanded in the Superfund Amendments and Reauthorization Act of 1986 (SARA). The third part of SARA, Title III, is known as the Emergency Planning and Community Right-to-Know Act of 1986. This portion of the legislation makes more than 300 "extremely hazardous substances" subject to routine and detailed reporting to designated local, State, and Federal government agencies. It also requires local planning committees to use this information (and other data on local hazards) to create effective plans for hazardous materials emergencies.

The National Oil and Hazardous Substance Pollution Contingency Plan (NCP)

The National Contingency Plan is the basis for Federal action to minimize pollution damage from discharges of oil or hazardous substances. In accordance with this law, Federal agencies assist in the development and evaluation of national, regional, and local oil and hazardous substance pollution contingency plans. This coordinated planning enables communities to prevent or lessen the harm that could accompany a hazardous materials release.

Working together as part of the National Response Team (NRT)—composed of 14 Federal agencies—experts publish guidance on emergency response planning and stand ready to assist States in the event of a major chemical emergency. As co-chairs of the NRT, the Environmental Protection Agency (EPA) and the U.S. Coast Guard (USCG) play key roles in environmental protection. The two agencies share specific responsibility for waterway protection, EPA having primary responsibility for most *inland* waters and the USCG handling responsibility for *coastal* water and some specifically-designated Federal navigable waterways such as Lake Michigan.

The NCP covers how to identify and investigate hazardous waste sites that could potentially pose such a serious threat to public health that the situation would be considered an emergency. It also specifies how to analyze costs and evaluate the best cleanup options, and details roles and responsibilities for Federal, State, and local governments in carrying out these requirements.

The Resource Conservation and Recovery Act of 1976 (RCRA)

This law, administered by EPA, establishes a Federal program to provide comprehensive regulation of hazardous waste, which includes certain materials held to pose a potential threat to public health and safety when they are discarded. RCRA regulations provide for and maintain a hazardous waste management system that covers the generation, transportation, use, and disposal of such waste (sometimes summarized as the regulation from "cradle to grave management of hazardous waste"). Major control mechanisms include a

manifest system to track hazardous waste shipments and a permit system requiring waste site owners and operators to comply with specified safety standards. While RCRA primarily regulates safety precautions at hazardous waste facilities in operation today, it also has strong provisions potentially relevant to cleanup if any part of a facility was in operation during the 1980s.

The Hazardous Materials Transportation Act (HMTA)

The Department of Transportation (DOT) has the authority to regulate the handling and interstate transportation of hazardous materials. More specifically, DOT's Office of Hazardous Materials Transportation (OHMT) issues regulations dealing with the shipping and packaging of hazardous materials, including how they are classified and labeled (both nationally and internationally). While the law enables DOT to regulate any traffic that "affects" interstate or foreign commerce, the agency has chosen to regulate only shipments of carriers engaged in interstate commerce, leaving the States themselves to regulate shipments by carriers that do not cross State lines.

The Occupational Safety and Health Act of 1970

The Occupational Safety and Health Act was enacted to assure safe and healthful working conditions for working men and women; by authorizing enforcement of the standards developed under the Act; by assisting and encouraging the States in their efforts to assure safe and healthful working conditions; by providing for research, information, education, and training in the field of occupational safety and health; and for other purposes.

The purpose of this law is to assure, so far as possible, "safe working conditions" to "every working man in the country." This is accomplished by the issuing of basic safety and health standards, assigning the Occupational Safety and Health Administration (OSHA) employees to inspect workplaces, and forcing industry to reduce or eliminate job hazards by imposing fines for identified violations.

Worker Exposures

OSHA sets standards for worker exposure to hazardous substances and requires that such substances bear warning labels. It also mandates that employees be given training and other information on dangers posed by chemicals, and be given instruction as to how to use these chemicals safely. OSHA has the authority to inspect a workplace to determine whether it is in compliance with these regulations. In current practice, only a worker complaint or high worker injury rates as shown in company records will trigger an actual inspection.

Hazardous Waste Operations and Emergency Response (HAZWOPER)

Under SARA, the Secretary of Labor was directed to issue a final standard to protect the health and safety of employees engaged in hazardous waste operations. In 1989, OSHA issued this rule on Hazardous Waste Operations and Emergency Response, which represents the first comprehensive approach to protecting public and private sector employees involved in the dangers of working on hazardous waste sites. Many of the workers affected by this rule are employees of State and local governments. Twenty-five States and Territories have their own job safety and health programs. Their standards are required to be at least as stringent as the Federal regulations.

The Toxic Substances Control Act (TSCA)

This legislation was passed in 1976 to reduce the threat from new chemicals that "present or will present an unreasonable risk of injury to health or the environment." As a result, chemical producers are required to research the effects of new chemicals and notify EPA before they are manufactured. EPA has the authority to ban or restrict chemical uses if there is sufficient evidence that the substance poses an "unreasonable risk."

Pesticides Legislation

Both the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) and the Federal Food, Drug and Cosmetic Act (FFDCA) regulate pesticides. Originally requiring mere registration of pesticides, FIFRA was amended in 1972 to require testing for short-term and long-term toxic effects prior to registration. For pesticides used on food crops, EPA establishes an upper limit on the amount of residue that can remain on food based on human tolerance levels. The FFDCA requires the Food and Drug Administration (FDA) to enforce these residue limits by monitoring and seizing foods whose residues are in excess of these standards.

The Clean Air Act (CAA)

The CAA was passed by Congress in 1970 and signed into law by President Nixon. This Act is the basic Federal law for controlling toxic air pollution. It requires EPA to keep an up-to-date list of industrial pollutants that are hazardous to human health, and set an emission standard for each "with an ample margin of safety." Under the law, EPA prepares minimum pollution standards, and States prepare implementation plans showing how these standards will be attained. States issue permits for the release of listed pollutants into the atmosphere, and take samples to evaluate the State's air quality. Of the 320 toxic air pollutants named in the act, EPA has to date completed regulations governing only 7, in large part because industry protests have resulted in legal precedents requiring costly and lengthy scientific studies to show that a pollutant has harmful effects at a certain level.

The CAA was expanded, with its central public health approach reaffirmed, under Presidents Carter and Bush. The CAA requires EPA to review public health standards for six major air pollutants every 5 years. Under the law, the standards must be set to **"protect public health with an adequate margin of safety"** and be based only upon a consideration of public health, with cost factors coming into account only during the implementation phase. EPA recently completed the scientific review for five of the six pollutants and has set new, updated standards for only two of these—ozone and particulate matter.

Why are the public health standards being revised for these two pollutants?

Recognizing that the scientific knowledge and understanding of air pollution and its effects on public health would advance over time, Congress directed EPA to review these public health standards every 5 years to ensure they are always based on the best available science. In these reviews, EPA, in consultation with an *independent* expert scientific review board, evaluated the latest scientific studies and research to determine whether the existing standards protect public health with an adequate margin of safety or need to be revised.

The Clean Water Act (CWA)

Originally enacted in 1972, this Act envisioned recreational use of the Nation's waterways by 1983 and pollution discharges halted by 1985. Obviously, these goals were not accomplished. The law continues to promote clean water by supporting construction of sewage treatment facilities (which are currently bearing a heavy burden in processing pollutants); supporting the preparation of water quality plans encompassing the entire Nation; and setting up a permit system restricting the amount and type of pollutants that can be discharged into the Nation's waterways. Modest fines may be imposed for illegal spills. The law is primarily designed to address point sources of pollution, paying far less attention to non-point sources such as agricultural runoff (currently estimated to be responsible for 65% of stream pollution).

The Safe Drinking Water Act

The Safe Drinking Water Act was enacted in 1974, specifically to protect the public water supplies from contamination by mandating water testing, denying Federal funds to projects that threaten critical water supplies, and requiring States to submit plans to protect public wells from contamination.

The law also has a “Right to Know” provision in which the public must be informed if certain contaminants are present in drinking water above Maximum Contamination Levels (MCLs) set by the EPA. MCLs are contaminant-specific, enforceable standards set for contaminants that EPA has determined have an adverse effect on human health above certain levels. MCLs are often used as a basis for developing groundwater protection and cleanup standards at RCRA corrective action sites.

RESPONSIBILITIES OF KEY FEDERAL AGENCIES

The Federal Emergency Management Agency (FEMA)

FEMA is responsible for coordinating all civil emergency planning, management, mitigation, and assistance functions of the Federal Government. Under SARA’s Title III, FEMA is the primary Federal agency responsible for planning and related training for hazardous materials emergency management. This authority encompasses accidents at manufacturing, processing, storage, and disposal facilities, as well as hazardous materials in transit by highways, on water, by rail, and by air.

FEMA provides resource information and technical and financial assistance to States for developing emergency plans for hazardous materials accidents and other types of emergencies, and assists State and local governments in hazardous materials training. FEMA also assists States and communities by interpreting Federal planning guidance, providing advice on plan preparation, and reviewing completed plans. FEMA Regional staff are available to provide this support. When emergency exercises are conducted, FEMA Regional officials provide support by reviewing the plans, observing exercises to test the plans, and providing technical evaluation of how well the plans worked.

Finally, FEMA is available to provide additional financial relief in the event of an incident so serious that both local and State funds prove inadequate.

The Environmental Protection Agency (EPA)

The primary mission of the EPA is to protect and enhance our environment. EPA is the lead agency responsible for carrying out Title III reporting requirements. Under Superfund and other related laws, it is the agency primarily responsible for hazardous waste site operations and Superfund site cleanup activities. EPA also conducts technical and environmental training programs related to hazardous materials, and chairs the 14-agency NRT. At the request of community officials, EPA can provide technical expertise on the full range of environmental contamination issues.

The EPA is responsible for monitoring hazardous waste site operations and cleanup activities, and has the lead responsibility for many Title III activities.

The Department of Transportation (DOT)

DOT establishes the Nation’s overall transportation policy. It bears the primary responsibility for issuing standards and regulations relating to the transportation of hazardous materials from State to State nationwide. (DOT regulates the shipment of hazardous materials *within* the United States, and between Canada, and Mexico in and out of the United States, as well as international transportation of these materials.) DOT is heavily involved in identifying safer modes of hazardous materials transport, and has significant regulatory, research and development, and training functions in this area. DOT trains and inspects carriers and shippers of hazardous materials to ensure that they are in full compliance with regulatory guidelines.

The Department of Energy (DOE)

DOE provides the framework for a comprehensive and balanced National energy plan through the coordination and administration of the energy functions of the Federal government. Its primary responsibilities in the

hazardous materials arena involve radioactive waste generated by the nuclear weapons program or by nuclear reactors, which supply energy.

DOE provides assistance in the removal and disposal of radioactive contamination, as well as in identifying the source and extent of radioactive releases. In addition, DOE conducts hazardous materials training workshops throughout the country.

The Department of Defense (DOD)

DOD manufactures, tests, and discards the full range of hazardous materials. Military installations are also a potential source of expertise on hazardous materials for local governments.

DOD is responsible for maintaining manpower, equipment, and other resources for potential use in military conflict. DOD manufactures, stores, and discards the full range of hazardous materials, and is also one of the Nation's largest shippers of such materials. The Agency also conducts hazardous materials courses at five military installations, primarily for military personnel responsible for the handling and control of such substances. DOD laboratories and bases can be a source of expertise, equipment, and supplies for use in local chemical emergencies.

The Department of Labor (DOL)

The purpose of the Department of Labor is to foster, promote, and develop the welfare of the wage earners of the United States, to improve their working conditions, and to advance their opportunities for profitable employment in carrying out this mission.

OSHA has responsibility for establishing rules and standards to ensure that occupational environments are safe for workers. As part of this function, OSHA regulates employee safety and health at hazardous waste operations, in work environments where hazardous materials are present (primarily chemical industries), or during emergency response to incidents involving hazardous materials.

THE EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT (TITLE III)

What is Title III?

On October 17, 1986, the Superfund Amendments and Reauthorization Act of 1986, also known as SARA, was signed into law. The third part of SARA is Title III: the Emergency Planning and Community Right-to-Know Act. Prior to this law, citizens had little or no legal backing in their attempts to obtain information about toxic releases from facilities in their own communities. As the public and its Congressional representatives became more aware of the increasing use of hazardous materials and the corresponding increase in the number of accidents, pressure grew for better information at the local level.

The single incident that is credited with raising the level of concern to the point that such a law could be passed occurred in Bhopal, India, where a release of methyl isocyanate killed at least 1,700 people and injured thousands more. To help reduce the likelihood that such a tragedy would occur in the United States, and simultaneously increase a local government's ability to anticipate and plan for such a major emergency if one were to occur, Title III seeks to provide reliable information to those who would be most affected by an accidental release of this kind: the communities located in the immediate area of industrial plants.

As used in SARA, the term "hazardous materials" refers to substances transported, used, and stored at petroleum refineries and natural gas facilities; hazardous chemicals such as PCBs and trichloroethylene (dry cleaning chemicals); acutely toxic chemicals; and fumes and dust from metals such as arsenic, lead, and cadmium. For the first time, the law even requires the agricultural industry to report production, use, storage, or release of certain chemicals. EPA maintains an updated list that includes more than 300 extremely hazardous

substances (EHS), selected on the basis of their ability to pose an *immediate* threat to life and health. These EHS chemicals have been involved in some of the most serious accidents that have occurred in the United States to date.

Title III establishes requirements for Federal, State, and local governments and industry regarding local emergency planning and reporting on hazardous materials. It also provides a comprehensive framework within which Federal, State, and local governments can work together with industry to reduce risks.

Title III has four major sections:

- Emergency planning
- Emergency notification
- Community right-to-know reporting requirements
- Toxic chemical release and emissions reporting

The four sections of Title III will be discussed in turn.

1. Emergency Planning

Title III requires that the governor of each State designate a State Emergency Response Commission (SERC). This commission generally includes representatives of public agencies and departments with expertise in environmental issues, natural resources, emergency services, public health, occupational safety, and transportation. Various public and private sector groups and associations with an interest in Title III issues may also be included in the State commission.

The SERC designates local emergency planning districts and appoints Local Emergency Planning Committees (LEPCs) within each of these districts. The SERC is responsible for supervising and coordinating the activities of the LEPCs, for establishing procedures for receiving and processing public requests for information collected under other sections of Title III, and for reviewing plans generated by the LEPCs.

The LEPC's primary responsibility is to develop a local emergency response plan.

Each LEPC is expected to include elected State and local officials; police, fire, civil defense, public health, environmental, hospital, and transportation officials; representatives of facilities subject to the emergency planning requirements; community groups; and the media. Public notice is given of meetings and activities, and procedures are established for handling public requests for information. Citizens who want to help their community prevent and plan for hazardous materials emergencies should contact the LEPC.

Local emergency response plan

The LEPC is responsible for developing and maintaining a local emergency response plan that will ensure a quick and effective response to a chemical emergency. These plans provide a range of information to facilitate an effective and efficient course of action if a chemical release were to occur. Issues such as which facilities use chemicals, where the chemicals are stored, and what routes are the quickest for first-responders and evacuation are addressed by the emergency plan.

SERC is responsible for coordinating emergency plans among districts

Delegating this responsibility to the LEPC ensures that communities will develop personalized, need-specific, and effective emergency plans. Many LEPCs contact neighboring LEPCs to coordinate procedures and

resources to ensure the most effective emergency response. Ultimately, the SERC is responsible for coordinating emergency plans among districts.

EPA suggests that LEPCs test their plans to ensure effectiveness

Developing the emergency plan is a continuing process. The reporting requirements of Title III are ongoing and provide LEPCs with up-to-date information about chemical hazards. The LEPC must review the plan at least annually, or more frequently as changed circumstances in the community or at any facility may require. Furthermore, EPA suggests that LEPCs test their plans to ensure effectiveness.

Community actively involved in the emergency planning process

The LEPC must make information and submitted reports publicly available during normal business hours. The LEPC must also notify the public of the availability of Title III information, such as the emergency plan, activities, and meetings, and provide opportunities for public comment. Getting the community actively involved in the emergency planning process offers several benefits: greater community awareness of the local emergency plan, development of an emergency plan that accurately addresses the community's needs and concerns, and active involvement by the community, which may serve as a catalyst for increased funding by local government entities.

Strategies for preventing or mitigating chemical emergencies

In developing their plans, local committees analyze local risks and evaluate resources available to their area that could help them to prepare for and respond to a hazardous materials accident. A progressive LEPC may also consider strategies for *preventing* or *mitigating* chemical emergencies—that is, identifying ways to keep emergencies from happening, or of making their consequences less severe.

Examples of this include the installation of sprinklers in a chemical plant or the routing of certain hazardous materials to be carried away from residential areas.

The contingency plan generated by the LEPC must include a list of hazardous materials facilities and the routes they use to transport listed materials, emergency response procedures, and evacuation plans. It is reviewed by the SERC and updated annually by the LEPC. Emergency plans must focus on the list of extremely hazardous substances published by the EPA, but they are not limited to this list. Any facility that uses these substances in excess of specified "threshold" quantities is subject to emergency planning requirements.

2. Emergency Notification

This section of Title III requires an industry to notify the LEPC, the State, and the National Response Center if there is a release of a listed hazardous substance that exceeds a certain quantity, as specified in the November 17, 1986, issue of the *Federal Register*.

Title III of SARA provides a framework for Federal, State, and local governments to work with industry to reduce hazardous materials risks and to develop comprehensive emergency response plans.

