HAZARDOUS MATERIALS
OPERATIONS-LEVEL TRAINING
FOR THE FIRST RESPONDER

2nd Edition
Revised May 1, 2000

ACKNOWLEDGEMENTS

Too often, those who "do the work" are not acknowledged in the development of programs and resources that we come to depend upon for our courses.

The Michigan Hazardous Materials Training Center extends a heartfelt thanks to everyone involved in the revising and development of the 2nd Edition of the Emergency Response to Hazardous Materials Incidents, First Responders, Operations student manual, revised in the year 2000.

Thank you to Captain John A. Jackson, Adrian Fire Department, and Captain J. Edward Halcomb, Portage Fire Department, for their leadership and guidance in being responsive to feedback from the field. Their wisdom in choosing what to alter in the curriculum was exceptional.

Thank you to Ms. Christine Wirth for her many hours of typing to enter the student manual into a more universal format of Microsoft Word. Her talents were exceptional when it came to scanning and pasting images into the manual.

Thank you, to Mrs. Susan Davidson for the numerous hours she spent proofing the manual for us.

Ron Tennant and Rich Mahaney as well as many others contributed feedback and input which was vital to this year 2000 update of our "Operations" student manual. Thank you to all of those unsung contributors.

TABLE OF CONTENTS

Introduction ... 5
- **Attachment A** ... 7
  - Kansas City Blast
- **Attachment B** ... 8
  - Flint Chemical Blaze
- **Attachment C** ... 9
  - Michigan Department of Labor Citation
- **Attachment D** ... 12
  - OSHA 1910.120 Standard
- **Attachment E** ... 49
  - How to Read A Material Safety Data Sheet
- **Attachment F** ... 55
  - MSDS Example
- **Attachment G** ... 63
  - MIOSHA Hazardous Waste Operations & Emergency Response Rules
- **Attachment H** ... 114
  - Office of Fire Safety Bulletin No. OFS-09

Unit One: Recognition ... 131
- **Recognizing Terrorist Incidents** ... 132
- **Chemical & Radiation Hazards, & Pesticide Recognition** ... 143
- **Toxicology For The First Responder** ... 160
- **Attachment J** ... 162
  - Cancer Forces Early Retirement
- **Toxic Products of Combustion** ... 172

Unit Two: Evaluation ... 180
Medical Surveillance ... 181
Chemical Effect on Organs & Diagnostic Tests ... 190
Personal Protective Equipment ... 205
Attachment K ... 212
Chemical Permeation Performance Chart
Attachment L ... 213
How Chemicals Affect Kevlar
Attachment M ... 214
PBI
Attachment N ... 215
Chemical Resistance of Nomex

Unit Three: Control ... 239
Decontamination ... 240
Attachment O ... 244
Chemtrec Emergency Assistance Guidelines
Attachment P ... 248
Decon Hot Zone Form
Attachment Q ... 249
Decon Zone Flow Chart
Attachment R ... 250
Decon Line Diagram
Attachment S ... 253
Emergency Decon Procedures
Attachment T ... 256
NFPA Emergency Decon Procedure
Confinement & Containment ... 258
SOPs in a Hazmat Emergency Response ... 264
Attachment T1 ... 267
Hazmat Incident Notification Message Form
Emergency Response ... 268
Attachment U ... 270
ICS Chain of Command
Attachment V ... 280
Hazmat Response Installations and Zones

Glossary of Hazmat Terminology ... 284

INTRODUCTION

❑ What are hazardous wastes and materials?

We are all familiar with wastes as materials not worth saving or used up and thrown away. Some are produced in homes and also in factories and farms. Waste can be a nuisance, and sometimes harmful. Hazardous wastes are categorically different from refuse and need to be handled differently. They pose risks to human health that range from harmful (immediately or long-term) to catastrophic. In addition, hazardous wastes are serious threats to air, water, and land whose purity is necessary to sustain life as well as animals, farmland and property. Both the toxicity of hazardous materials plus the danger of fire or explosion make them potentially life threatening. This course will teach respect for the extreme hazards posed by hazardous materials and at the same time give First Responder Operations personnel the confidence, through knowledge and understanding, to handle them safely and appropriately. This course will provide the first responder with some defensive techniques to aid in mitigation of hazardous materials incidents.

❑ What is a hazardous material?

A hazardous material is any substance in quantity of form that may pose an unreasonable risk to health, safety, or property.

❑ Where do we find hazardous materials and wastes?

Hazardous materials are shipped throughout the country by rail, highway, air, water, and pipeline. They are stored at terminals for loading and unloading. The largest quantities are transported by rail, water, and pipelines. More than 1 billion tons per year are shipped by highway, including 1 million tons of explosives, 300,000 tons of poisons, and 100,000 shipments of radioactive isotopes. They are stored in nearly every community on farms, in hospitals, local chemical dealers and petroleum tank farms.

❑ What kind of emergencies can occur with hazardous materials?

Sometimes accidents occur and hazardous materials or wastes are spilled during shipment or storage. This may be from a broken or rusted drum, leaking tanks, tank cars, barges, and boats. This also can happen in a factory from mistakes or faulty equipment. Sometimes chemicals or fuels are spilled during shipment, and thereby become wastes. We all have read about shorelines and beaches being damaged from leaking crude oil tankers. The threat of intentional releases of hazardous materials such as chemicals and biological toxins is increasingly prevalent in our society. International and domestic terrorist groups and individuals are

now demanding more attention to the threat of intentional, criminal releases of hazardous substances. Several significant events involving hazardous substances are described below.