The emergency notification must include the name of the chemical released, the quantity involved, how and into what it was released, and the health risks from exposure. This section of Title III also requires the industry to submit reports to the State and LEPC after the event that explains what actions were taken to control the release, and to provide more data on health risks and any medical attention required for victims.

This part of the law will allow communities to learn if significant releases from hazardous materials facilities are occurring or are likely to occur, and whether state-of-the-art technology is being used by the plants to protect nearby communities from unnecessary adverse health effects.

3. Community Right-to-Know Reporting Requirements

This is a particularly important part of Title III, because it grants citizens the *right* to obtain information on hazardous materials in their community. Environmental, health, and labor groups have worked hard for passage of this law.

This section of Title III requires facilities to submit *either* a form called a Safety Data Sheet (SDS) *or* lists of certain hazardous chemicals on sites in amounts over threshold quantities to the LEPC, the SERC, and the local fire department. SDS formats vary considerably among providers, but all include vital information about the properties and effects of the hazardous material involved. Industry facilities must also submit inventories of the amounts and locations of these chemicals in their plants. OSHA and EPA rules specify which chemicals must be reported and at what quantity.

4. Toxic Chemical Release and Emissions Inventory Reporting

This section of Title III requires hazardous materials facilities to inform the public about routine, day-to-day releases of chemicals. The intent is to provide information on the extent of the cumulative toxic chemical burden on the environment.

More than 300 chemicals listed by EPA must be reported if they are emitted regularly. Facilities must submit toxic chemical release forms for these chemicals. This requirement applies to facilities that have 10 or more full-time employees and that are in certain types of specified industries. Facilities that use less than 10,000 pounds of a listed chemical each year are currently exempted.

Citizens should have a basic awareness of the procedures spelled out in their local plans for protecting public safety in the event of a hazardous materials incident. How would a citizen be told that an incident had occurred, for example? Or if they were living near an area where an incident is considered more probable than at other locations?

How to Use Title III Legislation to Protect Yourself from Hazardous Materials

The Emergency Planning and Community Right-to-Know Act (Title III of SARA) was written with concern for the individual citizen. It is based on the principle that the more citizens know about hazardous materials in their communities, the more effective they can be in improving public safety. The law requires industry to make information available on potential chemical hazards. There are several ways a citizen can obtain and use this information to protect themselves during a hazardous materials incident or hazardous substance release.

- Make sure that your LEPC has been formed, and attend its meetings. Volunteer to serve on it as a citizen representative. Obtain information on the LEPC by calling the SERC, county health department, fire department, or emergency management agency.
- Review and comment on the emergency response plan, and ask questions about how the emergency procedures affect you, your family, and your place of business.
- Ask for information from the LEPC or SERC about hazardous materials in the community. Ask the LEPC what local facilities are doing to reduce the dangers from these materials.
- Use the National Toxic Release Inventory database to obtain information on routine releases of toxic chemicals in the community. If the LEPC does not have this information, you or your LEPC can get it from a library, the SERC, or the EPA Reporting Center in Washington, DC. A citizen with a home computer and a modem can access the national database on the National Library of Medicine’s

computer system for a nominal fee. (For additional information on accessible computer databases, see “Computer Networks Open to the Public” in the Resources section later in this course.)

- Call or visit your LEPC and ask if they have complied with the LEPC reporting requirements.

REDUCING RISKS FROM HAZARDOUS MATERIALS RELEASES

Federal Role

The Federal role in reducing public risk from exposure to hazardous materials includes technical guidance, legislated standards and procedures, and providing States with access to data about chemical releases and training. FEMA has the lead role for coordinating civil emergency response planning and disaster response. FEMA’s hazardous materials program is largely one of providing guidance, technical assistance, information, and training. For Title III reporting and enforcement activities, EPA is the key Federal agency: it maintains the national toxic chemical inventory, publishes regulations concerning hazardous materials, reports on the status of various emergency systems, conducts training, and assists with hazardous materials site identification and investigation.

State Role

Under Title III, each State governor must appoint a SERC. These commissions provide leadership to ensure that an emergency planning and implementation structure is developed at the local level, and review plans developed by communities. In addition, the SERCs provide training and technical assistance to local communities. In the case of an emergency which is too expensive for a local community to handle, the State may contribute resources. In general, the burden of funding for training and information management for Title III recordkeeping falls at the State and local level.

States may, of course, elect to exceed Federal requirements for hazardous materials management. For example, more than 30 States have enacted Right-to-Know laws similar to the Federal one, some of which cover more chemicals and more potentially hazardous situations.

Federal controls on operating hazardous materials waste treatment, storage, and disposal facilities contain many exceptions. Some States have added specific requirements to address these “loopholes” and increase their protection from particular hazards. For example, California prohibits discharge from an underground injection well if it is within one-half mile of a drinking water supply. States have broad authority to control how hazardous materials are stored, used, transported, and disposed of within their borders. For instance, States establish zoning control policies that determine where chemical plants may be located, and control site locations for hazardous waste facilities and landfills. Pennsylvania and Connecticut currently have laws that deny permits to companies found in violation of environmental protection laws. Regulating transportation of hazardous materials within State borders is also a State responsibility.

Local Role

Local communities play a key role in the system set up by Congress under Title III to inform and protect citizens from hazardous materials. Local communities, represented by LEPCs, are responsible for developing an emergency plan for disasters involving hazardous substances. This includes identifying the resources that would be available in an emergency (such as trained personnel and specialized equipment) and ensuring planning coordination among responding groups. The LEPC also collects and stores information from hazardous materials facilities, and makes that information available to the public.

Local officials have the lead role in responding to hazardous materials emergencies; usually, management of incidents is the specific responsibility of the local fire department. Communities also regulate the disposal of hazardous waste and inspect hazardous materials storage areas for violations of local codes. Many communities also regulate hazardous materials traffic through specific zoning requirements.

The Role of Industry

Under Title III, facilities that use hazardous materials are responsible for complying with packaging, labeling, storage, transportation, and workplace safety regulations. Additionally, industry is required to furnish information about the quantities and health effects of materials used at the plant, and to promptly notify local and State officials whenever a significant release of hazardous materials occurs. Small businesses and farmers are also included under the Title III umbrella if they use “extremely hazardous substances” in reportable quantities, as set by EPA rulemaking for the EHS list.

Reporting Releases Above a Reportable Quantity (RQ)

Any person in charge of a vessel or an offshore or an onshore facility shall, as soon as he or she has knowledge of any release (other than a Federally permitted release or application of a pesticide) of a hazardous substance from such vessel or facility in a quantity equal to or exceeding the reportable quantity determined by the EPA in any 24-hour period, immediately notify the National Response Center at (800) 424-8802, in Washington, DC, and the LEPC and the SERC of such release.

The Chemical Manufacturers Association (CMA) has set up a voluntary, industry-wide *Community Awareness and Emergency Response Program (CAER)*. This program encourages plant managers to listen to community concerns, participate in planning, and explain their plant’s operations and policies. By working with the community to ensure safe handling, storage, transportation, and disposal of dangerous chemicals, industry can protect itself, as well as the public, from the high costs of chemical accidents.

WHEN THE LAWS ARE NOT OBEYED

If you believe a problem exists in your community that should be addressed by an existing law, begin with research on the law and its specific provisions, working through the responsible government agency. (For fixed sites, your first stop is always your LEPC.) Many Federal and State agencies maintain hotlines for citizen inquiries and reports of violations. Title III has specific provisions that enable citizens to bring legal actions against facilities or industries that do not comply with its provisions. Find out as much as you can about the problem and report it to the responsible agency, citing the specific provisions of the law you believe are violated and stating whatever evidence you have. If possible, work with a public interest group that has experience in tackling pollution problems.

Litigation is a slow and costly process, and should be used only after discussions with the regulated facility and the enforcing agency have proven fruitless. However, lawsuits can force a government agency to act if it is shown to be:

- Violating normal agency procedures
- Violating a substantive statute or regulation
- Abusing its discretionary authority (that is, making a decision based on inadequate information or inappropriate standards)
- Violating legally required decision-making procedures
- Violating environmental impact review requirements

What about legal action to force polluters to pay cleanup costs? Traditionally, monetary awards for damages are not by any means sufficient to pay cleanup costs. Approaches differ in “balancing equities,” the relative interests of the complainant and the polluter. It is extremely important to know the specific provisions of environmental law for your particular State.

Under both Federal and State environmental laws, you have the right to file a suit for an injunction (halt) to pollution if you can show that the defendant is in violation of the State law, or (in some States) if it is creating an

imminent danger. However, it is only in extreme cases, when the potential damage is clear and irreparable, that a judge is likely to take short-term action before the full-scale legal process has come to its conclusion.

Summary

The Nation's regulation of hazardous materials is accomplished through several key pieces of legislation, each of which addresses a specific aspect of the problem. This legislation charges numerous Federal agencies with responsibilities to protect our environment and the public health, each agency bringing its expertise in a specific area to bear on particular areas of concern. These laws and agencies support State and local governments in addressing their hazardous materials problems, but leave a great deal of responsibility to lower levels of government. By becoming familiar with key Federal, State, and local legislation, you can recognize possible violations of the law and join others in working for full enforcement of its provisions.

HAZARDOUS MATERIALS IDENTIFICATION SYSTEMS

Objectives

In this unit, you will learn about:

- The National Fire Protection Association's 704 System
- Transportation of Hazardous Materials under the Department of Transportation's System
- The Emergency Response Guidebook
- Hazards associated with toxic industrial chemicals (TICs)
- Military designation of prominent chemical warfare agents (CWAs)

Introduction

Hazardous materials are frequently stored and transported in large quantities. An accidental release of these materials presents a potential danger to the public and the environment. Such an incident can be managed more expeditiously when the hazardous materials are specifically identified and characterized. Unfortunately, the contents of storage tanks and trucks may not be specifically or properly identified. Records or shipping papers may be inaccessible. Even with such information, an experienced person is needed to define the hazards and the gravity of the situation.

The immediate need for information concerning a hazardous material during an incident is vital. Therefore, two hazardous materials identification systems have been developed.

Both systems help first responders to deal with the hazardous materials present quickly and safely. Both were devised for personnel with no real training in chemistry.

- The first is the National Fire Protection Association (NFPA) 704 System, which is used on storage tanks and smaller containers (fixed facilities).
- The second system is used exclusively on containers and tanks transported in interstate commerce. The U.S. Department of Transportation (DOT) is responsible for this system. Information concerning chemical properties and hazards in transport is displayed by way of placards and labels. The DOT regulation covering this system is the Code of Federal Regulations 49 (CFR 49).

The National Fire Protection Association's 704 System

The National Fire Protection Association (NFPA) has devised a voluntary marking system to alert firefighters to the characteristics of hazardous materials stored in stationary tanks and facilities. This system, known as NFPA 704, can also assist citizens visiting a site in identifying the hazard presented by the stored substance. Use of the system is voluntary, unless specified by local codes.

NFPA 704 is a standardized system, which uses numbers and colors on a sign to indicate the basic hazards of a specific material being stored in large containers. Health, flammability, reactivity, and special hazards are identified and rated on a scale of 4 to 0 depending on the degree of hazard presented by the material (Figure 2-1).

The rating of individual chemicals can be found in the NFPA "Guide to Hazardous Materials." Other references such as the National Safety Council's "Fundamentals of Industrial Hygiene" contain the NFPA ratings for specific materials. Such information can be used not only during an emergency, but also when long-term remedial activities require extensive evaluation.

The NFPA 704 system for hazardous materials was devised to provide at-a-glance information to response personnel on how a substance could be expected to react in the event of an emergency.

The NFPA 704 label is diamond-shaped, and is divided into four parts, or quadrants.

The left quadrant is *blue*, and contains a numerical rating of the substance's health hazard. Ratings are made on a scale of 4 to 0, with a rating of 4 indicating a severe hazard that a very short exposure could cause serious injury or death. A zero, or no code at all in this quarter, means that no unusual hazard would result from the exposure.

The top quadrant of the NFPA symbol contains the substance's fire hazard rating. As you might expect, this quadrant is *red*. Again, number codes in this quadrant range from 4 to 0, with 3 representing a serious fire hazard. See Figure 2-1.

The NFPA label's right quadrant, colored *yellow*, indicates the substance's likelihood to explode or react. As with the health and fire hazard quadrants, ratings from 4 to 0 are used to indicate the degree of hazard. If a 2 appears in this section, the chemical is moderately unstable, and even under *NORMAL* conditions may explode or react violently. A zero in this quadrant indicates that the material is considered to be stable even in the event of a fire.

The bottom quadrant is *white*, and contains information about any special hazards that may apply. There are three possible codes for the bottom quarter of the NFPA symbol:

- OXY means this material is an oxidizer. It can easily release oxygen to create or worsen a fire or explosion hazard.
- The symbol W indicates a material that reacts with water to release a gas that is either flammable or hazardous to health. See Figure 2-2.
- If the material is radioactive, the usual tri-blade "propeller" symbol for radioactivity will appear.

It is important to remember that the system is chemical-specific. *No* chemical identification system can accurately assess the synergistic effects of one chemical combining with another, or the possible effects of combining unknown amounts of several chemicals.

The Department of Transportation (DOT), in cooperation with the United Nations, has devised an international classification system, which tags hazardous materials in transit with color-coded, symbolic warning placards.

The Department of Transportation’s (DOT's) Identification System

Hazardous materials are transported daily in the United States by air, water, road, rail, and pipeline. Of the 1.5 billion tons of hazardous materials transported in this country each year, more than half move by tankers along the Nation’s highways.

Highway transport of hazardous materials is so common that it is doubtful that any area of the country could be considered free of the threat of an accident. Sound State and local policies to regulate this transportation safely, and to ensure that firefighters and others who would respond to an incident are well prepared, are essential.

The DOT’s Hazardous Materials Transportation Administration regulates more than 1,700 hazardous materials. The regulation requires labels on small containers and placards on tanks and trailers (Figure 2-3). The placards and labels indicate the most serious hazard presented by the cargo being transported.

This code, called a North American (NA) or United Nations (UN) ID number, is located on placards or panels placed on all four sides of the cargo tank or rail car. If you are concerned about what sort of hazardous materials are passing through your community, you can use these UN ID numbers to categorize the transport vehicles by load. Interpretations of these codes are found in DOT’s *Emergency Response Guidebook*, which may be obtained through DOT. You can also contact your LEPC to determine the stationary locations of chemicals in your area, and ask the companies involved regarding the origination and destination of chemicals stored there.

DOT Hazard Classification System

The hazard class of dangerous goods is indicated either by its hazard class (or division) number or name. For a placard corresponding to the primary hazard class of a material, the hazard class or division number must be displayed in the lower corner of the placard. However, no hazard class or division number may be displayed on a placard representing the subsidiary hazard of a material. For other than Class 7 or the OXYGEN placard, text indicating a hazard (for example, “CORROSIVE”) is not required. Text is shown only in the United States. The hazard class or division number must appear on the shipping document after each shipping name. The DOT hazard classes and divisions are as follows:

Hazard Class 1

Class 1	**Explosives**
Division 1.1	Explosives with a mass explosion hazard
Division 1.2	Explosives with a projection hazard
Division 1.3	Explosives with predominantly a fire hazard
Division 1.4	Explosives with no significant blast hazard
Division 1.5	Very insensitive explosives; blasting agents
Division 1.6	Extremely insensitive detonating articles

For the purposes of this discussion, an explosive means any substance or article, including a device, which is designed to function by explosion (i.e., an extremely rapid release of gas and heat) or which, by chemical reaction within itself, is able to function in a similar manner even if not designed to function by explosion, unless the substance or article is otherwise classed under the provisions of this subchapter. The term includes a pyrotechnic substance or article, unless the substance or article is otherwise classed under the provisions of this subchapter.

Explosives in Class 1 are divided into six divisions as follows:

- Division 1.1 consists of explosives that have a mass explosion hazard. A mass explosion is one that affects almost the entire load instantaneously.
- Division 1.2 consists of explosives that have a projection hazard but not a mass explosion hazard.
- Division 1.3 consists of explosives that have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard.
- Division 1.4 consists of explosives that present a minor explosion hazard. The explosive effects are largely confined to the package and no projection of fragments of appreciable size or range is to be expected. An external fire must not cause virtually instantaneous explosion of almost the entire contents of the package.
- Division 1.5 consists of very insensitive explosives. This division is comprised of substances that have a mass explosion hazard but are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal conditions of transport.
- Division 1.6 consists of extremely insensitive articles, which do not have a mass explosive hazard. This division is comprised of articles which contain only extremely insensitive detonating substances and which demonstrate a negligible probability of accidental initiation or propagation.

Hazard Class 2

Class 2	**Gases**
Division 2.1	Flammable gases
Division 2.2	Non-flammable, non-toxic* compressed gases
Division 2.3	Gases toxic* by inhalation
Division 2.4	Corrosive gases (Canada)

- Division 2.1 Flammable compressed gas. Compressed gases are labeled according to their flammability. A compressed gas is defined as a material or mixture that has in its container either an absolute pressure exceeding 40 PSI at 70 degrees F, an absolute pressure exceeding 104 PSI at 130 degrees F, or both; or any liquid flammable material that has a Reid vapor pressure exceeding 40 PSI absolute at 100 degrees F.
- Division 2.2 Non-flammable compressed gas.
- Division 2.3 Poisonous gas.
- Division 2.4 Corrosive gas (Canadian).

Hazard Class 3

Class 3	**Flammable liquids, Combustible liquids [U.S.]**
No Divisions	

- Flammable Liquids. Flammable liquid is one that evolves flammable vapors in air at a temperature of 140 degrees F or below as determined by a specific method.
- Combustible liquids. A combustible liquid is one that evolves combustible vapors in air at a temperature between 140 degrees F and 200 degrees F as determined by a specific method.

Hazard Class 4

Class 4	**Flammable solids, Spontaneously combustible materials, and Dangerous when wet materials**
Division 4.1	Flammable solids
Division 4.2	Spontaneously combustible materials

Division 4.3	Dangerous when wet materials

- Division 4.1 Flammable solids. Flammable solids include materials other than explosives that are likely to cause fire by self-ignition through friction, absorption of moisture, spontaneous chemical changes, or as a result of heating.
- Division 4.2 Spontaneously combustible materials.
- Division 4.3 Dangerous when wet materials.

Hazard Class 5

Class 5	**Oxidizers and Organic peroxides**
Division 5.1	Oxidizers
Division 5.2	Organic peroxides

- Division 5.1 Oxidizers. Oxidizing materials are substances that yield oxygen readily to stimulate the combustion of organic materials.
- Division 5.2 Organic peroxide.

Hazard Class 6

Class 6	**Toxic* materials and Infectious substances**
Division 6.1	Toxic* materials
Division 6.2	Infectious substances

- Division 6.1 Toxic materials. These include chemical warfare agents.
- Division 6.2 Infectious substance (etiologic or disease-causing) agents.

* The words “poison” or “poisonous” are synonymous with the word “toxic.”

Hazard Class 7

Class 7	**Radioactive Materials**
No Divisions	

- Radioactive. Radioactive materials are particles or radioactive waves which are capable of killing or damaging cells. Radioactive materials have three labels: White I Label, Yellow II and III Labels.

Hazard Class 8

Class 8	**Corrosive materials**
No Divisions	

- Corrosives. Corrosive materials are liquids or solids that are capable of causing visible destruction or irreversible alteration in metals or human skin tissue at the site of contact.

Hazard Class 9

Class 9	Miscellaneous dangerous goods
Division 9.1	Miscellaneous dangerous goods (Canada)
Division 9.2	Environmentally hazardous substances (Canada)
Division 9.3	Dangerous wastes (Canada)

- Miscellaneous hazardous materials.
- Environmentally hazardous substances, liquids, and solids.
- Dangerous wastes (Canada).

Shipping Documents (Papers)

The shipping document provides vital information when responding to a hazardous materials/dangerous goods incident. The shipping document contains information needed to identify the materials involved. Use this information to initiate protective actions for your own safety and the safety of the public. The shipping document contains the proper shipping name, the hazard class or division of the material(s), ID number and, where appropriate, the Packing Group number. In addition, there must be information available that describes the hazards of the material that can be used in the mitigation of an incident. The information must be entered on or be with the shipping document. See Figure 2-4 on the next page.

This requirement may be satisfied by attaching a guide from the ERG to the shipping document, or by having the entire guidebook available for ready reference. Shipping documents are required for most dangerous goods in transportation. Shipping documents are kept in the cab of the motor vehicle, in the possession of the train crewmember, in a holder on the bridge of a vessel, or in the possession of the aircraft’s captain.

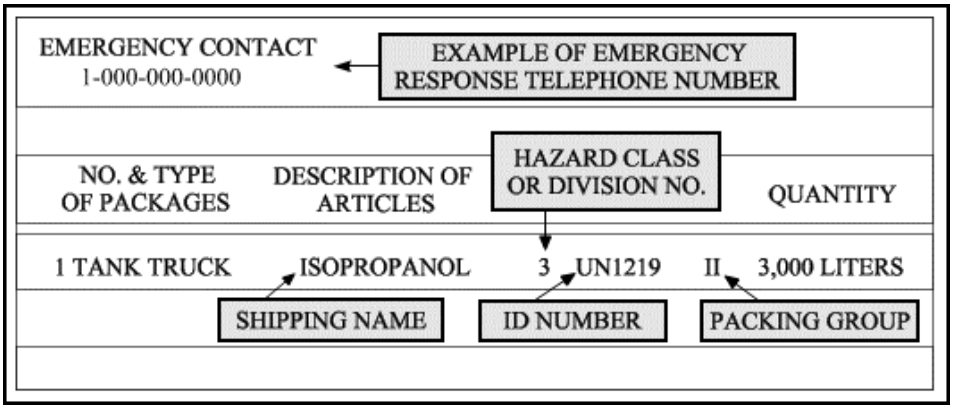


Figure 2-4, Sample Shipping Paper Entry

Example of Placard and Panel with ID Number

The four-digit ID Number may be shown on the diamond-shaped placard or on an adjacent orange panel displayed next to the placard on the ends and sides of a cargo tank, vehicle, or rail car. See Figure 2-5 below. For more labeling and placarding information, consult 49 CFR 172.400 and 500.

A Numbered Placard

Figure 2-5, Placard

or

A Placard and an Orange Panel

Placard and Panel

For the purposes of this unit, the terms “shipping document/shipping paper” are synonymous; and the terms “hazardous materials/dangerous goods” are used interchangeably. Shipping papers must accompany every HazMat shipment and be available for inspection. Drivers must keep shipping papers on the seat next to them within arm’s reach or in the driver’s side door. Shipping papers describe the HazMat being transported and contain valuable information for responders in the event of an incident or accident resulting in the spill or release of these materials.

The 2004 Emergency Response Guidebook (ERG2004) was developed jointly by Transport Canada (TC), the U.S. Department of Transportation (DOT), the Secretariat of Transport and Communications of Mexico (SCT), and with the collaboration of CIQUIME (Centro de Información Química para Emergencias) of Argentina, for use by firefighters, police, and other emergency services personnel who may be the first to arrive at the scene of a transportation incident involving dangerous goods and HazMat (see Figure 2-6). **It is primarily a guide to aid “first responders” in quickly identifying the specific or generic hazards of the material(s) involved in the incident, and protecting themselves and the general public during the initial response phase of the incident.**

Initial Response Phase

The “initial response phase” is that period following arrival at the scene of an incident during which the presence and/or identification of dangerous goods is confirmed, protective actions and area securement are

initiated, and assistance of qualified personnel is requested. It is not intended to provide information on the **physical or chemical properties of dangerous goods**.

The ERG is designed to assist responders in making initial decisions upon arriving at the scene of a dangerous goods incident. It should not be considered as a substitute for emergency response training, knowledge, or sound judgment. ERG does not address all possible circumstances that may be associated with a dangerous goods incident. It is primarily designed for use at a dangerous goods incident occurring on a highway or railroad. Be mindful that there may be limited value in its application at fixed facility locations.

ERG incorporates dangerous goods lists from the most recent United Nations recommendations as well as from other international and national regulations. Explosives are not listed individually by either proper shipping name or ID Number. They do, however, appear under the general heading “Explosives” on the first page of the ID Number index (yellow-bordered pages) and alphabetically in the Name of Material index (blue-bordered pages). Also, the letter **“P”** following the guide number in the yellow-bordered and blue-bordered pages identifies those materials which present a polymerization hazard under certain conditions, for example: Acrolein, stabilized **131P**.

First Responders

First responders at the scene of a dangerous goods or HazMat incident should seek additional specific information about any material in question as soon as possible. The information received by contacting the appropriate emergency response agency, the emergency response number on the shipping document, or by consulting the information on or accompanying the shipping document, may be more specific and accurate than this guidebook in providing guidance for the materials involved.

BECOME FAMILIAR WITH THIS GUIDEBOOK BEFORE USING IT DURING AN EMERGENCY! In the U.S., according to the requirements of the U.S. Department of Labor’s Occupational Safety and Health Administration (OSHA, 29 CFR 1910.120), and regulations issued by the U.S. Environmental Protection Agency (EPA, 40 CFR Part 311), first responders must be trained regarding the use of this ERG. The ERG can be obtained from the DOT for “first responders” or from private vendors for less than $4.00 a copy.

Most Transportation Accidents

Most transportation accidents involve *flammable or combustible liquids (hazard class 3)*. These materials are also the most transported by volume. They are substances that have low flash points, and include the frequently transported fuel, gasoline. The *flash point* of a liquid is the point at which sufficient vapor is produced to cause it to flash in the presence of an ignition source. The *lower* the flash point, the more volatile the substance.

The second most frequent type of incident involves *corrosives (hazard class 8)*, defined by DOT as “any liquid or solid that can destroy human skin tissue, or any liquid that has a severe corrosion rate on steel.” This class includes acids (such as sulfuric acid, used in chemical processing; and nitric acid, commonly used in the manufacture of fertilizers, explosives, and synthetic fibers) and bases (such as sodium hydroxide, used to purify petroleum products and in the manufacture of soap, pulp, and paper).

Appropriately Labeled and Placarded

Hazardous materials containers in transportation are required to be appropriately labeled and the vehicle placarded when the hazardous materials’ gross aggregate weight exceeds 1001 pounds; or they are classified as Table 1 materials. (Table 1 materials are required to have placards regardless of the amount being transported.) Labeling and placarding information can be found in 49 CFR 172.400, and 172.500 respectively.

How to Lessen the Impact of Accidents

How can your community lessen the impact of a serious accident involving a hazardous material? One good way is to be sure that existing regulations are enforced. This may require a *substantial* commitment in human resources. Another community responsibility is to ensure that the area has a good emergency plan for handling this type of incident, and that confusion over jurisdiction ("who's in charge?" and "who's in charge of what?") will not hinder an effective response. Hazardous materials routing through a community is designed to lessen the impact of a HMI.

Toxic Industrial Chemicals (TICs)

The term "toxic industrial chemical" refers to a variety of chemicals used by industry in various processes, created by industry for various purposes, or released to the soil, to water, or to the air by industry as byproducts of either. Any chemical can be toxic or harmful in some dose, and the most dangerous of TICs are those that have harmful effects in relatively low doses when in air or in contact with skin or eyes.

The potential exists for first responders and surrounding populations located downwind or near such an industry to be exposed to levels that may impact their health. (See Figure 2-7 below.) Toxic industrial chemicals (TIC) may pose a high risk when they are stored in large quantities in one location. An act of sabotage or an accident can result in a large release of liquids, which could volatize and be breathed in by those nearby, or travel some distance downwind. An example would be a release of chlorine gas from a large tank into the surrounding air. Such a release could cause injuries and deaths into the thousands.

TICs may pose a terrorist threat as a weapon of mass destruction (WMD). Rail cars, tanker trucks, and fixed facilities are considered by some authorities as "soft targets" and could be high on the terrorist's hit list. (See Figure 2-8 below.) Described on the next page are a few TICs, commonly called chemical warfare agents (CWA). The ability to detect an immediate hazard and take corrective action can save your life. Increased security measures are being implemented around these sites which could be "targets of opportunity."

Excellent data on rail traffic can be obtained from the Federal Railroad Administration (FRA) and the individual railway lines serving your area. Many individual rail lines can provide detailed information on the hazardous materials shipments in your area.

In addition, State regulatory agencies can tell you which hazardous materials travel most frequently by rail in your State.

Phosgene and Chlorine

Phosgene (CG) and chlorine (CL) are lung-damaging agents. They are the first chemical warfare agents (CWA) used and are also classified as TICs. They are shipped via rail cars and tanker trucks daily throughout the United States. Phosgene and chlorine cause irritation of the bronchi, trachea, larynx, pharynx, and nose, and may contribute to the sensation of choking. Initial symptoms include eye irritation, burning, pulmonary irritation, running nose (rhinorrhea), cough, dyspnea, chest tightness, reddening of the skin (erythema), and lung damage (pulmonary edema).

Decontaminate (remove clothing and wash your entire body with soap and water) and do not exert yourself if you have been exposed to one of these agents.

Cyanides

Cyanides are classified as blood agents. They are called blood agents because they produce their effects by interfering with oxygen utilization at the cellular level. The Chemical Warfare Agents (CWA) that could be possible terrorist's weapons are: **Hydrogen Cyanide and Cyanogen Chloride**.

Their **Military Designations** are: AC (hydrocyanic acid) and CK (cyanogen chloride). Both of these substances are liquids, but they vaporize (evaporate) at about 73°F and 23°C, so they will be in a gaseous form under standard temperature and pressure (STP). AC has an odor of bitter almonds; CK is pungent. AC vapor is lighter than air, whereas CK gas is heavier than air. Inhalation is the usual route of entry of these chemicals. Initial symptoms are rapid shallow breathing, followed by vertigo and nausea. Progressive symptoms include a decrease in respiratory rate, convulsions, cessation of breathing, and cardiac arrhythmia over 2 to 4 minutes depending on the dose and exposure time. The symptoms of cyanide poisoning include:

- Dryness and burning of the throat
- Dyspnea, or shortness of breath
- Hyperpnea, rapid shallow breathing
- Apnea, lack of breathing
- Convulsion and coma
- Cardiovascular collapse
- Death

Decontamination is usually not necessary because cyanide evaporates rapidly, but skin under cyanide-contaminated clothing should be washed with soap and water.

For water transportation facts, the Army Corps of Engineers and the U.S. Coast Guard are most likely to be of assistance, while the Federal Aviation Administration is the best source for data on air traffic. The safety of our Nation does not rest entirely with the Department of Homeland Security, but with each citizen’s vigilance and timely reporting to their local law enforcement agency any suspicious activities of any person in and around one of the possible “targets of opportunity” mentioned above. See also the National Response Center’s guidance on page B-7.

Commodity Flow Survey (CFS)

The Commodity Flow Survey (CFS) contains data on shipments by domestic establishments in manufacturing, wholesale, mining, and selected other industries. The U.S. Census Bureau, in partnership with the Bureau of Transportation Statistics of the U.S. Department of Transportation, conducts the CFS as part of the Economic Census. This information may be obtained from your LEPC. They are required to keep records of what materials are transported through their communities on a regular basis so as to plan for HazMat incidents and accidents.

Verify the date that the study was completed. Work with the LEPC to update it, if necessary. Fixed facilities receive hazardous materials by highway, ship, and rail. It is important to look at the transportation routes, number of shipments, and quantities of chemicals carried in or near your jurisdiction. DOT also requires that these transporters develop and implement Security Plans that address security risks related to the transportation of hazardous materials in commerce in accordance with 49 CFR 172.800.

Hazard Vulnerability Assessments

Knowing the kind of hazardous materials being shipped and their routes through your community can provide the information your LEPC needs to conduct hazard vulnerability assessments (HVA).

For more detailed information regarding CFS, you should visit the Bureau of Transportation Statistics of the U.S. Department of Transportation website: http://www.bts.gov.

Summary

The transportation of hazardous materials poses many challenges to the DOT, the public, and responders during a HazMat incident. The need for information regarding the product is essential for the safety of the responders and the public. As discussed, an accidental release of these materials presents a potential danger to the public and the environment. Such an incident can be managed more expeditiously when the hazardous materials are specifically identified and characterized.

The immediate need for information concerning a hazardous material during an incident is vital. Therefore, two hazardous materials identification systems have been developed.

The first system is the NFPA's 704 System, which provides immediate information on chemical hazards during a response to fixed facilities by indicating the product's health, fire, reactivity, and special hazards. This information is necessary for firefighters and HazMat responders to quickly assess the hazards posed by the materials so as to properly protect themselves from health and physical hazards.

The second system is the DOT's System for identifying, marking, labeling, and placarding HazMat during the transportation of these materials. The DOT systems can warn first responders of the worst potential hazards posed by these materials being shipped on our Nation's highways, railways, waterways, and by air. The nine hazard classes (several with divisions) are designed to break down more specifically the hazards posed by these materials in their various hazard classes.

Both systems help first responders to deal with hazardous materials quickly and safely. Both were devised for personnel with no real training in chemistry. As a citizen who may become involved in a HazMat incident, it is important for you to know the various hazard classes and what steps you should take to protect yourself and your family from their hazards.

Next, you should also know how to identify a possible terrorist's use of a chemical and biological agent. There are specific warning signs for both kinds of attacks. The informed citizen is on the watch for these signs and knows how to contact his/her local law enforcement officials when they are evident. You should now be more aware of possible target locations, which may involve toxic industrial chemicals (TICs): refineries, parked rail cars, and tanker trucks carrying flammable, corrosive, and poisonous materials.

IDENTIFYING HAZARDOUS MATERIALS

Objectives

In this unit, you will learn about:

- Clues that indicate the presence of hazardous materials
- How to identify where hazardous materials are located in your community
- Common problems and remedies for hazardous materials sites
- How to use a Safety Data Sheet (SDS) to learn more about acutely toxic substances

How do you know where hazardous materials exist in your community, and whether or not they pose a threat to public health? In some cases, lengthy testing of samples from numerous locations is required to prove that a threat does (or may) exist. In others, the danger is clear and immediate. As a concerned citizen, you need to be aware of where hazards may exist and know how to recognize and report a possible problem.

Detecting the Presence of a Hazard

The ability to detect a hazard and take corrective action can save lives. In Roseburg, Oregon, a number of years ago, several people observed a truck with an “explosives” placard on it parked by a lumberyard. Later that night, a fire broke out in a dumpster in the lumberyard, igniting the explosives. Eighteen city blocks were destroyed; 13 people were killed, and 125 others were injured. Had someone recognized that this location was a questionable one for a truck with this placard and called the police or fire department, this disaster could have been averted.