❑ Love Canal

In other cases, hazardous wastes may leak out of landfill areas. Much of the public pressure for passage of current laws on controlling hazardous wastes resulted from reports about Love Canal in the early 1980's. This was an unfinished canal in the southeast corner of the city of Niagara Falls that was lined with a layer of hazardous waste in the 1950's. After it was filled it was sealed on top with clay, given by the owner, Hooker Chemical, to the city as a gift for use as a park. A school was built on this land, and residential housing was built closely around the canal. After some time, noxious chemicals leaked into basements of nearby houses. Some were identified as possible causes of cancer. There also was concern that the Niagara River could be contaminated, since this is an important drinking water source for several U.S. and Canadian cities.

The residents of the area were highly alarmed and organized for action. After years of study and dispute, the homes were purchased by the state and evacuated. Much of the area has now been reclaimed and is inhabited. It is difficult to prove that the chemicals caused the cases of cancer that were seen there, because about one quarter of all deaths across the United States are from cancer. Although millions of dollars were spent on the investigation of this one case, there are 152 hazardous waste disposal sites in Niagara and adjacent Erie counties, and thousands more elsewhere.

❑ Bhopal, India

One of the most lethal hazardous materials incidents occurred on December 2, 1984, at the Union Carbide plant in Bhopal, India. Late that night, a large quantity of methyl isocyanate (MIC) was released into the surrounding environment. The resulting exposure killed over 2,600 people and 2,000 animals. Another 200,000 persons were injured. The cause of the release was attributed to a lack of several safety devices being in place in addition to speculation indicating possible intentional sabotage. This incident became a significant catalyst for the promulgation of hazardous materials legislation in the United States.

❑ Kansas City

Firefighters are at special risk from accidents involving hazardous materials. On November 30, 1988, six Kansas City firefighters were killed when 45,000 pounds of ammonium nitrate exploded in an evacuation site south of the city. This was the worst single firefighter tragedy to occur in the United States in that decade.

Firefighters were called to the scene to fight a fire in a pickup truck. The truck was located at a construction site where the ammonium was stored in a 40 to 50 foot tractor trailer. The first blast occurred as firefighters were handling the blaze. The second blast took place 40 minutes later in another trailer located nearby. The blasts left two craters measuring 40 feet wide and 6 feet deep. The remains of one fire truck were sitting next to one of the craters. Another fire truck was completely destroyed, leaving no evidence that it was ever there. The dispatcher did warn the firefighters to use caution because of the presence of explosives. However, the construction company did not inform the fire department as to the specific hazardous material present or the amount.

This disaster could have been prevented if the firefighters knew what danger was awaiting them. The Missouri Department of Natural Resources is investigating the accident to determine if the construction company violated the chemical reporting requirements under Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA).

This case provides a gruesome example of the need for fire departments to demand access to hazardous materials information, to conduct pre-incident planning, and to provide training to firefighters who are called upon to respond to hazardous materials incidents. (See Attachment A)

Kansas City blasts kill 6 firefighters

Associated Press

KANSAS CITY, Mo. — Construction trailers loaded with 45,000 pounds of a chemical used in dynamite exploded Tuesday, killing six firefighters, ripping large craters in the ground and shattering windows up to 10 miles away.

The first trailer was filled with an estimated 30,000 pounds of ammonium nitrate, which is used to make dynamite explode more evenly, authorities said. The second trailer was storing about 15,000 pounds of the material. A third explosion occurred moments later in what was believed to be a portion of the first trailer that had been blown apart.

"It's the worst thing I've ever seen," said Battalion Chief Marion Germann.

Debris was scattered over several acres around the construction site in south Kansas City and onto nearby U.S. 71, said police spokesman Sgt. Greg Mills.

The blasts left two very large craters, 30 to 40 feet wide and 6 or 7 feet deep, and a smaller one about 15 feet across and 4 feet deep.

Associated Press

"The remains of one fire truck are sitting very close to one crater," said fire department spokesman Harold Knabe. "There is another vehicle of some sort, a large red truck. The other fire truck — there is absolutely no evidence that it was ever there."

Firefighters were already at the construction site when the explosions rocked the area about 4 a.m.

Investigators believe the fires might have been intentionally set.

Firefighters unaware of chemicals that injured 85

By Dennis B. Mulqueen
News Lansing Bureau

FLINT — Fire officials said they were not fully aware they were dealing with dangerous chemicals when they arrived to battle a plastics plant blaze that injured 85 persons early Wednesday.

Flint Township Fire Capt. James Bielby said Wednesday his department had lost track of records indicating dangerous chemicals were stored at the factory because the business had changed hands.

"It used to be a garage door manufacturer, but we weren't made aware of (the change)," he said. "It's one of those cases where everything's against you."

SIX FIREFIGHTERS remained hospitalized Wednesday after inhaling toxic fumes from the fire at the Diverse Plastics Inc. manufacturing plant.

A total of 194 firefighters from 27 departments battled the blaze in rural Flint Township from 8 p.m. Tuesday until 4 a.m. Wednesday. Seven residents living near the plant and 78 firefighters were sent to area hospitals after inhaling isocyanate fumes from the blaze.

All of the residents were treated and released, said Flint Township Fire Chief Donald S. Rowley. Of the six hospitalized firefighters, one had a broken shoulder suffered in a fall from a platform and five suffered from smoke inhalation, he said.

ABOUT 500 families from a mile square area north, west and east of the plant were evacuated from their homes and not allowed to return until 3 a.m., Rowley said.

Bruce Dorland of the Genesee County Coordination Center said residents were evacuated as a precaution because isocyanate — used by the company to manufacture plastic automotive bumpers — could be harmful if consumed or absorbed through the skin.

Bielby, when asked if firefighters knew they were facing a fire involving isocyanates, said "I wish I could tell you yes. We had one person on duty (in the fire house) — and he went to the fire."

LOCAL OFFICIALS credited the availability of information from the firm, plus the presence of compa-

Please see Flint/2B

CHARLES V. JAKE/The Detroit News

Workers are outlined Wednesday to clean up after the fire at the Diverse Plastics plant in Flint Township.