Hazardous waste sites knowingly or unknowingly affect thousands of communities across the country.

Sometimes there are *sensory* clues that indicate the presence of hazardous materials. However, sensory clues are the least dependable and potentially the most dangerous method of identification. Many materials do not have such warning signals as smell or taste. If you notice that an area has a terrible smell, your eyes water, your skin is irritated, or you begin to cough or feel nauseous, *leave* immediately and telephone your local police or fire department. If you encounter a suspicious substance, do *not* handle it yourself. You might only add to the problem.

Sometimes no sign reveals that hazardous chemicals exist beneath the surface of the ground, but occasionally unusual circumstances suggest their presence. Water that has an oily appearance, unusual algae growth, or white froth may be contaminated. Discolored soil, bare spots in the ground where vegetation has died off, dead animals, and the presence of metal drums or other specially designed containers also signal a potential problem. Should you ever actually *see* someone dumping what appears to be a hazardous material in a place not designed to receive it, note the identifying features of the person and vehicle and call the police immediately. “Midnight dumping,” whether by individuals or corporations, is a growing threat to public health that requires prompt attention.

Some State and local areas offer programs to help the public identify hazardous materials problems. The New Jersey Attorney General’s Office, for example, has a program to sensitize people to evidence of illegal waste disposal. You may wish to inquire about similar programs in your area.

Your LEPC should be able to give you precise information about where reportable quantities of extremely hazardous materials are stored or released from fixed sites in your community. (Or, you can use the Toxic Release Inventory database to find this out for yourself.) Remember, however, that *all* the hazardous materials that might pose a problem may not be known to the LEPC. Hazardous materials of a type not on the list or stored at levels just below the reportable quantity may still cause a serious incident. Undocumented waste sites or underground storage tanks may exist, or large quantities of toxic materials may be regularly transported through your community.

In identifying where hazardous materials are found in your community, consider the five phases of a hazardous material’s “life”—production, transportation, storage, use, and disposal. At *each* phase, the possibility exists either for controlled, careful use or for shortsighted mismanagement.

Hazardous Materials Production and Storage

Hazardous materials are stored before and after they are transported to their intended use. For example:

- Service stations store gasoline and diesel fuel in underground tanks
- Hospitals store radioactive materials, flammable materials, and other hazardous substances
- Manufacturers, processors, distributors, and recycling plants for chemical industries store a variety of chemicals on site

In addition to the LEPC, your local police and fire departments should maintain specific information on industries in your community that use, store, or generate hazardous materials. Your local codes are critical elements in protecting community health, for they determine what handling, reporting, and emergency preparedness practices are considered “safe.” It is usually the local fire department’s role to inspect facilities to ensure code compliance. A fire department with a strong prevention emphasis may require businesses to document a hazardous materials management plan that indicates how materials are stored, how compatible substances are separated, where they are disposed of, and other pertinent information. Of particular interest is the existence of underground storage tanks, which can present a significant groundwater contamination hazard. (Old tanks are often overlooked in inspections or not known to exist.) Small volunteer fire departments often lack the personnel and skills required to inspect and maintain records on hazardous materials stored locally; some train citizen volunteers to assist them in these tasks.

The likelihood of the accidental release of a toxic substance from a fixed site such as a factory can be prevented or minimized by regular local inspections of facilities to ensure compliance with hazardous materials storage and handling regulations. Should a release occur, the cloud would contain areas of greater and lesser concentration.

At the local level, citizens can often express their concern about a local industry’s safe manufacture and storage of hazardous materials by conducting a neighborhood inspection. If approached in an atmosphere of cooperation and concern, businesses may respond positively, for they have a great deal to gain by being “good neighbors.” Wherever possible, the inspection team should be accompanied by an industrial hygienist or specialist trained in industrial health and safety issues. In one such neighborhood inspection in Massachusetts, a potentially dangerous situation was noted where hundreds of chemicals were stored in alphabetical order. As a result of the inspection, the storage system was altered to separate chemicals that could react with one another. The discovery of this problem may well have prevented a serious accident in which neighborhood residents could have been injured or killed.

Reading and Interpreting a Safety Data Sheet (SDS)

Hazardous materials are common in the modern workplace, and it is clearly important that workers know when they are handling these materials to ensure adequate protection and compliance with the proper safety procedures. Fortunately, the Hazard Communication Standard created by OSHA requires that employers who use hazardous substances must make SDSs available for employee use and reference, and must provide appropriate warning labels on containers of hazardous substances within the facility.

The manufacturer or distributor of a hazardous substance usually prepares the SDS. SDS forms are found in a wide variety of formats, but regardless of the format, they must contain certain key information for employee reference. In many cases, more information is provided on the SDS than is required by law. The Hazard Communication Standard *requires* that the following categories of information be written in English on a SDS form. (A sample SDS is found at the end of this unit; refer to it when reading this section.)

The Identity of the Substance

This category features required information on the identity of the material as given on the product label. If the material is a single hazardous substance, its chemical and any common names that it is known by must be given. If the material is a mixture, which has been tested as a whole to determine its hazards, the chemical and common name(s) of the ingredients, which contribute to these known hazards, will be listed. If the product is a mixture and has not been tested as a whole, the hazardous ingredients which comprise 1% or greater of the mixture must be given. If the hazardous ingredient is a carcinogen, those contents which comprise greater than 0.1% must be listed.

A SDS provides important information on a substance’s composition, potential hazards, and specific first aid procedures required in the event of an emergency.

An example of this information can be found in Section I of the sample SDS at the end of this unit. This SDS is for hydrofluoric acid—a mixture of hydrogen fluoride gas in water, whose properties vary with its concentration.

Physical and Chemical Characteristics

This category includes the physical and chemical characteristics of the hazardous substance—such as whether it is a liquid, gas, or solid, and data pertaining to characteristics such as vapor pressure and flash point.

The physical data may provide information on how the product will act under a variety of temperatures and conditions. You may learn from this category of information if the material has an odor (and at what level the odor becomes noticeable), the color of the material, and other items about the material's behavior.

This information can be found in Sections III, IV, and VI of the sample SDS at the end of this unit.

Physical Hazards

The physical hazards of the material must be noted on the SDS, including the potential for fire, explosions, or reactions, and the conditions under which they may occur. The recommended extinguishing media (water, foam, dry chemical, carbon dioxide, graphite, etc.) for fires can be found here—this information is of great value to community emergency responders.

Some chemicals are *stable* by nature—that is, they are unlikely to undergo a chemical reaction or change that may result in a dangerous situation, such as an explosion, fire, or toxic release. On the other hand, some chemicals are *unstable* and are likely to react either alone or in combination with other chemicals and substances. This knowledge can be of great value when selecting storage locations for the product.

This information can be found in Sections IV and V of the sample SDS form at the end of this unit.

Health Hazards

The health hazards of the hazardous substance must be given, including the signs and symptoms of exposure (such as a rash or burning of the eyes and throat) and any medical conditions which are generally recognized as being aggravated by exposure to the material. For example, people with respiratory problems should avoid the inhalation of solvent vapors from paint since these vapors may bring on breathing difficulties.

This information can be found in Section VI of the sample SDS form at the end of this unit.

Routes of Entry

Potential routes of entry into the body for a hazardous substance must be noted on its SDS. For example, our sample SDS indicates that the routes of exposure for hydrofluoric acid include eye contact, skin contact, inhalation, and ingestion.

This information can be found in Section VI of the sample SDS form at the end of this unit.

Permissible Exposure Limits

The OSHA Permissible Exposure Limit (PEL), Threshold Limit Value (TLV), and any other exposure limit recommended by the manufacturer, distributor, or employer preparing the SDS must be given if such values are available.

If such values are listed, they may indicate the maximum exposure a worker should have to the substance during an 8-hour working day, as expressed in parts per million (ppm) in air. The PEL is set by OSHA and is a

mandated exposure level. However, some PELs have not been updated recently and a number of employers follow exposure limits based on TLVs.

The TLV is the recommended level set by the American Conference of Governmental Industrial Hygienists (ACGIH). TLVs are advisory guidelines that are revised each year as more information becomes available for different chemicals. TLVs are airborne concentrations of hazardous substances and their values vary from one substance to another.

This information can be found in Section II of the sample SDS form at the end of this unit.

Carcinogens

If the material is listed in the National Toxicology Program (NTP) Annual Report on Carcinogens or has been found to be a potential carcinogen by OSHA or the International Agency for Research on Cancer, this information must be noted on the SDS.

The product used for the sample SDS at the end of this unit is not a carcinogen. Had it been, this information might have been found in Sections II or VII.

Safe Handling

This category of required information includes any generally applicable precautions for safe handling and use of the product which are known to the preparer of the SDS, including appropriate hygienic practices, protective measures during repair and maintenance of contaminated equipment, and procedures for spills and leaks of the material.

This information can be found in Section VII of the sample SDS form at the end of this unit.

Control Measures

Any generally applicable control measures which are known to the preparer of the SDS, such as appropriate engineering controls, work practices, or personal protective equipment (PPE) that is needed to safely handle the material, are included in this category.

This information can be found in Section IX of the sample SDS form at the end of this unit.

First Aid Procedures

The first aid procedures that are to be used on a person who is exposed to the product must be listed for the various routes of exposure and noted on the SDS.

On some SDS forms, this category may be expanded to include procedures that should be followed by medical authorities treating those who have been exposed to the material. In all cases of suspected overexposure, medical advice should be sought.

This information can be found in Section VI of the sample SDS form at the end of this unit.

Date of Preparation

The date that the SDS was prepared, and the date that the information was last updated, if applicable, must be noted on the SDS.

This lets you know exactly how current an SDS is. Some SDS forms may be updated once or twice a year, while others, such as those for steel, do not require frequent updating. A call to the manufacturer or supplier can determine if you have the most recent update of the SDS form that is available.

This information can be found in the header of the sample SDS form at the end of this unit.

Manufacturer Information

The name, address, and telephone number of the chemical manufacturer or responsible party who prepared the SDS and can provide additional information on the hazardous chemicals and appropriate emergency procedures to be followed, if necessary, must be listed on the form.

This information can be found in the header of the sample SDS form at the end of this unit.

If no relevant information can be located for a required category, the SDS will be marked to indicate that no applicable information has been found for that entry.

Hazardous Waste Sites

Hazardous waste sites affect thousands of communities across the country. These include abandoned dumpsites, municipal landfills, industrial ponds, storage piles, military base waste sites, and similarly designated areas. Sites that are *inactive* (not receiving hazardous waste) are generally listed and ranked for cleanup under the Federal Superfund legislation or State cleanup programs, while *active* sites are regulated under RCRA.

Only the most dangerous sites are eligible for Superfund, which ranks qualified sites on the *National Priorities List (NPL)*. A site is placed on the NPL after a *preliminary assessment* and a more thorough *site investigation* demonstrate that a potentially serious health threat exists. While approximately 22,000 hazardous waste sites are identified in EPA's inclusive Emergency Response and Remedial Information System (ERRIS), *less than 1% of this number is included on the NPL.*

A score assigned to the site by the State and reviewed by EPA usually determines the NPL ranking. The score reflects the severity of the contamination, and the vulnerability of residents and the environment to damage from any of the pathways of exposure. Careful testing is required to establish concentrations of pollutants at various points.

State and local officials have been taking an active role in the hazardous waste discovery process. Many local officials have actively sought out these sites with the aid of local citizens. Ideally, the "responsible party" who left the waste assists in cleanup, but in some cases, the polluting company no longer exists or responsibility cannot be proven. The State or local area may be left with extremely large cleanup costs in such cases—which is why *prevention* of poor waste disposal practices is by far the best option.

Unfortunately, "cleanup" is not as "clean" a process as the name implies. There are basically three approaches to cleaning contaminated soil:

1. *Containment.* The objective of this approach is to leave the waste in place and try to keep it from moving into the soil, air, or groundwater. Unfortunately, natural forces have triumphed in many landfills to date, and systems expected to last decades have made it only a few years before leaking.

2. *Off-Site Disposal.* Under this approach, hazardous materials are removed to a RCRA site. Often, risks are transferred rather than eliminated; a number of RCRA landfills have begun to leak and have been added to the NPL for cleanup.

3. *Treatment.* Numerous technologies are available or are currently being explored to chemically treat waste so that it is no longer harmful. The best method varies according to the waste. Some waste can be *biodegraded* by adding microorganisms specifically bred to "eat up" the chemicals; organic chemicals can sometimes be forced to break down when high temperatures are applied.

Decontaminating groundwater is an even lengthier process. Since groundwater moves slowly through the soil, as long as 20 years may be needed to complete decontamination once pollution has occurred. Three water treatment approaches are currently in use:

1. *Air Stripping/Aeration.* Water is brought to the surface and agitated or sprayed into the air to accelerate the evaporation of organic compounds. Citizens near a site using this method need to ask questions about the rate at which toxic elements are released into the atmosphere, particularly if residential areas are located near the stripping tower.

2. *Activated Carbon.* This treatment passes water through columns containing activated carbon, leaving many chemicals attached to the carbon particles. A sensitive issue in this type of treatment is how to dispose of the contaminated carbon.

3. *Chemical Precipitation.* In this approach, primarily used to remove metals such as lead and arsenic, chemicals are added which can convert metals to insoluble particles. These particles then settle out of the water as sludge. The controversial issue with this method is the disposal of the toxic sludge.

Hazardous Materials in Rural Areas

Even rural areas face hazardous materials problems. In addition to the ever-present possibility of a hazardous materials transportation accident, or storage problems associated with small businesses such as agricultural chemical dealers, threats exist which are unique to the rural environment.

Since wells are a primary water supply in most rural areas, a major concern is the introduction of contaminants into groundwater. A serious, and fortunately infrequent, hazard is that of flammable gas in wells. Small volumes of naturally occurring methane gas can enter wells that are drilled into carbonate or shale rock, causing explosions and fire. Venting the wellhead and other areas of the house where gas can be trapped may lessen this hazard. Another source of concern is the common farming practice of applying fertilizers and pesticides to crops next to a barnyard or farmyard, where many can be drawn into a well—a problem that can be reduced by decreasing the use of pesticides in that general area.

Groundwater contamination is a major concern in rural areas, which must deal with pollutants such as livestock waste and pesticide runoff in addition to the problems found in more heavily populated environments.

Farmers sometimes use sewage sludge as a source of plant nutrients. However, some industrial sludge contains heavy metals that may be toxic to crops, humans, and other animals. Because tolerance levels for heavy metals depend on the soil's physical and chemical characteristics, farmers should work with a professional to determine their soil's tolerance and stay within its limits.

Phosphate fertilizer can also cause problems. If you notice that fish are dying in an area where phosphates can reach the water from farm runoff, it is possible that phosphates are promoting the growth of algae and other aquatic plants that deplete oxygen. Reduced use of phosphates and runoff control can reduce this problem. Similarly, excessive use of nitrogen can contaminate groundwater and surface water, particularly when fertilizer is applied far in advance of the crop or to improve poor soils.

Accidents involving excessive use of pesticides have resulted in fish kills, human illness, and even death. Pesticides have been known to contaminate groundwater, particularly in very permeable soils or at sinkholes in limestone; once these substances are introduced into the groundwater supply, they can also be carried to surface waters. Developing other pest control procedures to reduce pesticide use and avoiding applications to permeable soils can reduce contamination. Protective clothing is also important whenever pesticides are applied.

Agricultural runoff can carry soil particles, pesticides, bacteria, and other pollutants directly into estuaries and coastal waters, or into rivers that flow into these waters. Control of runoff by each farmer is extremely important

in limiting the spread of harmful products.

Summary

It is not possible to rely on the senses to detect the presence of hazardous materials—such clues as pungent odors or a feeling of nausea may or may not be present. (Radon, the second leading cause of lung cancer in the United States, is a colorless, odorless, tasteless gas.) To find out whether you are exposed to hazardous materials is, therefore, a matter of research. Federal laws require disclosure and identification of hazardous materials in specific circumstances. For example, hazardous materials shipments crossing State lines, and many hazardous materials used in the workplace, must be labeled. For such substances a SDS is often available that provides detailed information on the material's attributes and required self-protection. State laws often "close loopholes" in Federal legislation (such as transportation of hazardous materials within State lines) to provide further citizen protection.

To identify the presence of hazardous materials in your community, consider all five phases of the material's "life"—production, transportation, storage, use, and disposal. Thoughtful policies are needed at each phase to protect local residents from unnecessary health risks.

HAZARDOUS MATERIALS AND HUMAN HEALTH

Objectives

In this unit, you will learn:

- Why hazardous materials are a concern
- What hazardous materials are
- How hazardous materials affect the body
- How hazardous materials enter and move through the environment

Hazardous Materials in the United States

In the years since World War II, new technologies have developed at a stunning pace. Nearly every business in our consumer society has grown accustomed to daily use of manufactured products that offer us increased convenience and efficiency. Hazardous materials or chemicals are used in every industry today in some form or another.

This year alone, more than 1,000 new synthetic chemicals will be manufactured for use in the chemical industry within the United States. Some will require careful handling during manufacture, transport, storage, use, and disposal in order to avoid causing harm to individual users and handlers, other living things, and the environment.

Many of these chemicals are not "biodegradable" (that is, they are able to be broken down into their components by microorganisms); for such chemicals in particular, the potential for adverse health effects can continue for decades or even centuries.

We are becoming increasingly aware of the limited space that our planet has to offer for the disposal of toxic products. Prior to release reporting, the EPA noted that industry manufacturers alone in one year discharged into the environment (air, land, and water) about seven billion pounds of toxic substances. Numerous small

businesses, such as printing industries and vehicle maintenance shops, also released toxic chemicals not included in these estimates. Few communities are eager to have hazardous waste deposited in their "backyard." A lone barge loaded with garbage made headlines that same year as it sailed the seas seeking a place to leave its unwanted cargo. It seemed an apt expression of our country's dilemma.

While hazardous materials attract us by promising to make our lives easier, they often confront us with complex problems—many of which have no easy or immediate solutions.

Naturally occurring toxic substances can also pose problems. For example, ponds near a wildlife refuge in California became contaminated by selenium, an element commonly found in alkaline desert soil. The high level of selenium was the result of irrigation methods used at nearby farms. Water removed the selenium from the soil, dissolved it, and carried enough of the element to non-farm portions of the refuge to threaten wildlife. As waterfowl ingested (ate) the selenium, deformities were found more frequently in developing embryos. Naturally occurring substances have sometimes led to expensive cleanup operations comparable to those required for human-created hazardous waste.

Sometimes, the challenge posed by hazardous materials glares at us in headlines and stories like these:

- In Bhopal, India, 44 tons of methyl isocyanate gas spewed into the atmosphere, killing at least 1,700 people and injuring tens of thousands.
- In a small Kentucky community, tank cars containing toxic substances derailed and burned. The fire caused a column of toxic smoke 3,000 feet high that forced 7,500 area residents to evacuate.
- In Florida, vandals broke the valves of chemical tanks at a local swimming pool supply company. The chemicals mixed to form a toxic acid, and a poisonous cloud of vapors sent 45 people to the hospital.
- In Louisiana, up to 41,000 pounds of hydrobromic acid fouled part of the Mississippi River after two ships collided.
- In Pennsylvania, a garbage truck operator found his load on fire and dumped it in a residential driveway; mixed chemicals, discarded by a high school science department, released cyanide vapors that sent 100 people to the hospital.
- Two New Jersey workers were killed and five injured by vapors inhaled as they cleaned a chemical mixing vat at a local company.

Often, however, problems posed by hazardous materials are less clear-cut. Many of the effects attributed to toxic substances, such as certain types of cancer, have multiple causes. In any single case of illness or death, it is difficult to point the finger at a specific instance of exposure to a particular hazardous material. In fact, one study found traces of more than 200 industrial chemicals and pesticides in members of an American sample group. Determining at what exposure level each of these common substances becomes harmful to human health is not only a scientific question but also a social, political, and economic issue.

Our legal system seeks to control these materials at every level of government—Federal, State, and local—but it is hampered by funding limitations, debates over emerging technology, lack of definitive research in certain areas, and competing rights and interests. Laws and regulations at all three levels of government address various aspects of the hazardous materials problem by specifying how chemicals must be stored, what employees are told about chemicals they handle at work, how chemicals are labeled, what containers are needed to transport specific chemicals, and what emissions levels are acceptable from industries. In each instance, the *local* government's role in regulating its own hazardous materials problems is critical.

In 1986, the Emergency Planning and Community Right-to-Know Act made history by requiring a local farm, industry, or small business that stores a certain quantity of "extremely hazardous substances," as defined by an EPA list, to report them to the SERC. This law, also known as the Superfund Amendments and Reauthorization Act of 1986, or just "Title III," includes provisions intended to help local-level planners work with industry to identify and reduce risks from toxic chemicals, and, if necessary, to seek corrective action through legal

remedies. It also creates new opportunities for citizens to identify and alter potentially hazardous conditions in their communities. It is based on the assumption that the more citizens know about local chemical hazards, the better equipped they and their local governments will be to make wise decisions about how risks associated with hazardous materials are managed in their communities.

Because Americans are exposed to toxic substances from so many sources, it is often difficult to trace a health effect to a particular source.

Chemicals being released into the environment (intentionally or accidentally) by industries are major challenges facing our country today. The chemical industry, plus manufacturers of hazardous chemicals, transporters, and users of hazardous substances, when combined with the many hazardous materials spills each year within the same community, presents local government with a potentially serious threat to the local environment and public health. Furthermore, automobiles emit nitrous oxides (one source of “acid rain”) and several air toxins. By becoming informed about hazardous materials laws, issues, and protective actions, local citizens can contribute to reducing their community’s hazardous materials threat.

Glossary

Hazardous materials, as discussed in this course, may be defined as:

A substance or material that the Secretary of Transportation has determined is capable of posing an unreasonable risk to health, safety, and property when transported in commerce. The term includes hazardous substances, hazardous wastes, marine pollutants, elevated temperature materials, materials designated as hazardous in the Hazardous Materials Table (see 49 CFR 172.101), and materials that meet the defining criteria for hazard classes and divisions in the standard.

Definition of Hazardous Materials

Substances or materials, which because of their chemical, physical, or biological nature, pose a potential risk to life, health, or property if they are released.

A “release” may occur by spilling, leaking, emitting toxic vapors, or any other process that enables the material to escape its container, enter the environment, and create a potential hazard. Hazards are classified in many different ways. The following introduces several common terms:

1. *Explosive* substances release pressure, gas, and heat suddenly when they are subjected to shock, heat, or high pressure. Fourth of July celebrations use many types of explosive substances that require careful storage and handling to avoid injury.

2. *Flammable* and *combustible* substances are easy to ignite. Paint thinners, charcoal lighter fluid, and silver polish are all highly flammable. Oxidizers, which will lend oxygen readily to support a fire, and reactive materials, which are unstable and may react violently if mishandled, pose related hazards.

3. *Poisons* (or toxic materials) can cause injury or death when they enter the bodies of living things. Such substances can be classified by chemical nature (for example, heavy metals and cyanides) or by toxic action (such as irritants, which inflame living tissue, and corrosives, which destroy or irreversibly change it). One special group of poisons includes *etiological* (biological) *agents*. These are live microorganisms, or toxins produced by these microorganisms, that are capable of producing a disease.

4. *Radioactive materials* are a category of hazardous materials that release harmful radiation. They are not addressed specifically in this course.

These categories are not mutually exclusive. For example, acids and bases are listed as corrosive materials, but can also act as poisons.

How Hazardous Materials Harm the Body

Absorption and injection are two routes of entry that occur through direct skin contact with a hazardous material.

Chemicals and hazardous substances may enter the body by several routes, and the nature and onset of signs and symptoms may vary accordingly. Gases, vapors, and aerosols, when inhaled, may be absorbed through any part of the respiratory tract, from the mucosa of the nose and mouth to the alveoli of the lungs. The eye may also directly absorb them. Aerosol particles larger than 5 **micrometer (µm)** tend to be retained in the upper respiratory tract, while those smaller than 1 µm tend to be breathed in and out again, although some of these smaller particles may be retained. Droplets of liquid and, less commonly, solid particles may be absorbed through the surface of the skin and mucous membranes. Toxic compounds with a characteristic action on the skin can produce their effects when deposited on the skin as solid or liquid particles.

Chemicals or hazardous substances which penetrate the skin may form temporary reservoirs so that delayed absorption may occur. Even the vapor of some volatile chemicals and agents can penetrate the intact skin and intoxication may follow. Wounds or abrasions (even minor injuries caused by shaving or by chemical depilation) present areas which are more permeable than intact skin. Chemicals and hazardous substances may contaminate food and drink and so be absorbed by the gastrointestinal tract. The penetration of chemicals and hazardous substances by these various routes may not be accompanied by irritation or damage to the surfaces concerned.

Methods of exposure to these chemicals are called *routes of entry*. They are:

1. Absorption
2. Ingestion
3. Injection
4. Inhalation

1. Absorption (through the skin or eye)

If a child were to walk barefoot through contaminated soil, the contaminant would contact the skin of the foot. This could cause mild skin irritation, or more serious problems like burns, sores, or ulcers on the outer layers of the skin. Contact with a substance may also occur by spilling it on the skin or brushing against a contaminated object.

Depending on the substance and the condition of the skin, the contaminant might also be absorbed through the skin and poison the body. While some chemicals are not absorbed easily unless the skin is cut, others are absorbed quite readily regardless of the skin’s condition. When you are using a material that bears instructions recommending the use of gloves, this is to prevent skin contact or absorption through the skin (also called *dermal* exposure).

When you work with chemicals, it is particularly important never to put your hand to your eye. Eyes are particularly sensitive to toxic substances; since capillaries are near the surface, the substance can enter the bloodstream more readily. Eye contact with toxic substances can cause irritation, pain, or even blindness.

2. Injection

The most familiar example of injection is that of shots given to administer medicine, in which the skin is punctured with needles so that a substance can enter the body. Injection can also occur accidentally. For example, if a contaminated can or a piece of glass that had been in contact with a contaminant cut the skin, the contaminated substance could be injected into the body. This is a very powerful means of exposure because the contaminant enters the bloodstream *immediately*.

When we ingest (eat) or inhale a substance, the body tries to filter it out through internal defenses. If there is enough of the substance, these filters are overwhelmed.

3. Ingestion

If we eat a substance that contains a harmful material, that substance enters our bodies by means of our digestive system. An example of inadvertent ingestion is a battery factory employee who eats lunch in the work area and ingests inorganic lead that has contaminated a sandwich. A more common instance is the child who puts a toxic substance in his or her mouth out of curiosity. We may also ingest residue from chemicals that have been added to our food to kill germs or parasites.

4. Inhalation

It is also possible to be contaminated by toxic substances when we breathe them into our lungs. The amount of air inhaled in a workday can be extremely large, so if we work or live in a contaminated area, we can be exposed to significant quantities of a substance in this way.

Some chemicals have excellent warning properties that let us know when they are in the atmosphere. There is the well-known “rotten egg” smell of hydrogen sulfide, for example. But at high concentrations of this gas, our sense of smell is quickly lost. Many toxic substances, such as carbon monoxide, are both colorless and odorless, providing us with no sensory clues that we are being exposed to anything unusual.

Pathways of Exposure

If we consider these routes of entry, it is possible to think of a number of ways in which contaminants escaping into the environment from their *source* may reach a living plant or animal, or *receptor*. Each specific route a chemical might travel from a source to a receptor is called an **exposure pathway**.

The pathway may be either **direct** or *indirect*. If an open toxic waste dump were near you, you could inhale the vapors from the toxic material, or your skin could contact toxic contaminants if you walked through the substance. These are *direct* means of exposure. The substance can also reach you by *indirect* pathways. For example, toxic vapors or particles from a site at which hazardous waste has been illegally discarded could be carried in the air to a cornfield and deposited on the crop as it rains. You ingest some of the toxic chemical as you eat the corn; or perhaps a farm animal eats the corn and you later eat meat from that animal.

Another pathway might be through drinking water. When rain falls and passes through polluted soil, it carries chemicals deeper into the earth as well as horizontally across the surface of the soil. If they are able to move far enough—which depends on the geology of that particular area—they could contaminate the groundwater. The contaminants could also be carried along the land by means of *surface runoff*, water that moves along the top of the soil, until they reach a recreational pond where children swim. Now there would be another opportunity for dermal contact.

Assessing Risk

How much *risk* is associated with a particular source depends on the characteristics of the source, the availability of pathways for it to reach the receptor, and the characteristics of the receptors. No single piece of information alone is sufficient, and incomplete information can be highly misleading. Among the key questions that must be asked in determining risk are the following:

1. What are the *hazardous properties* of the substance? What effects can it have on living things or on the environment? (To answer this question, it is often necessary to consider the state of research on the substance, and how much is really known about it.)

2. How *much* of the substance exists at the source, and in what *concentration*? A higher quantity or concentration of a toxic substance is more dangerous. However, the risk posed by a highly concentrated toxic substance entering the environment depends on the pathways available to it, and to what extent the concentration is reduced by the time it reaches receptors.

3. In what *form* is the substance? Whether the substance is in large blocks or tiny particles, or whether it is a liquid or a vapor, will be important in determining not only how it might travel, but also how it could contact and enter the body.

4. What are the *chemical and physical characteristics* of the substance? These characteristics determine in what environmental pathways it is likely to move and how rapidly. They include, for example, whether the substance can easily dissolve in water.

5. How is the substance *contained*? If the chemical is in old, rusting containers that can leak, the danger is clearly greater than if the container is solid and appropriate to the substance.

6. What *pathways of exposure* exist? When scientists study the risk in any particular situation, they look at all the ways a contaminant could reach the population at risk and make measurements to see how much of it is moving through each identified path. For example, if the source were near a stream, water samples would be taken at several places to see what level of contamination exists at different distances from the source.

A possible exposure pathway involving the food chain: toxic fumes and particles from a waste dump are carried through the air to a cornfield, corn grown in this field is fed to an animal, which is later processed for human consumption.

7. Where is the population *located* in relation to the source? Distance is a critical factor. For example, if you are far downstream from a place where toxic waste is entering a waterway, you may have little risk because the substance is so diluted. Closer to the source there might be a high enough concentration to pose a real problem.

8. What are the *characteristics* of people who are at risk? The susceptibility of any individual to a toxic substance varies depending on age, weight, sex, and individual sensitivity.

9. How long does the exposure to the chemical last? Its *duration* is another key factor in determining risk. Are receptors exposed for only a few hours at a high level (such as when a contaminated air plume passes over a home), or at a low level over a number of years (such as when groundwater supplying a well becomes contaminated)?

The analysis of a situation to determine the level of risk inherent in that situation is called **risk assessment**. A risk assessment is conducted by scientists from many different disciplines and uses data about a chemical's effects combined with research into the particular situation to get a clear picture of the risk posed. A decision will then be made as to what action, if any, is needed to remedy the situation. This is called *risk management*.

Toxic Materials in the Body

A poison, or toxic substance, may be defined as *a chemical that, in relatively small amounts, produces injury when it comes in contact with susceptible tissue*. Clearly, the phrase "relatively small amounts" is less than precise, but this uncertainty is necessary because of the wide variance in the amount of each chemical needed to have an effect. A substance is generally not thought of as toxic if it is unreasonable to expect that a person would be exposed to the amount necessary to cause injury. A "susceptible" tissue is defined as that part of the body which is injured after exposure to that particular substance.

Toxic Effects

There have been many attempts to categorize toxic 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.

The first method or *acute exposure* is the exposure to a hazardous substance over a short period of time or at a high dose. A reaction to a chemical can occur at the time of exposure, and might include vomiting, eye irritation, or other symptoms that often may be readily linked to a chemical exposure. These are *immediate and adverse* effects.

The second method or *chronic exposure* is the exposure to a hazardous substance over a long period of time. If a carpenter used a stripper regularly and breathed in a little of it 8 hours a day for 40 years, a chronic exposure would result. This type of exposure occurs when a person is repeatedly exposed to the same chemical or hazardous substance over a long period of time at very low levels.

Similarly, the term chronic effect is often used to cover only carcinogenicity, teratogenicity, and mutagenicity (terms to be discussed below). 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 (wasting, losing function, or size).

Local and Systemic Effects

Local effects from chemical exposure occur at the site of contact, i.e., eye irritation, skin burns or blistering, respiratory distress, or pulmonary edema. Systemic effects occur at a location distant from the point of contact, i.e., liver, CNS, heart, or kidneys. These effects may occur years after a single high level of exposure, or as the result of chronic exposure. Systemic effects are often more difficult to trace to their cause, and can include organ damage, respiratory diseases, and other illnesses in an exposed population.

Certain toxic substances produce their long-term effects by altering the genetic code, or DNA, which tells the body’s cells to perform certain activities. Three categories of effects can result from such substances:

1. A *carcinogenic* effect is an increase in an individual’s risk of contracting cancer.
    - (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.
2. A *mutagenic* effect is a permanent change in the genetic material (DNA), which may be passed along to later generations.
3. A *teratogenic* effect is an increased risk that a developing embryo will have physical defects.

Determining what level of exposure causes these effects requires laboratory research under controlled conditions. Even then, results must be *extrapolated* from laboratory animals to humans. That is, scientists must make assumptions and apply formulas to decide what their experiments tell them about *human* exposures.

Another way to classify a hazardous substance or chemical is by their physiological effects. This classification includes the following major groups:

1. *Irritants* are chemicals which are not corrosive, but which cause 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 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.

2. *Corrosives* are chemicals that cause 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 4 hours. This term shall not refer to action on inanimate surfaces.

3. *Asphyxiants* can be physical or chemical. *Physical asphyxiants* are gases or vapors that dilute or displace oxygen normally in the atmosphere. (Vapors from flammable and combustible liquids displace oxygen in the environment, being heavier than air.) **Chemical asphyxiants** are chemicals that prevent the cells from taking up or transferring oxygen in the body or to the tissues. Carbon monoxide is a well-known asphyxiant, which chemically "ties up" the hemoglobin in the blood so that the body's metabolism slows and stops.

4. *Central Nervous System (CNS) Depressants* affect the nervous system. This broad category includes vapors from most anesthetic gases, depressants, and organic solvents (a general category that includes most household cleaners as well as many paints, glues, and adhesives). Some CNS depressants produce a feeling of dizziness or giddiness. More severe effects (including death) can also result.

5. *Systemic Toxicants* dramatically affect specific organ systems. For example, mercury vapor, which Victorian hat makers had to inhale regularly when mercury was used in making hats, causes a serious nervous system disorder which could lead to insanity. (The "Mad Hatter" in Alice in Wonderland suffered from an occupational illness.)