Flint

Crews unaware of chemical peril

From page 1B

ny officials on the scene, with keeping the situation from becoming worse.

Bielby blamed the wind direction for problems suffered by firefighters.

"It was just a bad situation because of the wind," Bielby said. "We had to go upwind about 400 or 500 yards to get in there."

Bob Zeffero, co-owner of Diverse Plastics, estimated damages at $3 million. But he praised firefighters for saving portions of the building.

ZEFFERO SAID no one was inside the building when the fire started.

Michigan State Police will conduct an investigation as soon as the building is safe to enter, said Lt. Thomas Endelman of the State Police fire marshal division.

"Our investigation will be aimed at determining the cause and origin of the fire as well as what specifically went wrong and how some of the injuries and exposures could have been avoided," Endelman said.

He said the Michigan Occupational Safety and Health Administration also will investigate.

INITIALLY, command officers at the scene decided to allow the blaze to burn itself out without risking injury to firefighters, according to Rowley. The decision to attempt to extinguish the blaze was made after receiving a weather report which predicted shifting winds.

"If every decision we made was perfect and every response was perfect and the weather was perfect then of course we wouldn't have had anybody go to the hospital," Rowley said.

"But things just don't happen that way. There are just too many unforeseens in this business."

John H. West Jr., director of the Genesee County Civil Defense Department, which is in charge of disaster planning for the county, said the incident raises several questions.

"Could better training have prevented some of the injuries?" he said. "Could better and more readily available information about the chemicals in there have prevented some of this exposure? Could better storage at the plant or other safety precautions there have prevented this?

"These are some of the things we'll be taking a close look at."

Detroit News
12/1/88

LABOR

Inspection/In . . Date November 30, 1988

C.M. - 12-29-88
C.R. - 12-23-88

Michigan Department of Labor, -
Bureau of Safety and Regulation
Occupational Industry Safety Division
State Secondary Complex, 7150 Harris Drive
P.O. Box 30015, Lansing, Michigan 48909
Telephone 517/322-1831

CITATION

Citation No. G1 [illegible]-9001

County: GENESEE

Page 1 of 1

Employer	Location of Inspection	Street Address	City	Zip	Phone
Flint Township Fire Department Station #1		5331 Ruben St.	Flint, MI 48532		732-4412

Mailing address if other than above address	City	Zip	Phone

Based on conditions found or information obtained at the location of inspection/investigation, it is alleged that you have violated Act 154, P.A. 1974. Alleged violations must be corrected by abatement date(s) noted below. In accordance with Sec. 33 & 35, Act 154, P.A. 1974, penalties are as indicated and shall be paid within 15 days after becoming a final order of the Board of Health and Safety Compliance and Appeals.

Item No.	Abatement Date		Type of Viol.	Penalty	Standard, Rule, Order, Part Number or Sec. of Act Allegedly Violated and Description of Alleged Violation The employer failed to comply with:
1	02/06/89		S	$300	ACT 154 PA of 1974, Sec. 14(1) Failed to prepare and disseminate to each fire fighting employee a plan for executing the department's responsibility with respect to each site within the fire department's jurisdiction where hazardous chemicals are used or produced.
2	02/06/89		OTS	$115	Fire Fighting, PART 74, RULE 7411(2) Failed to prepare a written policy which establishes the type, amount and frequency of training to be provided to fire service personnel.

Page Total ~~$515~~

-17-

❑ Diverse Plastics, Flint

On November 29, 1988, a total of 194 firefighters from 27 departments battled a blaze at the Diverse Plastics plant in Flint Township. Seven residents living near the plant and 78 firefighters were sent to area hospitals after inhaling isocyanate fumes created by the fire.

Although many of the firefighters were sent to the hospital as a precautionary measure, this incident also demonstrates the critical need of providing hazard information before a fire occurs. As in the Kansas City case, fire officials said they were not fully informed they were dealing with hazardous chemicals when they arrived to fight the fire. The plant had recently changed hands and the local fire department did not have accurate records on the chemical contents of the plant.

The severity of the incident was lessened because the company did provide the information after the fire began and did have representatives on the scene.

The Flint Township Fire Department was cited by the Michigan Department of Labor for failure to prepare for fighting fires at this facility. The Fire Department was also cited for failure to establish a training program for its firefighters. The State Police were also investigating violations regarding the availability of information and the manner in which chemicals were stored at the plant. (See Attachment B & C)

Again, this incident brings home the importance of providing chemical information to fire departments and developing plans for fighting fires that involve hazardous materials. Without pre-planning, the threat to first responders increases dramatically.

❑ Terra Industries

An explosion in an ammonium nitrate fertilizer facility in the early morning hours of December 13, 1994, in Port Neal, Iowa killed four persons and injured eighteen others. Approximately 5,700 tons of anhydrous ammonia, 25,000 gallons of nitric acid, and a large volume of liquid ammonium nitrate solution were released. Off site ammonia releases continued for about six days and migrated several miles. The releases of chemicals has resulted in extensive environmental contamination.

❑ Is there a difference between a structural fire and a hazardous materials incident?

Although many structural fires include the burning of plastics and other synthetic materials that give off a toxic gas, there are differences. A hazardous materials incident occurs when toxic chemicals or materials are released from their proper container causing unreasonable risks. That release could involve a fire but many times does not. However, as our knowledge and awareness of hazardous materials increases, the differences seem to be growing smaller. The similarities involving these incidents reinforce the need for wearing protective clothing, including breathing protection and implementing simple decontamination procedures at every fire.

❑ What legal protections exist for emergency responders?

A number of laws, regulations and standards have been adopted at the federal and state level, all of which were designed to protect emergency responders from hazardous materials. In this course we will focus on three of these laws or regulations. These include:

- **The Superfund Amendments and Reauthorization Act of 1986 (SARA).**

  Title I – Hazardous Waste Operations and Emergency Response Standard (OSHA 29 CFR 1910.120)

Title III – Emergency Planning and Community Right-to-Know

- **The Michigan HAZWOPER Law (1991)**
- **Michigan's Firefighter and Employee Right-to-Know Laws**

NOTE: In this section on Rights and Responsibilities, these three laws are described in outline form. Additional material is provided at the end of this unit.