6. *Sensitizers* are chemicals that cause a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical. (Examples are formaldehyde, poison ivy, and poison oak. Some epoxy resins and polyester resins can cause many people to have a *sensitivity reaction* and become ill.)

Many chemicals can have multiple effects. For example, xylene, commonly used in paint, is both an irritant and a CNS depressant.

Symptoms of toxic exposure include a broad range of reactions: chronic coughs, difficulty in breathing, skin ulcers, diarrhea, irregular heartbeat, headaches, dizziness, chest pain, sore eyes and skin, difficulty in sleeping, lack of appetite, weight loss, nausea, tremors, and many others.

However, the same symptoms can result from many other causes as well. Tracing a particular reaction to a specific source can be a challenge to even the most experienced environmental toxicologists, allergists, and industrial hygiene specialists. This is further complicated by the fact that many effects are delayed, and are apparent only later in life. The individual experiencing the symptom may no longer live near the original source, or may not even know that the exposure occurred.

At low enough exposure levels, a toxic substance will produce no observable harmful effects. As the dose increases, so does the potential for harm. For every substance—even table salt—there is a lethal dose.

Internal Defenses

When the body is exposed to a hazardous chemical, its internal defenses try to remove the unwanted substances. The primary internal defense is *excretion* of the contaminant with other wastes in the feces or urine. Prior to excretion, primarily the liver and kidneys filter wastes. As a result, these two organs are both subject to damage from toxic substances, storing in their tissues what they are unable to break down. Portions of the lungs contain cilia, which try to remove particles so that they can be coughed out. Particles that are too small or cannot be removed for other reasons will remain as deposits in the lower part of the lungs (alveoli), where they can cause scaring, fibrosis, or cancer.

Other body defenses against toxic substances are *breathing* and *sweating*. When an intoxicated person has the smell of alcohol on his or her breath, the smell indicates that the body is exhaling material it has no use for.

Tears also remove contaminants that enter the eyes. However, these defenses contribute only a small amount to the body's detoxification (that is, its attempt to rid itself of toxic substances).

The body's ability to defend itself against toxic substances varies with the individual. Small children are liable to be more affected by the same amount of a substance than are larger or older persons. Elderly individuals also may have less ability to remove toxicants from the body. Gender can be a factor in toxic responses; for example, some cancers are sex-linked (such as prostate and ovarian cancers). Personal hygiene and the overall health of an individual can also adversely affect the body's ability to process certain toxic substances. For example, a smoker is likely to be much more susceptible to lung cancer if he or she has also been exposed to high levels of radon gas.

Exposure to a poison becomes a problem when the material is of a type that inner defenses cannot break down and remove, or when there is more of it than the body can handle. In these instances, *antidotes* are available for a limited number of substances. However, only about 20 antidotes are in existence for the thousands of poisons in the world—and each antidote may work for only a few poisons.

Clearly, the safest barrier to toxic exposure is the **prevention** of exposure. This is why it is so important for citizens to be aware of the threat posed by hazardous materials in their own home and community, and to learn to minimize or eliminate unnecessary exposure.

Studies of Toxic Effects

Scientists determine what levels of exposure in human beings will produce observable symptoms by two types of studies. **Epidemiological** studies use data on how toxic substances affect human populations. This type of study might compare the number of workers exposed to a certain substance who develop lung cancer to those who develop it in the rest of the population. Other *clinical* studies test the effects of concentrated doses of substances on animals or animal tissue.

Scientists conduct two kinds of studies—epidemiological and clinical—to determine what levels of exposure to a hazardous substance will produce observable symptoms.

A basic principle of research on toxic substances is that the seriousness of the effect a poison has on the body increases as the *dose* increases. Theoretically, there is a **threshold** for exposure to each poison. Beneath the threshold, the dose is so small that no harmful effect will occur. As the dose increases, there is a point at which there is an effect, but the animal can compensate for it by internal healing, and no permanent injury will occur.

Beyond that, there is a dose at which the animal cannot repair itself from the damage and disease results. Finally, at the upper limit of the curve, death occurs.

Terminology

The terminology used in this unit to explain the dose response relationship is as follows:

Dose

Glossary The dose is the quantity of the compound received by the subject.

LD_{50}

Glossary The LD (lethal dose)$_{50}$ is the dose which kills 50% of the exposed population.

ID_{50}

Glossary

The ID (incapacitating dose)$_{50}$ is the dose which incapacitates 50% of the exposed population.

Ct (Concentration time)

Glossary

The Ct is a measure of exposure to a vapor or aerosol. The concentration in the air and the time of exposure govern the dose received, as dose rate of respiration. It is assumed that, when the product of concentration and time is constant, so is the biological effect over a limited range of concentration and time. For very short or long exposures the biological effect may vary. Concentration is expressed as milligram per cubic meter (mg/m3) and time as minutes, so that the concentration time (Ct) is expressed as milligram-minutes per cubic meter (mg-min/m3).

LCt_{50}

Glossary

The LCt (lethal concentration time)$_{50}$ is the Ct which will kill 50% of the exposed population.

ICt_{50}

Glossary

The ICt (incapacitating concentration time)$_{50}$ is the Ct which will incapacitate 50% of the exposed population.

Death would occur if sufficient quantities of any substance were taken into the body. For example, if a large group of people with similar characteristics ate half a pound of table salt, half of them would probably die. Through experiments, scientists try to establish the particular dosage of chemical (in mass per kilogram of body weight) that will result in the death of half the test animals: that is the *Lethal Dose for 50% or LD_{50}*. They also try to establish the point at the other end of the curve at which there is no observable effect from the substance on the animal. This is called the *NOAEL: No Observable Adverse Effect Level*.

Once the LD_{50} for a substance has been established by repeated experiments with animals, it must be extrapolated to determine what the LD_{50} would be for humans. This means adjusting the results to apply to human body weight and similar characteristics. But a toxic substance often has different effects on different species, so tests on animals cannot predict the exact effect that the substance will have on a human population. As a result, scientists are usually quite conservative in their estimates, which mean that they assume that the smallest dose that causes an effect in animals will also cause an effect in humans. In addition, scientists study the effect of a substance on human populations wherever statistics are available.

A toxic substance will sometimes combine with another substance to create a new chemical. The potential for harm of this new chemical can be greater or lesser than that of its individual components.

Another uncertainty associated with the LD_{50} concept is that most LD_{50} data is gained from acute exposure (single dose) testing rather than by chronic exposure. Extrapolation from these studies is complicated by the fact that chemicals are sometimes distributed differently in the body when the exposure is chronic; for example, a different target organ may be attacked, or the material may be excreted more easily.

Given these uncertainties, it is understandable why there is often considerable debate about what constitutes a “safe” level of exposure. For most substances, agency experts extrapolate conservatively from the NOAEL to set exposure limits for humans. OSHA uses *Permissible Exposure Limits (PELs)*, while the American Conference of Governmental Industrial Hygienist (ACGIH) uses **Threshold Limit Values (TLVs)**, to define the workroom air concentration that is considered a safe upper limit of exposure. For carcinogens and mutagens,

however, there is considered to be no such “safe” exposure limit for regulatory purposes. Every exposure carries some risk.

Hazardous Materials in the Environment

The movement of contaminants within a medium such as air, groundwater, or soil is known as transport.

Hazardous materials can enter the environment either from a specific source that can be pinpointed, known as a **point source**, or from sources that are more spread out, known as **area sources**. A factory smokestack and the flow of toxic waste from a pipe to a stream are point sources, while the liquid runoff from a field in which pesticides were used is considered an area source.

Contaminants behave differently in the environment depending on their *physical state*. A solid may stick to surfaces, scatter, or form a dust cloud; a liquid may seep into the ground, flow along the ground, or vaporize and become a gas; a gas will expand and be carried by the wind. Some chemicals are **volatile**, meaning that they evaporate easily. Such a chemical may enter a stream as a liquid but rapidly become an *air* pollution problem.

A non-volatile chemical entering the same stream at the same point may behave quite differently. A **soluble** chemical is one that will dissolve readily in water, and would be carried by the stream. Soluble chemicals tend to be **mobile**, meaning that they will move rapidly in the ground because they can be easily dissolved in groundwater. Another chemical might be more likely to **adsorb** to soil particles, becoming attached to particle surfaces. Such a chemical would attach to particles in the stream and eventually settle at the bottom. If the chemical were a **persistent** one, which resists breakdown in the environment, it might remain there for some time in the same form, while bacteria might break down a less persistent chemical. This breakdown is called **biodegradation**, and is an important risk management concept. Sometimes it is possible to **increase** biodegradation so that materials lose their harmful properties more readily.

The process of chemical breakdown, or biodegradation, can cause materials to lose their harmful properties and, in effect, “disappear.”

Certain chemicals tend to become more highly concentrated as they move through the food chain. This process is known as biomagnification.

Contaminants enter any of the various **media**—air, groundwater, surface water, or soil—and move as a mass along with the general flow of that medium. This movement of contaminants within a medium is called transport. Substances in **transport** also tend to spread out as they move, becoming diluted to a varying extent by the medium. This generally reduces the concentration, and therefore lowers the level of hazard.

Once a toxic substance is released into a medium, a number of different processes can occur:

1. The substance moves in a pathway determined by its own characteristics and those of the medium that is carrying it.

2. The substance spreads out or disperses, reducing the level of hazard. This means of reducing risk is not always reliable or consistent, however. For example, there may be periods of low flow in streams when the volume of water is reduced and less dilution occurs.

3. The material may change chemically or break down into other elements or compounds. Sometimes a contaminant will combine with another substance to become a more dangerous chemical; at other times it will be rendered less harmful by the encounter. Some chemicals have a *synergistic* effect. (A synergistic effect is the effect of two chemicals acting together causing a greater effect than the simple sum of their effects when acting alone.)

4. A chemical may also *potentiate*. (Potentiation is the ability of one or more chemicals to increase the toxicity of another chemical to cause greater harm than the total effects of the two expected reactions.) An example is an alcohol. When mixed it will potentiate the effects of many chlorinated hydrocarbons.

5. The reverse is also possible regarding a chemical. It may present an antagonistic effect. Or the results of two or more chemicals may lessen the total effects of their combined exposure in the body. An example might be one taking aspirin to lessen the effects of an alcohol (wine or beer) exposure from the night before.

6. A toxic substance may move from one medium to another (for example, evaporating from water into air)

7. Toxic substances can build up in the food chain. Organisms can absorb contaminants such as pesticides in a process known as bioaccumulation. These contaminants are later released into another organism that eats that animal or plant. Certain chemicals also tend to become more concentrated as they move up the food chain. (For example, toxic concentrations may be higher in a bird that ate insects containing poison than in the insects themselves.) This is known as *biomagnification*. Often, an important part of understanding a chemical's risk to humans is being aware of how a particular contaminant will move through a food chain and how each animal or plant in the chain may be affected.

The Movement of Contaminants in Different Mediums

The way a pollutant is *transformed* by chemical reactions and *transported* through the environment is called its *fate*. As we have seen, the fate of chemicals released at the same site may be extremely different.

Hazardous substances move and disperse differently, depending on the medium in which they are deposited. Regulators set standards for exposure in each media separately, trying to take the unique features of each one into account. There are four *transport mediums* in which contaminants travel.

Air

Hazardous chemicals can enter the atmosphere from a point source (such as an industrial stack), or from an area source (such as the evaporation of volatile compounds from hazardous waste sites). A major factor affecting the level of contaminants in the air is the rate of dispersion, which is affected by both weather and *topography* (the shape of the land, including buildings). With a good, strong wind, air pollutants are dispersed more rapidly; when the air is calm, contaminant concentration increases. As a rough rule of thumb, contaminant levels are *halved* when wind speed is doubled. (This rule of thumb assumes no effect from topographical features.)

In urban locations, a turbulent "mixing area" of air exists which helps diffuse contaminants. This is due in part to the irregular surfaces of various-sized buildings and hot and cold spots created by contrasting materials such as concrete and grass.

Contaminant levels are also affected by the amount of *vertical mixing* that occurs. Normally, temperature decreases with height; we have all noticed how much colder the air is on top of a high mountain. In urban areas, under such temperature conditions, a turbulent *mixing area* of air exists, characterized by swirls, gusts, updrafts, and downdrafts. This movement is partly attributable to the irregular surfaces of small and tall buildings, and hot and cold spots created by contrasting materials (asphalt or concrete vs. grassy park areas). Polluted air is carried upward and dispersed, while relatively cleaner air moves downward. The net result is that pollutants move up and away from us.

Under weather conditions in which temperature increases with height, much less vertical mixing occurs, and pollutants can grow thick in the breathing zone. Such conditions typically occur when a warm air mass moves over a cooler layer of air. In areas with basin-like topography, such as Los Angeles, high-pressure systems can develop in which air above the 2,000- to 3,000-foot level dips and warms, while the air near the earth stays relatively cooler. Hazardous situations called "episodes" can last for days in such areas, often confining persons with respiratory difficulties such as emphysema indoors.

Under certain weather conditions, a "temperature inversion" can occur which traps contaminants and can promote unusually high levels of exposure.

The height of the source can also affect the distribution of pollutants in air. For ground-level releases, the highest concentrations are almost always near the source; for elevated sources such as stacks more than 30

feet above ground, however, the highest concentrations may be further downwind from the source. The size of the particles emitted is also relevant; larger particles are more likely to settle out near the source, while small ones will travel further in the air.

Groundwater

Groundwater, defined as water moving through soil and rock, is a common route for chemical movement. The source of groundwater contamination can include surface *impoundments* in which hazardous materials are disposed or stored, such as ponds and lagoons, leaking underground storage tanks, or any spill where contaminants can seep downward. The type of soil configuration is crucial in groundwater contamination. Some soil layers, such as clay, are harder for contaminants to move through (less permeable) and can protect the underlying groundwater.

While contaminants in rivers or streams are generally churned and diluted by movement as they are in the air, contaminants can move great distances in groundwater without dilution. Also, chemicals in the groundwater last longer; chemicals cannot evaporate, and they resist breakdown in the absence of air and light. It is difficult and sometimes impossible to purify contaminated groundwater.

Surface Water

Surface water includes oceans, rivers, lakes, streams, or any aboveground water source. It may be contaminated by industrial and sewage discharge pipes, chemical spills, or hazardous waste landfills.

The concentration of chemicals in surface water depends on the amount of the substance entering the water, its properties, and the water's rate of flow. Chemicals that are heavier than water, which include PCBs and dioxin, settle out in the sediment at the bottom and can remain there for long periods, while lighter chemicals will flow with the stream. Exposure to light, oxygen, and organisms will break down some chemicals; others, such as heavy metals (lead and mercury), are persistent and do not break down easily. Substances that are *persistent* may be transported to estuaries (areas where rivers meet oceans) and accumulate in shellfish and fish.

Soil

Soil may become contaminated through dumping, spills, and other sources. Rainwater leaches some contaminants from the soil and carries them to the groundwater; other contaminants remain near the surface, where they can affect human health by entering the food chain (ingestion), emitting toxic vapors (inhalation), or rubbing onto the skin of children playing in the dirt (dermal absorption). Because contaminated soil is a basic contaminant medium that affects other media, it is of considerable importance.

Surface water generally dilutes contaminants as it moves; they tend to break down as they contact air and light. Contaminants resist breakdown in groundwater and do not disperse readily because there is nowhere to go.

Once a contaminant has gained a foothold in one medium, it may be released into others as well. Whether this happens or not depends on the contaminant's characteristics and pathways available in the environment. Contaminants evaporate from the soil or water and enter the air through *volatilization*. Contaminants can also *leach* from the soil and enter water, or be blown by the *wind* and become airborne particles. When it rains, contaminated *runoff* from the soil can enter a stream. Therefore, it is impossible to simply place a chemical in one medium and forget about it. Careful thought must be given to how it may be released into other media.

Summary

While we often associate our hazardous materials problems with industry, naturally occurring toxic substances, products used in average households, and automobiles all contribute to our country's challenge. Materials may be considered hazardous for different reasons—for example, some are liable to explode or burst into flame

easily, while others can poison us. Poisons can enter our bodies by absorption, ingestion, inhalation, or injection, through various environmental pathways in different mediums.

Predicting how much of a substance will actually reach us from a particular source is complicated. Chemicals often follow complex pathways through the environment, leaving one medium to enter another, and being transformed and transported in different ways by each medium. They may either disperse harmlessly or become concentrated as they move through the food chain.

Numerous sources contribute to groundwater contamination. Because groundwater is a source of drinking water for half the Nation's population, and because it is so hard to clean up, protecting this resource from contamination is a major concern.

While our bodies have many internal defenses against poisons, these defenses can be overwhelmed. Whether we are exposed to chemicals all at once or gradually over time, we can reach a threshold at which harmful effects are noticeable—sometimes years after our first exposure. To ensure our health and safety, we should take reasonable precautions to limit our potential exposure to hazardous substances.

PREPARING FOR HAZARDOUS MATERIALS INCIDENTS

Objectives

In this unit, you will learn about:

- The importance of the Local Emergency Operations Plan
- Responsibilities of local, State, and Federal government and emergency response forces in a hazardous materials incident
- How to protect yourself and your family during a hazardous materials incident
- How to review a facility's compliance with health and safety regulations

In September 1988, a minor chemical accident at a swimming pool supply plant near Los Angeles released a highly toxic gas over a 6 square mile area, forcing 25,000 people from their homes within a matter of hours. Emergency personnel and city and county government staff members responded to the incident. Over the next few hours, fire engines, police cars, emergency medical technicians, the mayor, the county emergency services director, and the response team arrived to assist with hazardous materials management and cleanup duties.

The rapid escalation of resources on the scene associated with such serious hazardous materials incidents raises a key issue. How do all these people know what to do in the crucial first minutes of an emergency to contain the disaster and avoid making the situation even worse?

The answer lies in a good Emergency Operations Plan. Such a plan will prevent role confusion and logistical tie-ups that can hamper an efficient response.

Is Your Community Prepared for a Hazardous Materials Incident?

Experience in disasters has shown repeatedly that when emergency plans and procedures are known, exercised, and kept up-to-date by operating forces, reaction times are reduced, coordination is improved, and overall response and recovery measures are more effective and efficient.

Your community's Emergency Operations Plan serves as a blueprint for its response to a potential hazardous materials incident.

Your community's Local Emergency Operations Plan serves as a blueprint for response to many types of

emergencies that could occur in your community, including a hazardous materials incident. Ideally, a multi-disciplinary team of specialists will have prepared the plan, which consists of:

- The hazards in your area
- The local resources available to respond to an incident
- The resources of neighboring jurisdictions, as well as from States and the Federal government

The hazardous materials plan should be one component of a more comprehensive plan detailing how your community would respond to various types of disasters. The key components of **a complete local plan** are the following:

- The *basic plan*, which is a relatively broad conceptual framework describing the policy and approach to emergency operations.
- *Supporting annexes* that contain information on specific functional responsibilities, tasks, and operational actions needed to deal with particular hazards. The focus of an annex is on operations—what the function is and how it is carried out. Annexes are action-oriented and written for personnel charged with execution of the plan. Examples of annexes include warning, evacuation, and fire and rescue.
- *Implementing procedures*—these may be in the form of hazard-specific appendices, standard operating procedures, or checklists. They support annexes and contain technical and detailed operational information for use by emergency personnel, including such information as lists of people to alert under specified conditions, and specific "how to" instructions for operating departments or individuals to carry out assigned responsibilities.

Because the requirements of hazardous materials incidents differ markedly from those of other emergencies, a separate hazardous materials annex to the generic operations plan is needed to address these issues. The plan outlined in the annex should be comprehensive, but specifically tailored to your community's unique situation. For example, local fire service jurisdictions must reach specific agreements on how they will communicate and work together in an emergency. Local industries must be approached *beforehand* to ensure that critical equipment can be made available in the event of an emergency, with agreements in place to facilitate leasing or lending.

Once in place, the hazardous materials annex to the plan should allow your community to respond quickly and effectively to a hazardous materials incident. Its benefits will extend beyond this, however. The planning process itself—by bringing together local officials, response workers, citizen volunteers, and industry representatives involved with hazardous materials—opens important lines of communication. Through dialogue, planners can find options for minimizing the chances of a major hazardous materials incident, and prepare to work together efficiently if a major or minor incident does occur.

The following summary reviews the basic elements that comprise an effective plan.

Detailed instructions for preparing an effective plan are published by the National Response Team. (See the listings at the end of this course.)

To be effective, an emergency response plan must address the unique characteristics of the community it is to serve—a "fill-in-the-blanks" type of plan simply will not do.

The Planning Process

Under Title III provisions, the State Emergency Response Commission (SERC) decides how many planning districts are needed to prepare adequate plans for responding to chemical emergencies throughout that State. Some States have LEPCs at the county level, while others have designated the entire State as a planning

district with one LEPC. The SERC is responsible for appointing individuals to serve as LEPC members in each planning district.

Each LEPC prepares a plan based on a thorough understanding of the hazards faced by the specific area and the resources it has to meet them. The following steps would be required to complete a sound plan for *any* emergency.

1. **Identifying Participants**
   The LEPC should include members with diverse experience in the execution of the plan. The group's collective expertise should include experience in planning; knowledge of the community; experience with the local response forces; and knowledge of hazardous materials, their effects, and appropriate medical treatments.

2. **Analyzing Risks**
   The LEPC reviews and critiques any community plans that may already exist. It then determines the community's potential hazardous materials risks, primarily through the use of reports submitted by local industries under Title III, but supplemented by analysis of hazardous materials transport and other potential local hazards not addressed by the legislation.

3. **Identifying Special Populations and Areas of Concern**
   The LEPC takes a close look at the community to identify areas that are particularly vulnerable to incidents, and populations that would require special planning to protect or evacuate them in an emergency (such as nursing home residents).

   Makeup of a typical Local Emergency Planning Committee (LEPC).

4. **Identifying Available Resources**
   The LEPC works with local police and fire officials to determine the response capabilities of their departments, then gathers information to understand the incident response role played by surrounding communities and State and Federal government agencies. Capabilities of these secondary sources are then assessed. The Committee then determines the response capabilities of local industry and transporters, specifically those that have the potential to be involved in a hazardous materials incident.

   On the basis of this information, the LEPC develops a resource list, detailing where equipment and personnel may be obtained to help with a hazardous materials emergency, and whom to call for assistance. It also designates the specific responsibilities of all resources—police, fire, and other city departments, as well as volunteers and key private sector Local Emergency Planning organizations —in the event of a hazardous materials incident.

5. **Drafting the Plan**
   Draft hazardous materials emergency plan is prepared by the LEPC, reviewed and approved by all parties assigned responsibilities under the plan, and revised to incorporate comments. Finally, the LEPC distributes and explains the plan to key emergency response and government personnel, and *periodically updates* it to reflect changes within the community or within its local government.

6. **Testing the Plan**
   Once the plan is in place, the community must conduct *exercises* (simulations of emergency situations) to determine whether responders are prepared to handle their assigned roles, and whether the planned procedures are effective. Exercises provide a means of validating the emergency plan and evaluating training programs used to prepare responders. Ranging in complexity from "tabletop" discussions to the actual deployment of significant resources and personnel (as if in response to an incident), exercises are the best way to find out if the community is ready for a specific type of emergency. Potential problems with plans and procedures are often

Problems in Past Incidents

When a hazardous materials incident plan either does not exist or is inadequate, a wide range of problems can occur. A lack of trained personnel or insufficient resources to handle the incident can lead to rapid escalation

and unnecessary injuries. Unless these problems are corrected, dealing the jurisdiction better in the development and pleasant surprises can occur. Examples from recent incidents include the following:

- Difficulties occurred in locating victims and in finding a hospital or reception center to receive them.
- Reception centers were uncertain about who was to obtain food, medical supplies, and bedding for evacuees.
- The Emergency Operations Center was inundated with so many citizen calls that communications among emergency organizations were paralyzed.
- Medical personnel were unfamiliar with the treatment and effects of the hazardous material involved.
- Organizational “turf” issues were not worked out in advance, and role conflicts impeded operations.

Often responders discover that their resources are inadequate to handle the incident, or that personnel were insufficiently trained in the specific role they must perform in the incident.

Roles in Incident Response

Any chemical incident, or potential release, may draw firefighters, police, and emergency medical technicians to the scene. Response to a hazardous spill or fire is a complex process, requiring specially trained personnel and specialized equipment. A buddy system is needed to ensure personnel protection. A typical team would consist of approximately **a minimum of eight well-equipped and trained members**. Of these, two individuals perform incident operations and rescue, two others serve as operations backup, two are the Decontamination Team, and there is one safety and one operations officer.

A truly serious incident would require representatives of all three levels of government (Federal, State, and local) to be present at the scene, with each level consisting of personnel from between 5 and 15 different agencies. Scientists familiar with chemical properties would help develop a strategy for controlling the incident that is appropriate to the properties of the material. Environmental scientists would project the movement of materials and provide advice on minimizing the adverse impact on the environment. Local firefighters and specialized hazardous materials response teams (their capabilities enhanced through specialized training and additional resources brought in through interagency agreements) would manage the incident, as public safety personnel controlled crowds and traffic. The media, as well as lawyers and management representatives of the chemical company, would also be on hand. At a recent Florida incident, in fact, some 200 officials responded to the scene: this figure did **not** include the 21 workers handling the actual cleanup!

Given the large number of personnel at the site, roles and responsibilities must be clearly established in the contingency plan **before** the incident occurs. The Emergency Operations Plan will spell out these roles and responsibilities for each responding agency—but whether these responding agencies work smoothly together is largely dependent on the function of planning, and on how well the plan was communicated to key personnel.

Successful management of a hazardous materials incident falls upon the shoulders of the *Incident Commander*. In most States and jurisdictions, this individual is from the local fire service. The Incident Commander is tasked with directing all response and supporting operations in accordance with procedures specified in State or local ordinances and the local Emergency Operations Plan. As additional officials with higher rank arrive on the scene, they may assume the Incident Commander role. A good plan will eliminate any confusion as to who the Incident Commander is at any point in the emergency.

The Local Role in Incident Response

In a hazardous materials incident (as in other types of emergencies), a successful outcome depends largely on *local* level preparedness. The amount of training response personnel have received, the extent to which

responsible personnel were involved in planning, and other key factors in the planning process will become abundantly clear in an exercise or in an actual incident.

As first responders at the scene of a hazardous materials transportation spill, local firefighters and/or police typically have the lead responsibility for:

- Identifying the materials involved
- Determining the risk or hazard posed by the spill
- Calling for additional resources, if necessary, to monitor and contain the spill
- Isolating the scene, restricting or rerouting traffic, and conducting evacuation, if necessary
- Providing first aid, as needed
- Fighting the fire and protecting against explosions
- Keeping the public informed of the hazard that exists, the actions being taken, precautionary measures to take, and evacuation routes and destinations (if necessary)
- Taking overall scene management responsibilities

Local Public Health Departments

The local public health department safeguards the public when food and/or water supplies may be affected or when dwellings may become contaminated.

Medical personnel may need to take appropriate precautions when patients and victims arrive at local and area hospitals presenting with signs and symptoms of a possible biological agent release such as smallpox or plague.

These agents may require more than the normal “standard precautions” health personnel might wear while handling patients with normal illnesses and diseases, as shown in Figure 5-2. Hazardous materials incidents will also require doctors and nurses to wear PPE that provides them protection from these chemicals and hazardous substances.

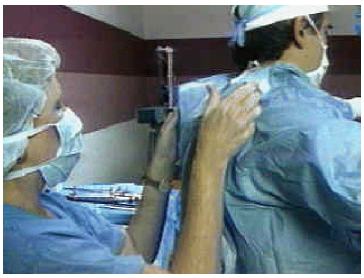


Figure 5-2, Standard Precautions

Known or suspected chemical and biological attacks will require a higher level of protection for hospital personnel while handling patients and victims suspected of being contaminated with these agents.

A chemist and toxicologist from the health department may provide advice on toxicity and personnel protection, as well as recommendations to the scene manager regarding actions to be taken to reduce public health hazards. The Public Works Department may assist in containment and cleanup, if it has adequate PPE.

State Role

In a major incident, a local government may have to call on State agencies for specialized resources and knowledge. Such an action could involve a number of State agencies; their potential roles are described below.

- The *Office of Emergency Services* arranges State and *Regional* mutual aid support and provides liaison with State agencies.
- The *Department of Transportation* assists and/or provides for identification and containment of all materials on State highways and freeways or unincorporated county roadways.
- The *State Police* or *Highway Patrol* provides general control of the perimeter of the incident (regulating traffic, for example) and will play other roles depending on State law and incident requirements.
- The *Department of Fish and Game* and *Regional Water Quality Control Boards* provide recommendations and guidelines when hazardous material spills are likely to contaminate streams and/or waterways, or would otherwise affect wildlife resources.
- *State OSHA personnel* often possess a large reservoir of technical knowledge useful to an Incident Commander in the areas of exposure to, protection from, and control of hazardous materials. In an incident in which employees have been injured due to exposure, or in a prolonged incident, State OSHA personnel may respond.
- The *State Department of Health* employs health scientists who can help assess the potential human impact of a toxic release.
- The *State Department of Environmental Protection* can predict the environmental impact of actions the Incident Commander is considering.
- The *State and local Fire Marshals* have specific expertise relating to chemical behavior and State fire codes.

Federal Role

In the event of a major incident, the Federal government can also provide assistance to the local Incident Commander through the National Response Center (NRC). This center, staffed by the U.S. Coast Guard, operates a 24-hour hotline to receive and relay notices of major hazardous materials discharges to the appropriate authorities. When needed, the NRC can also make the expertise and other resources of Federal agencies available to the local government.

Other Sources of Information and Assistance

Other types of specialized assistance are available from governments, local industries, and from national organizations representing chemical manufacturers and transporters.

Hazardous Materials Response Teams (HMRTs). An HMRT is a specialized emergency response team formed to provide the particular skills, knowledge, and technical equipment needed to handle hazardous materials incidents. The chemical industry was the first provider of these services because it manufactured, transported, and used the products involved.

An HMRT is a major investment; whether the investment is warranted for a community depends on the nature of the risks it is facing as well as its resources. An HMRT would need specialized equipment, including expensive specialized protective clothing and detection instruments, containment vessel repair equipment, substance containment and recovery equipment, decontamination equipment, and instruments. The operating costs can be high—but so are the costs of a mismanaged incident. Often, local areas that cannot afford their own HMRTs pool their resources to form a more practical multijurisdictional team.

Specialized groups of emergency response personnel, known as Hazardous Materials Response Teams (HMRTs), meet the need for the specific knowledge and technical equipment required to handle hazardous materials incidents.

Regional Response Teams (RRTs). Regional Response Teams may be assembled to provide advice and support for transportation or fixed facility incidents that surpass the capability of State and local governments.

The RRT reports to an On-Scene Coordinator who directs the response in keeping with the local Incident Commander. RRTs are composed of representatives from Federal agencies and a representative from each State within a Federal Region. Overall responsibility for coordinating Federal emergency preparedness and planning on a nationwide basis rests with the NRT, which is composed of representatives from 14 Federal agencies with major environmental, transportation, emergency management, worker safety, and public health responsibilities.

The Federal resources available in a significant emergency are immense. How they are used, however, is determined by the Incident Commander, and regulated by State statutes and local ordinances.

CHEMTREC, CHLOREP, and NACA. The **Chemical Manufacturers Association established the CHEMical TRansportation Emergency Center, called CHEMTREC**, in 1971, to provide information for responders to chemical or hazardous materials emergencies. CHEMTREC operates in two stages:

1. Upon receipt of the name of a specific chemical, CHEMTREC provides immediate advice on the nature of the product and steps to be taken in handling the early stages of an emergency involving that product.

2. CHEMTREC promptly contacts the shipper of the material involved to obtain more detailed information and appropriate follow-up, including on-scene assistance when feasible.

3. CHEMTREC's operators can assist incident responders by providing information such as the physical properties of the chemical involved, appropriate protective clothing to be worn by response personnel, and general tactics to use with the various hazardous materials (e.g., certain hazardous materials-induced fires will need to be extinguished with water, while others should be smothered or covered with a special type of foam). CHEMTREC will not, however, tell the Incident Commander how to manage the incident.

Never call CHEMTREC unless a true emergency exists. It is important that telephone lines be open at all times for those who urgently need help. If you do call CHEMTREC, you will need to provide them with as much of the following information as is possible:

- Your name, and a number at which you can be called back
- The location of the problem
- The type of container involved
- The product, or type of product, involved
- The rail car or truck number
- Local conditions
- The shipper or manufacturer
- The intended receiver

The Chlorine Institute can provide specific technical assistance for chlorine emergencies. *CHLOREP*, the **CHLOR**ine *E*mergency *P*lan, provides telephone instruction to on-scene personnel in the United States and Canada, and, if necessary, can notify the nearest producer of chlorine and request that a trained team be dispatched.

The National Agricultural Chemicals Association (NACA) has identified a group of specialists designated as the Pesticides Safety Team (PST). The team provides advice for incidents involving pesticides and will dispatch

a response team to the site if one is needed.

Local Industry. Local industries, which use or generate hazardous materials, can also be sources of assistance. In general, the larger the firm, the more likely that it will be able to provide assistance in an emergency. The following types of companies are likely to have the knowledge, equipment, or personnel to provide local-level assistance:

- **Chemical companies**, which often have the equipment and personnel to respond to chemical spills.
- **Oil refining** and storage facilities, which may be able to assist at a spill of oil or gasoline.
- *Construction companies*, which can provide heavy equipment and operators when needed.
- **Transportation companies**, which can provide detailed information on the materials they carry, assist in evacuation, and may have trained personnel and specialized equipment.
- **Pollution cleanup contractors**, which have specialized equipment and trained personnel. Although a fee will be charged for the services provided, professional cleanup contractors are often the best (and quickest) source of advice and physical assistance at a spill.

Your local Emergency Operations Plan should maintain a current list of contacts and telephone numbers for all potential sources of assistance. Compiling this information during an emergency can waste valuable time when the need for action is urgent.

The Public. Unlike many other emergencies in which volunteer help is often welcome, in a hazardous materials emergency, there is usually little that untrained members of the public can do. Citizens should **never** try to approach the command post in a hazardous materials emergency; any information you wish to offer should be given by telephone from a safe distance. Observe all posted exclusion zones, and listen for public announcements on the radio or other local information system.

Communities use different methods to inform and direct the public in the event of an incident. In your community, which would most likely be used to notify you if an incident occurred that required you to evacuate or take other protective action?