❑ SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT OF 1986

SARA was passed by the U.S. Congress in the fall of 1986 in response to the growing pressure of unions, environmental groups, firefighters, health professionals, and concerned citizens. These groups were reacting to continuing problems regarding hazardous materials accidents, contamination, and the lack of adequate hazard information.

Although other hazardous materials and environmental laws existed before SARA was passed, SARA is likely the single most important of all such laws from the stand point of emergency response and planning.

It is estimated that in the U.S. alone there are up to 50,000 shipments of hazardous materials **every day**. Unfortunately for us, many times these materials do not reach their desired destination or are inappropriately used once they do. This has resulted in an estimated **25,000 Hazardous Materials Accidents a Year in the United States.**

The long term damage to health and the environment is of course difficult to assess, but the immediate effects alone have led to hundreds of deaths and thousands of injuries to workers, emergency responders, and ordinary citizens every year. In Bhopal, India more than 2,000 citizens were killed in a single day when a deadly gas leaked from a chemical plant. With the passage of SARA, Congress hoped that the likelihood of such accidents could be drastically reduced.

SARA includes three separate sections or titles that define the law. The first and third titles deal extensively with emergency response and planning, while the second primarily concerns the establishment of a fund for hazardous waste clean-up. Title I and III are described below.

- **Hazardous Waste Operations and Emergency Response Standard (from SARA, Title I) 29 CFR 1910.120**

Title I of SARA directed the Federal Occupational Safety and Health Administration (OSHA) to draft a standard which protects workers, including emergency responders, from exposures to hazardous materials. OSHA adopted an interim standard in December of 1986. The final standard became effective in March, 1990. (*See Attachment D)*

In this standard, OSHA defines requirements for training, medical surveillance, and emergency response plan preparations for fire departments, fire brigades, and other emergency response organizations. Some of the specific provisions found in Sections (p) and (q) of the standard are as follows:

- **Preparation of Emergency Response Plans**

Emergency response organizations must prepare a written emergency response plan for the protection of its employees. This plan must include the use of the Incident Command System (ICS). Additional elements of a plan must address, at a minimum:

1. Pre-emergency planning
2. Personnel roles, lines of authority, training and communication
3. Emergency recognition and prevention
4. Safe distances and places of refuge

1910.120 – HAZARDOUS WASTE OPERATIONS AND EMERGENCY RESPONSE

(a) Scope, application, and definitions.

(1) **Scope.** This section covers the following operations, unless the employer can demonstrate that the operation does not involve employee exposure or the reasonable possibility for employee exposure to safety or health hazards:

(i) Clean-up operations required by a governmental body, whether Federal, state, local or other, involving hazardous substances that are conducted at uncontrolled hazardous waste sites (including, but not limited to, the EPA's National Priority Site List (NPL), state priority lists, sites recommended for the EPA NPL, and initial investigations of government identified sites which are conducted before the presence or absence of hazardous substances has been ascertained);

(ii) Corrective actions involving clean-up operations at sites covered by the Resource Conservations and Recovery Act as amended (42 U.S.C. 6901 *et seq.)*

(iii) Voluntary clean-up operations at sites recognized by Federal, state, local or other governmental bodies as uncontrolled hazardous waste sites;

(iv) Operations involving hazardous wastes that are conducted at treatment, storage, and disposal (TSD) facilities regulated by 40 CFR Part 264 and 265 pursuant to RCRA; or by agencies under agreement with U.S.E.P.A. to implement RCRA regulations; and

(v) Emergency response operations for releases of, or substantial threats of releases of, hazardous substances without regard to the location of the hazard.

(2) **Application.**

(i) All requirements of Part 1910 and Part 1926 of Title 29 of the Code of Federal Regulations apply pursuant to their terms to hazardous waste and emergency response operations whether covered by this section or not. If there is a conflict or overlap, the provision more protective of employee safety and health shall apply without regard to 29 CFR 1910.5(c)(1).

(ii) Hazardous substance clean-up operations within the scope of paragraphs (a)(1)(I) through (a)(1)(iii) of this section must comply with all paragraphs of this section except paragraphs (p) and (q).

(iii) Operations within the scope of paragraph (a)(1)(iv) of this section must comply with only the requirements of paragraph (p) of this section.

Exceptions: For large quantity generators of hazardous waste who store those wastes less than 90 days and for small quantity generators of hazardous wastes, who have emergency response teams that respond to releases of, or substantial threats of releases of hazardous substances, for their RCRA workplaces only paragraph (p)(8) of this section is applicable. Such generators of hazardous wastes who do not have emergency response teams that respond to releases of hazardous substances are exempt from the requirements of this section.

(iv) Emergency response operations for releases of, or substantial threats of releases of, hazardous substances which are not covered by paragraphs (a)(1)(I) through (a)(1)(iv) of this section must only comply with the requirements of paragraph (q) of this section.

(3) **Definitions.** "Buddy system" means a system of organizing employees into work groups in such a manner that each employee of the work group is designated to be observed by at least one other employee in the work group. The purpose of the buddy system is to provide rapid assistance to employees in the event of an emergency.

"Clean-up operation" means an operation where hazardous substances are removed, contained, incinerated, neutralized, stabilized, cleared-up, or in any other manner processed or handled with the ultimate goal of making the site safer for people or the environment.

"Decontamination" means the removal of hazardous substances from employees and their equipment to the extent necessary to preclude the occurrence of foreseeable adverse health affects.