Protecting Yourself in a HazMat or Terrorist Incident

If an accident involving hazardous materials occurs in your community, emergency services personnel will notify you as to what steps to take. Your best protection is to follow these directions, which are aimed at minimizing your exposure to the hazardous materials.

Public Warning and Notification Methods

Communities generally alert and notify the public as to emergency situations through one of the following methods:

- *Warning Sirens or Horns.* These audible warning devices are used to attract attention and alert citizens to an emergency situation. Different tones or tone patterns may have various meanings. These devices are outdoor warning systems, and may not be heard indoors or inside vehicles.
- *Emergency Alert System (EAS).* The radio and television Emergency Alert System can disseminate community emergency information, including where to go for additional information. This notification system requires individuals to be tuned in to the radio or television at the time of the announcement.

- *“All-Call” Telephoning.* This notification method uses an automated system to ring up area telephones and provide a recorded message when telephones are answered. Obviously, this type of notification works only for people who are within earshot of a telephone.

- *Announcements Over Cable Television.* In some communities, cable systems are hard-wired to enable emergency response forces to relay announcements over all cable television stations. Viewers may be alerted by a tone alert with a line of text across the bottom of their television set, an automatic cut-in with a picture and voice transmission from the emergency scene or a local agency, or a cut-in using voice communication only. As with the Emergency Broadcast System, this notification method is useful to people who are tuned in to a broadcast channel.

- *Residential Route-Alert.* In this method, motor vehicles equipped with public address systems travel predesignated routes to notify people of the emergency situation. Persons inside buildings may not hear this method. An alternative is door-to-door knocking by officials on foot.

What You Should Do

After you have been alerted of a hazardous materials incident, you should await further information from emergency response personnel. Upon receiving this information, follow it carefully. Your primary objective is to keep your distance from the incident in order to minimize your chances of contamination.

If you are caught outdoors during a hazardous materials incident, it is best to stay upstream, uphill, and/or upwind. Move toward a crosswind, so the wind is blowing from either the right or the left rather than directly in your face or at your back.

If you are caught outside in an incident, try to stay *upstream, uphill*, and *upwind*. You want to stay upstream from toxic waste flowing in water, so it is not carried towards you. Many toxic vapors are heavier than air and will tend to settle in low areas; thus, you are usually safest uphill where the topography will provide some protection.

Wind will play a critical role in distributing the toxic material, so you want to stay **upwind**—i.e., in the opposite area from where the wind is spreading the toxic fumes. If you are already caught in a plume, however, move in a crosswind direction, so the wind is blowing from either the right or left and not into your face or at your back.

How far away from an incident should you go to be safe? The answer to this will depend on weather conditions, topography, and the characteristics of the chemical itself. A high wind can carry the toxic substance many miles from the spill. Hills can delay dispersal, while the opposite is true of open country. (Your LEPC can gain low-cost access to highly sophisticated computer software that can project how far a plume is likely to extend under specific incident conditions.) In general, however, you should go at **least** 10 city blocks (one-half mile) from the danger area; for many incidents, you will need to go much further.

Evacuation

A major hazardous materials incident could require an evacuation of a large area. When a burning rocket fuels plant blew up in Henderson, Nevada, thousands had to leave the area, and interstate highway traffic was gridlocked. An overturned propane truck on New York’s Long Island kept 1,000 families from their homes for several days until the danger of explosion was over. At the peak of a fire at a plant where chlorine was stored, some 25,000 residents of Springfield, Massachusetts, were evacuated.

If you are asked to evacuate because of a hazardous materials emergency, **do so immediately**. Your local radio station or television channels should give you precise directions. Before leaving your home or office, close your windows and shut all vents to minimize contamination. If time permits, place a sign on your door or front window to notify the Public Service Department that your building has been evacuated and no one remains inside. It is also a good idea to provide a telephone number where you can be reached.

In a major emergency, the Red Cross and other local volunteer organizations will establish temporary shelters for evacuated residents. These shelters most frequently are located in schools or other large public facilities. Stay tuned to your radio for updates on the situation, evacuation routes, and alternative routes for traffic. If you are handicapped or need special assistance in order to evacuate, call your local police. (If you do **not** need this assistance, do **not** call; keep the line open for those who do!)

Your LEPC can gain access to highly sophisticated computer software that can project how far a plume will extend under specific incident conditions.

In-Place Sheltering

In certain circumstances, it is safer to keep community residents indoors than to evacuate them. Local authorities sometimes choose this option, known as in-place sheltering, when evacuation may expose people to large doses of toxic chemicals. If you are sheltered in your own home, strictly follow all instructions given by the emergency forces. The following procedures are intended to reduce risk in most incidents where in-place sheltering is used:

- To reduce the amount of toxic vapors entering your home, seal entry routes as efficiently as possible. Close windows and doors, and seal drafty places with wet towels, blankets, or tape.
- Turn off all ventilation, including furnaces, air conditioners, vents, and fans.
- If dangerous vapors are entering the building, take shallow breaths through a cloth or towel. (The same procedure may offer some protection from smoke in a fire.) While use of a cloth may be of value, it is important to emphasize that it is strictly a defensive measure and can provide only minimal protection. It certainly does *not* enable the wearer to enter a toxic environment! Portrayal of daring rescues on television using handkerchiefs for protection is erroneous and misleading, and should *not* be imitated.
- Remain in protected areas of the house where toxic vapors are reduced, and be sure to take your radio with you.

Other Protective Measures

A hazardous materials incident offers opportunities for exposure by three primary routes discussed earlier in this manual: inhalation, absorption, and ingestion. The following guidance will help you minimize your exposure by these routes. This guidance is intended to supplement—not replace—information given by local emergency services personnel.

Minimizing the Inhalation Hazard. If you are in a motor vehicle, close off ventilation and shut your windows. As we have seen, covering your mouth and nose with a cloth provides a minimal amount of protection from contamination. The best protection is to **distance** yourself from the source; sightseeing at an incident of this type is an unnecessary risk to your health.

Minimizing the Risk of Skin Absorption. The skin can easily absorb many toxic materials. Since even a small amount of a chemical substance may be toxic, you should avoid contact with any spilled liquid material, mist in the air, or condensed solid chemical deposit. Keep your body fully covered—including gloves and socks—but remember that these measures are only minimally effective. Once you have left the area, you should fully disrobe, proceed through decontamination, and dress in fresh clothing.

Avoiding Ingestion of Toxic Substances. Toxic substances can be ingested if your food or water supply becomes contaminated. If you learn that you will be sheltered indoors, quickly fill up your bathtub with a supply of uncontaminated water and turn off the intake valve to your home. Do not eat any food that could have become contaminated in an incident.

Decontamination. A person or item that has been exposed to a hazardous material is *contaminated* and can contaminate other people or items (i.e., *cross-contamination*). For example, if you enter your car after being

exposed to a toxic substance, you will contaminate your car.

Decontamination is the process of removing or neutralizing contaminants that have accumulated on people and equipment. At hazardous waste incidents, “clean” areas must be established and maintained, and materials in contaminated areas must be confined to specific “hot” zones. Response personnel who have had to enter the middle area—the contamination reduction zone—must later remove their clothing and equipment, shower in fresh water, be rinsed with neutralizing agents, re-shower, and change into clean clothing.

The specific procedure for decontamination will vary according to the chemical to which the individual was exposed. Certain items—e.g., leather and some plastic and rubber materials—absorb toxic substances so easily that they cannot be completely decontaminated; these items must be discarded.

Decontamination methods seek to:

- Physically remove contaminants
- De-activate contaminants by chemical detoxification or disinfection/sterilization
- Remove contaminants through a combination of both physical and chemical methods

The manufacturer of the substance can provide information on the appropriate decontamination method to follow. Basic information should be readily available on the substance’s container.

Once exposed to a toxic substance, clothing must be decontaminated or discarded prior to contact with human skin or other objects. Some materials, such as leather, absorb contaminants easily and must be discarded.

If you believe you may be contaminated and medical assistance is not immediately available, remove all of your clothing, shower thoroughly, don fresh loose warm clothing, and seek medical help. Advise *all* who come in contact with you that you may have been exposed to a toxic substance so they can take proper precautions. To avoid contaminating your home and others, place your exposed clothing in a nonpermeable container without allowing it to contact other materials, and arrange for proper disposal.

1. Wash down outer clothing (*unless the chemical is water-reactive*).
2. Remove clothing, working from the top down.
3. Wash down your entire body (*unless the chemical is water-reactive*).
4. Wrap up or dress in clean clothing.
5. Discard contaminated clothing in a well-secured plastic bag. Then, report to trained medical personnel at the earliest opportunity.

Reporting a Hazardous Materials Incident

If you witness a hazardous materials accident, spill, or leak, call 911 or your local emergency notification number as soon as possible. In rare cases in which no local emergency forces appear to be available, you can contact the NRC to report an emergency. Provide as much of the following information as possible:

- The chemical involved, if known
- Information on the substance’s placard or label, if it is visible

- Precise location of the incident
- Size of the incident, in quantitative terms
- Direction in which the plume is moving
- Color of the smoke or spilled liquid
- Altitude and movement of the plume (i.e., is the plume rising or sinking?)
- Number of injuries
- For a transportation incident, a description of the vehicle involved (e.g., tanker or pickup truck), including any identifying marks, numbers, or placards

What Citizens Can Do to Enhance Local Preparedness

If you witness a hazardous materials accident, spill, or leak, call 911 or your local emergency notification number with precise information about the incident.

As a concerned citizen, the first thing you can do is to find out how well—or poorly—your community is prepared for a hazardous materials incident.

Emergency Response Plans

Ask your LEPC if it has an emergency response plan in place for dealing with a hazardous materials incident for your community. A place to start if they do not have an emergency response plan is the guidance provided by the National Response Team (NRT) in their document entitled: “Integrated Contingency Plan Guidance.”

Integrated Contingency Plan Guidance (ICP)

The National Response Team has developed Integrated Contingency Plan (“ICP” or “One Plan”) Guidance. The ICP Guidance provides a way to consolidate into one functional emergency response plan the multiple plans that a facility may have prepared to comply with various regulations.

The ICP Guidance resulted from recommendations in the December 1993 NRT Report to Congress: *A Review of Federal Authorities for Hazardous Materials Accident Safety*. Facilities can use the ICP Guidance to consolidate their existing plans and to simplify their plan development and update process.

The ICP is available to facility owners and operators who must prepare emergency response plans for responding to oil discharges and releases of non-radiological hazardous substances. The NRT and the agencies responsible for reviewing and approving Federal response plans agree to accept plans prepared in the ICP format if the ICP option is appropriate for the facility. Your LEPC should be familiar with these plans and integrate the community plans into its template.

Few Community Plans Conform

Furthermore, of the relatively few communities that have Emergency Response Plans which include hazardous materials annexes or information, only a small fraction currently have plans that are considered acceptable and that conform to the NRT’s ICP Guidance.

Opportunities for Coordinated Planning

In addition to providing a mechanism for consolidating multiple facility response plans, the ICP Guidance also will improve coordination of response activities within the facility and with outside responders, minimize duplication, and simplify plan development and maintenance. The ICP sample format is based on the Incident Command System or "ICS." Organizing an ICP according to the ICS structure will allow the plan to dovetail with established response management practices and promote the usefulness of any given plan in an emergency. Response planners can use **ICP formatted plans to coordinate facility response plans with those maintained by LEPCs**, and as a tool for determining whether the facility complies with multiple agency regulations.

Tour Local Facilities

Community groups such as Neighborhood Watches, Environmental Coalitions, and Local Community Health Organizations should tour their neighborhood's chemical manufacturing and processing plants. Things to look and ask for during your site visit might include:

- Location of hazardous materials/chemicals storage areas
- Copies of their local Emergency Response Plans
- Location and access to company's SDSs
- Copies of Accident/Incident Report involving hazardous materials/chemicals onsite
- Review of Health and Safety Plans
- Review of employee training records

Review Local Emergency Response Plans

Each facility or plant will have its own local emergency response plan that will govern employees' actions during an upset or emergency condition. Local, State, and Federal laws require these emergency response plans. Ask to see the plan, and review it for notification requirements to the community during an emergency. Plans should incorporate evacuation and notification requirements. Ask them if their plan has been tested. That is, has it been activated through simulated emergency drills, which included all the major response agencies that are mentioned in the plan (fire department, law enforcement, hospitals, etc.)?

If they have had a drill or simulated emergency, there will be an After-Action Report (AAR), which will describe their response strengths and weaknesses. You can ask to see their last AAR; they may or may not provide you a copy of this report. Local fire departments responsible for servicing these companies keep records of their inspections, responses, and calls to these facilities. For a small fee, you can have copies of these reports. As discussed earlier, the LEPCs are notified regarding such emergencies and incidents that released a reportable quantity (RQ) of a hazardous substance into the environment. As a good community partner, these companies will have no problem cooperating with your requests on how they do business.

Review Accident/Incident Reports Involving Hazardous Materials/Wastes Onsite

Another means of evaluating the effectiveness of an organization's hazardous materials and waste programs will be how often the fire department and other emergency agencies have to come to the site as a result of a chemical release or spill. Fire departments must maintain records of these incidents and what actions they took to mitigate them during their response to onsite fires, spills, and leaks of hazardous materials and waste. There may be a small cost in obtaining these incident reports, but they are well worth the expense in determining how

effectively the site operations are being performed. Most fire departments will process your request for such reports without a lot of discussion. If they are unable to assist you, they can provide you the name, telephone number, and the address of someone who can help you obtain these reports.

Review of Written Safety and Health Program

These facilities are required to have in place a Site Safety and Health Program for workers and community safety. They will provide you with a copy of these Plans, or at least allow you to review them while you are visiting their sites. Things to look out for are: emergency procedures and community notification. Emergencies that impact the community are to be addressed in these plans, and also, how they will inform the community, and what steps they will take to ensure the health and well being of their surrounding communities.

Employers shall develop and implement a written safety and health program for their employees involved in hazardous waste operations or hazardous waste handling procedures. The program shall be designed to identify, evaluate, and control safety and health hazards, and to provide for emergency response for hazardous waste operations.

The written safety and health program shall incorporate the following:

- An organizational structure;
- A comprehensive work plan;
- A **site-specific safety and health plan;**
- The safety and health training program;
- The medical surveillance program;
- The employer’s standard operating procedures for safety and health; and
- Any necessary interface between general program and site-specific activities.

Effectiveness of the Site Safety and Health Plan

Inspections shall be conducted by the site safety and health supervisor or, in the absence of that individual, another individual who is knowledgeable in occupational safety and health, acting on behalf of the employer as necessary to determine the effectiveness of the site safety and health plan.

The employer, when identified through inspections or site incidents, must correct any deficiencies in the effectiveness of the site safety and health plan. These inspections reports should be a part of the community’s evaluation of the site’s compliance with OSHA’s health and safety standards.

Review Employee Training Records

All employees working onsite (such as but not limited to equipment operators, general laborers, and others) exposed to hazardous substances, health hazards, or safety hazards, and their supervisors and managers responsible for the site operations, shall receive training before they are permitted to engage in hazardous waste operations or waste handling duties that could expose them to hazardous substances, safety, or health hazards. They are also required to receive annual refresher training.

Employees shall not be permitted to participate in or supervise field activities until they have been trained to a level required by their job function and responsibility.

The training shall thoroughly cover the following information:

- Names of personnel and alternates responsible for site safety and health;
- Safety, health, and other hazards present on the site;
- Use of personal protective equipment;
- Work practices by which the employee can minimize risks from hazards;
- Safe use of engineering controls and equipment on the site;
- Medical surveillance requirements, including recognition of symptoms and signs which might indicate overexposure to hazards;
- Emergency procedures; and
- The contents of the site safety and health plan.

Training records are a good means of determining how well site personnel have been trained to perform their jobs and to respond to site emergencies. These records should be reviewed during your site visit to ensure first training is being conducted, and finally, that each worker's refresher training is current. The lack of real training is the root cause for accidents and spills during daily operations. This *training is mandatory*. All training records must be maintained onsite, and should be made available for review during your site visit.

Educate Other Residents

Finally, another way to enhance local emergency preparedness is to help educate other residents. Write articles for your local newspaper (or interest someone who can) about the potential for injury and death to people and great harm to the environment that can be caused by hazardous materials. Also, offer to speak to community groups, or locate effective speakers who can help the community understand the issues and correct local problems.

Summary

Protecting a community from the consequences of a hazardous materials accident requires teamwork that does not happen automatically. Responders to an incident must be working in a framework that clearly specifies their respective responsibilities. This means agreeing together on how they would locate and direct the resources—both personnel and equipment—a hazardous materials incident might require, documenting their shared understanding in a plan, training responders to fulfill their responsibilities, and conducting periodic tests to be sure the plan is realistic and responders are ready to carry it out.

In the event of a major incident, local responders could access additional expertise through State and Federal agencies. Local citizens, however, can do little to assist in most such incidents. Rather than trying to volunteer to assist, citizens should be aware of what public information systems would be used and tune in to them for instructions. Citizens should also do what they can to minimize their exposure to toxic substances; in some cases, staying indoors with tightly closed windows may be healthier than evacuating through toxic vapors. The responding agencies will have access to information about the chemical, its behavior, weather conditions, and other data essential to make the best decision about protecting lives; therefore, it is of primary importance to follow their directions.