"Emergency response" or "responding to emergencies" means a response effort by employees from outside the immediate release area or by other designated responders (i.e., mutual-aid groups, local fire departments, etc.) to an occurrence which results, or is likely to result, in an uncontrolled release of a hazardous substance. Responses to incidental releases of hazardous substances where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area, or by maintenance personnel are not considered to be emergency responses within the scope of this standard. Responses to releases of hazardous substances where there is no potential safety or health hazard (i.e.. fire, explosion, or chemical exposure) are not considered to be emergency responses.

"Facility" means (A) any building, structure, installation, equipment, pipe or pipeline (including any pipe into a sewer or publicly owned treatment works), well, pit, pond, lagoon, impoundment, ditch, storage container, motor vehicle, rolling stock, or aircraft, or (B) any site or area where a hazardous substance has been deposited, stored, disposed of, or placed, or otherwise come to be located; but does not include any consumer product in consumer use or any water-borne vessel.

(4) "Hazardous materials response (HAZMAT) team" means an organized group of employees, designated by the employer, who are expected to perform work to handle and control actual or potential leaks or spills of hazardous substances requiring possible close approach to the substance. The team members perform responses to releases or potential releases of hazardous substances for the purpose of control or stabilization of the incident. A HAZMAT team is not a fire brigade nor is a typical fire brigade a HAZMAT team. A HAZMAT team, however, may be a separate component of a fire brigade or fire department.

"Hazardous substance" means any substance designated or listed under paragraphs (A) through (D) of this definition, exposure to which results or may result in adverse affects of the health or safety of employees.

(a) Any substance defined under section 101(14) of CERCLA;

(b) Any biological agent and other disease-causing agent as defined in section 101(#3) of CERCLA;

(c) Any substance listed by the U.S. Department of Transportation as hazardous materials under 49 CFR 172.101 and appendices; and

(d) Hazardous waste as herein defined.

"Hazardous waste" means

(a) A waste or combination of wastes as defined in 40 CFR 261.3, or

(b) Those substances defined as hazardous wastes in 49 CFR 171.8

"Hazardous waste operation" means any operation conducted within the scope of this standard.

"Hazardous waste site" or "Site" means any facility or locations within the scope of this standard at which hazardous waste operations take place.

"*Health hazard*" means a chemical, mixture of chemicals or a pathogen for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees, the term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, heptaotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and agents which damage the lungs, skin, eyes, or mucous membranes. It also includes stress due to temperature extremes. Further definition of the terms used above can be found in Appendix A to 29 CFR 1910.1200.

"IDLH" or "Immediately dangerous to life or health" means an atmospheric concentration of any toxic, corrosive or asphyxiant substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere.

"Oxygen deficiency" means that concentration of oxygen by volume below which atmosphere supplying respiratory protection must be provided. It exists in atmospheres where the percentage of oxygen by volume is less than 19.5 percent oxygen.

"Permissible exposure limit" means the exposure, inhalation or dermal permissible exposure limit specified in 29 CFR Part 1910, Subparts G and Z.

"Published exposure level" means the exposure limits published in "NIOSH Recommendations for Occupational Health Standards" dated 1986 incorporated by reference, or if none is specified, the exposure limits published in the standards specified by the American Conference of Governmental Industrial Hygienists in their publication "Threshold Limit Values and Biological Exposure Indices for 1987-88" dated 1987 incorporated by reference.

"Post exposure level" means that portion of an emergency response performed after the immediate threat of a release has been stabilized or eliminated and clean-up of the site has begun. If post emergency response is performed by an employer's own employees who were part of the initial emergency response, it is considered to be part of the initial response and not post emergency response. However, if a group of an employer's own employees, separate from the group providing initial response, performs the clean-up operation, then the separate group of employees would be considered to be performing post-emergency response and subject to paragraph (g)(11) of this section.

"Qualified person" means a person with specific training, knowledge and experience in the area for which the person has the responsibility and the authority to control.

"Site safety and health supervisor (or official)" means that individual located on a hazardous waste site who is responsible to the employer and has the authority and knowledge necessary to implement the site safety and health plan and verify compliance with applicable safety and health requirements.

"Small quantity generator" means a generator of hazardous wastes who in any calendar month generates no more than 1,000 kilograms (2.205 pounds) of hazardous waste in that month.

"Uncontrolled hazardous waste site" means an area where an accumulation of hazardous waste creates a threat to the health and safety of individuals or the environment or both. Some sites are found on public lands, such as those created by former municipal, county, or state landfills where illegal or poorly managed waste disposal has taken place. Other sites are found on private property often belonging to generators or former generators of hazardous wastes. Examples of such sites include, but are not limited to, surface impoundments, landfills, dumps, and tank or drum farms. Normal operations at TSD sites are not covered by the definition.

(b) Safety and health program.

Note to (b): Safety and health programs developed and implemented to meet other Federal, state, or local regulations are considered acceptable in meeting this requirement if they cover or are modified to cover the topics required in this paragraph. An additional or separate safety and health program is not required by this paragraph.

(1) **General.**

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

(ii) The written safety and health program shall incorporate the following:

(a) An organized structure;

(b) A comprehensive workplan;

(c) A site-specific safety and health plan which need not repeat the employer's standard operating procedures required in paragraph (b) (1)(ii)(F) of this section;

(d) The safety and health training program;

(e) The medical surveillance program;

(f) The employer's standard operating procedures for safety and health; and

(g) Any necessary interface between general program and site specific activities.

(iii) **Site excavation**. Site excavations created during initial site preparation or during hazardous waste operations shall be shored or sloped as appropriate to prevent accidental collapse in accordance with Subpart P of 29 CFR Part 1926.

(iv) Contractors and sub-contractors. An employer who retains contractor or sub-contractor services for work in hazardous waste operations shall inform those contractors, sub-contractors, or their representatives of the site emergency response procedures and any potential fire, explosion, health, safety or other hazards of the hazardous waste operation that have been identified by the employer, including those identified in the employer's information program.

(v) Program availability. The written safety and health program shall be made available to any contractor or sub-contractor or their representative who will be involved with the hazardous waste operation; to employees; to employee designated representatives; to OSHA personnel, and to personnel of other Federal, state, or local agencies with regulatory authority over the site.

(2) **Organizational structure part of the site program.**

(i) The organizational structure part of the program shall establish the specific chain of command and specify the overall responsibilities of supervisors and employees. It shall include, at minimum, the following elements:

(a) A general supervisor who has the responsibility and authority to direct all hazardous waste operations.

(b) A site safety and health supervisor who has the responsibility and authority to develop and implement the site safety and health plan and verify compliance.

(c) All other personnel needed for hazardous waste operations and emergency response and their general functions and responsibilities.

(d) The line of authority, responsibility, and communication.

(ii) The organizational structure shall be reviewed and updated as necessary to reflect the current status of waste site operations.

(3) **Comprehensive workplan part of the site program.** The comprehensive workplan part of the program shall address the tasks and objectives of the site operations and the logistics and resources required to reach those tasks and objectives.

(h) The comprehensive workplan shall address anticipated clean-up activities as well as normal-operating procedures, which need not repeat the employer's procedures available elsewhere.

(ii) The comprehensive workplan shall define work tasks and objectives and identify the methods for accomplishing those tasks and objectives.

(iii) The comprehensive workplan shall establish personnel requirements for implementing the plan.

(iv) The comprehensive workplan shall provide for the implementation of the training required in paragraph (e) of this section.

(v) The comprehensive workplan shall provide for the implementation of the required informational programs required in paragraph (i) of this section.

(vi) The comprehensive workplan shall provide for the implementation of the medical surveillance program described in paragraph (f) of this section.

(4) **Site specific safety and health plan part of the program.**

(i) **General.** The site safety and health plan which must be kept on site, shall address the safety and health hazards of each phase of site operation and include the requirements of procedures for employee protection.

(ii) **Elements.** The site safety and health plan, as a minimum, shall address the following:

(a) A safety and health risk or hazard analysis for each site task and operation found in the workplan.

(b) Employee training assignments to assure compliance with paragraph (e) of this section.

(c) Personal protective equipment to be used by employees for each of the site tasks and operations being conducted as required by the personal protective equipment program in paragraph (g)(5) of this section.

(d) Medical surveillance requirements in accordance with the program in paragraph (f) of this section.

(e) Frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used, including methods of maintenance and calibration of monitoring and sampling equipment to be used.

(f) Site control measures in accordance with the site control program required in paragraph (d) of this section.

(g) Decontamination procedures in accordance with paragraph (k) of this section.

(h) An emergency response plan meeting the requirements of paragraph (l) of this section for safe and effective responses to emergencies, including the necessary PPE and other equipment.

(i) Confined space entry procedures.

(j) A spill containment program meeting the requirements of paragraph (j) of this section.

(iii) **Pre-entry briefing.** The site specific safety and health plan shall provide for pre-entry briefings to be held prior to initiating any site activity, and at such other times as necessary to ensure that employees are apprised of the site safety and health plan and that this plan is being followed. The information and data obtained from site characterization and analysis work required in paragraph (c) of this section shall be used to prepare and update the site safety and health plan.

(iv) **Effectiveness of 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. Any deficiencies in the effectiveness of the site safety and health plan shall be corrected by the employer.

(c) Site characterization and analysis.

(1) **General.** Hazardous waste sites shall be evaluated in accordance with this paragraph to identify specific site hazards and to determine the appropriate safety and health control procedures needed to protect employees from the identified hazards.

(2) **Preliminary evaluation.** A preliminary evaluation of a site's characteristics shall be performed prior to site entry by a qualified person in order to aid in the selection of appropriate employee protection methods prior to site entry. Immediately after initial site entry, a more detailed evaluation of the site's specific characteristics shall be performed by a qualified person in order to further identify existing site hazards and to further aid in the selection of the appropriate engineering controls and personal protective equipment for the tasks to be performed.

(3) **Hazard identification.** All suspected conditions that may pose inhalation or skin absorption hazards that are immediately dangerous to life or health (IDLH), or other conditions that may cause death or serious harm, shall be identified during the preliminary survey and evaluated during the detailed survey. Examples of such hazards include, but are not limited to, confined space entry, potentially explosive or flammable situations, visible vapor clouds, or areas where biological indicators such as dead animals or vegetation are located.

(4) **Required information.** The following information to the extent available shall be obtained by the employer prior to allowing employees to enter a site:

(i) Location and approximate size of the site.

(ii) Description of the response activity and/or the job task to be performed.

(iii) Duration of the planned employee activity.

(iv) Site topography and accessibility by air and roads.

(v) Safety and health hazards expected at the site.

(vi) Pathways for hazardous substance dispersion.

(vii) Present status and capabilities of emergency response teams that would provide assistance to hazardous waste clean-up site employees at the time of an emergency.

(viii) Hazardous substances and health hazards involved in or expected at the site, and their chemical and physical properties.

(5) **Personal protective equipment.** Personal protective equipment (PPE) shall be provided and used during initial site entry in accordance with the following requirements:

(i) Based on the results of the preliminary site evaluation, an ensemble of PPE shall be selected and used during initial site entry which will provide protection to a level of exposure below permissible exposure limits and published exposure levels for known or suspected hazardous substances and health hazards, and which will provide protection against other known and suspected hazards identified during the preliminary site evaluation. If there is no permissible exposure limit or published exposure level, the employer may use other published studies and information as a guide to appropriate personal protective equipment.

(ii) If positive pressure self-contained breathing apparatus is not used as part of the entry ensemble, and if respiratory protection is warranted by the potential hazards identified during the preliminary site evaluation, an escape self-contained breathing apparatus of at least five minute's duration shall be carried by employees during initial site entry.

(iii) If the preliminary site evaluation does not produce sufficient information to identify the hazards or suspected hazards of the site, an ensemble providing protection equivalent to Level B PPE shall be provided as minimum protection, and direct reading instruments shall be used as appropriate for identifying IDLH conditions. (See Appendix B for a description of Level B hazards and the recommendations for Level B protective equipment.)

(iv) Once the hazards of the site have been identified, the appropriate PPE shall be selected and used in accordance with paragraph (g) of this section.

(6) **Monitoring.** The following monitoring shall be conducted during initial site entry when the site evaluation procedures information that shows the potential for ionizing radiation or IDLH conditions, or when the site information is not sufficient reasonably to eliminate these possible conditions:

(i) Monitoring with direct reading instruments for hazardous level of ionizing radiation.

(ii) Monitoring the air with appropriate direct reading test equipment (i.e., combustible gas meters, detector tubes) for IDLH and other conditions that may cause death or serious harm (combustible or explosive atmospheres, oxygen deficiency, toxic substances).

(iii) Visually observing for signs of actual or potential IDLH or other dangerous conditions.

(iv) An ongoing air monitoring program in accordance with paragraph (h) of this section shall be implemented after site characterization has determined the site is safe for the startup of operations.

(7) **Risk identification.** Once the presence and concentrations of specific hazardous substances and health hazards have been established, the risks associated with these substances shall be identified. Employees who will be working on the site shall be informed of any risks that have been identified. In situations covered by the Hazard Communication Standard, 29 CFR 1910.1200, training required by that standard need not be duplicated.

Note to (c) 7. – Risks to consider include, but are not limited to:

(a) Exposures exceeding the permissible exposure limits and published exposure levels.

(b) IDLH concentrations.

(c) Potential skin absorption and irritation sources.

(d) Potential eye irritation sources.

(e) Explosion sensitivity and flammability ranges.

(f) Oxygen deficiency.

(8) **Employee notification.** Any information concerning the chemical, physical, and toxicologic properties of each substance known or expected to be present on site that is available to the employer and relevant to the duties an employee is expected to perform shall be made available to the affected employees prior to the commencement of their work activities. The employer may utilize information developed for the hazard communication standard for this purpose.

(d) Site control.

(1) **General.** Appropriate site control procedures shall be implemented to control employee exposure to hazardous substances before clean-up work begins.

(2) **Site control program.** A site control program for protecting employees which is part of the employer's site safety and health program required in paragraph (b) of this section shall be developed during the planning stages of a hazardous waste clean-up operation and modified as necessary as new information becomes available.

(3) **Elements of the site control program.** The site control program shall, as a minimum, include: a site map; site work zones; the use of a "buddy system"; site communications including alerting means for emergencies; the standard operating procedures or safe work practices; and, identification of the nearest medical assistance. Where these requirements are covered elsewhere they need not be repeated.

(e) Training.

(1) **General.**

(i) All employees working on site (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 management responsible for the site shall receive training meeting the requirements of this paragraph before they are permitted to engage in hazardous waste operations that could expose them to hazardous substances, safety, or health hazards, and they shall receive review training as specified in this paragraph.

(ii) 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.

(2) **Elements to be covered.** The training shall thoroughly cover the following:

(i) Names of personnel and alternatives responsible for site safety and health;

(ii) Safety, health and other hazards present on the site;

(iii) Use of personal protective equipment;

(iv) Work practices by which the employee can minimize risks from hazards;

(v) Safe use of engineering controls and equipment on the site;

(vi) Medical surveillance requirements, including recognition of symptoms and signs which might indicate overexposure to hazards; and

(vii) The contents of paragraphs (g) through (j) of the site safety and health plan set forth in paragraph (b)(4)(ii) of this section.

(3) **Initial training.**

(i) General site workers (such as equipment operators, general laborers and supervisory personnel) engaged in hazardous substance removal or other activities which expose or potentially expose workers to hazardous substance removal or other activities which expose or potentially expose workers to hazardous substances and health hazards shall receive a minimum of 40 hours of instruction off the site, and a minimum of three days actual field experience under the direct supervision of a trained, experienced supervisor.

(ii) Workers on site only occasionally for a specific limited task (such as, but not limited to, ground water monitoring, land surveying, or geo-physical surveying) and who are unlikely to be exposed over permissible exposure limits and published exposure limits shall receive a minimum of 24 hours of instruction off the site, and the minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.

(iii) Workers regularly on site who work in areas which have been monitored and fully characterized indicating that exposures are under permissible exposure limits and published exposure limits where respirators are not necessary, and the characterization indicates that there are not health hazards or the possibility of an emergency developing, shall receive a minimum of 24 hours of instruction off the site and the minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.

(iv) Workers with 24 hours of training who are covered by paragraphs (a)(3)(iii) of this section, and who become general site workers or who are required to wear respirators, shall have the additional 16 hours and two days of training necessary to total the training specified in paragraph (e)(3)(i).

(4) **Management and supervisor training.** On-site management and supervisors directly responsible for, or who supervise employees engaged in, hazardous waste operations shall receive 40 hours initial training, and three days of supervised field experience (the training may be reduced to 24 hours and one day if the only area of their responsibility is employees covered by paragraphs (e)(3)(ii) and (e)(3)(iii) and at least eight additional hours of specialized training at the time of job assignment on such topics as, but not limited to, the employer's safety and health program and the associated employee training program, personal protective equipment program, spill containment program, and health hazard procedure and techniques.

(5) **Qualifications for trainers.** Trainers shall be qualified to instruct employees about the subject matter that is being presented in training. Such trainers shall have satisfactorily completed a training program for teaching the subjects they are expected to teach, or they shall have the academic credentials and instructional experience necessary for teaching the subjects. Instructors shall demonstrate competent instruction skills and knowledge of the applicable subject matter

(6) **Training certification.** Employees and supervisors that have received and successfully completed the training and field experience specified in paragraphs (e)(1) through (e)(4) of this section shall be certified by their instructor or the head instructor and trained supervisor as having successfully completed the necessary training. A written certificate shall be given to each person so certified. Any person who has not been so certified or who does not meet the requirements of paragraph (e)(9) of this section shall be prohibited from engaging in hazardous waste operations.

(7) **Emergency response.** Employees who are engaged in responding to emergency situations at hazardous waste clean-up sites that may expose them to hazardous substances shall be trained in how to respond to such expected emergencies.

(8) **Refresher training.** Employees specified in paragraph (e)(1) of this section, and managers and supervisors specified in paragraph (e)(4) of this section, shall receive eight hours of refresher training annually on the items specified in paragraph (e)(2) and/or (e)(4) of this section, any critique of incidents that have occurred in the past year that can serve as training examples of related work, and other relevant topics.

(9) **Equivalent training.** Employers who can show by documentation or certification that an employee's work experience and/or training has resulted in training equivalent to that training required in paragraphs (e)(1) through (e)(4) of this section shall not be required to provide the initial training requirements of those paragraphs to such employees. However, certified employees new to a site shall receive appropriate, site-specific training before site entry and have appropriate supervised field experience at the new site. Equivalent training includes any academic training or the training that existing employees might have already received from actual hazardous waste-site work experience.

(f) Medical surveillance.

(1) **General.** Employers engaged in operations specified in paragraphs (a)(1)(i) through (a)(1)(iv) of this section and not covered by (a)(2)(iii) exceptions and employers of employees specified in paragraph (g)(9) shall institute a medical surveillance program in accordance with this paragraph.

(2) **Employees covered.** The medical surveillance program shall be instituted by the employer for the following employees:

(i) All employees who are or may be exposed to hazardous substances or health hazards at or above the permissible exposure limits, or, if there is no permissible exposure limit, above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more than a year;

(ii) All employees who wear a respirator for 30 days or more a year or as required by § 1910.134;

(iii) All employees who are injured due to overexposure from an emergency incident involving hazardous substances or health hazards; or

(iv) Members of HAZMAT teams.

(3) **Frequency of medical examinations and consultations.**

Medical examinations and consultations shall be made available by the employer to each employee covered under paragraph (f)(2) of this section on the following schedules:

(i) For employees covered under paragraphs (f)(2)(I), (f)(2)(ii), and (f)(2)(iv):

(a) Prior to assignment;

(b) At least once every twelve months for each employee covered unless the attending physician believes a longer interval (not greater than biennially) is appropriate;

(c) At termination of employment or reassignment to an area where the employee would not be covered if the employee has not had an examination within the last six months;

(d) As soon as possible upon notification by an employee that the employee has developed signs or symptoms indicating possible overexposure to hazardous substances or health hazards, or that the employee has been injured or exposed above the permissible exposure limits or published exposure levels in an emergency situation;

(e) At more frequent times, if the examining physician determines that an increased frequency of examination is medically necessary.

(ii) For employees covered under paragraph (f)(2)(iii) and for all employees including those of employers covered by paragraph (a)(1)(v) who may have been injured, received a health impairment, developed signs or symptoms which may have resulted from exposure to hazardous substances resulting from an emergency incident, or exposed during an emergency incident to hazardous substances at concentrations above the permissible exposure limits or the published exposure levels without the necessary personal protective equipment being used:

(a) As soon as possible following the emergency incident or developments of signs or symptoms;

(b) At additional times, if the examining physician determines that follow-up examinations or consultations are medically necessary.

(4) **Content of medical examinations and consultations.**

(i) Medical examinations required by paragraph (f)(3) of this section shall include a medical and work history (or updated history if one is in the employee's file) with special emphasis on symptoms related to the handling of hazardous substances and health hazards and to fitness for duty including the ability to wear any required PPE under conditions (i.e., temperature extremes) that may be expected at the work site.

(ii) The content of medical examinations or consultations made available to employees pursuant to paragraph (f) shall be determined by the attending physician. The guidelines in the *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (See Appendix D, Reference #10) should be consulted.

(5) **Examination by a physician and costs.** All medical examinations and procedures shall be performed by or under the supervision of licensed physician, preferably one knowledgeable in occupational medicine, and shall be provided without cost to the employee, without loss of pay, and at a reasonable time and place.

(6) **Information provided to the physician.** The employer shall provide one copy of this standard and its appendices to the attending physician, and in addition the following for each employee:

(i) A description of the employee's duties as they relate to the employee's exposures.

(ii) The employee's exposure levels or anticipated exposure levels.

(iii) A description of any personal protective equipment used or to be used.

(iv) Information from previous medical examinations of the employee which is not readily available to the examining physician.

(v) Information required by §1910.134.

(7) **Physician's written opinion.**

(i) The employer shall obtain and furnish the employee with a copy of a written opinion from the attending physician containing the following:

(a) The physician's opinion as to whether the employee has any detected medical conditions which would place the employee at increased risk of material impairment of the employee's health from work in hazardous waste operations or emergency response, or from respirator use.

(b) The physician's recommended limitations upon the employee's assigned work.

(c) The results of the medical examination and tests if requested by the employee.

(d) A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions which require further examination or treatment.

(ii) The written opinion obtained by the employer shall not reveal specific findings or diagnoses unrelated to occupational exposures.

(8) **Recordkeeping.**

(i) An accurate record of the medical surveillance required by paragraph (f) of this section shall be retained. This record shall be retained for the period specified and meet the criteria of 29 CFR 1910.20.

(iii) The record required in paragraph (f)(8)(i) of this section shall include at least the following information:

(a) The name and social security number of the employee;

(b) Physician's written opinions, recommended limitations, and results of examinations and tests;

(c) Any employee medical complaints related to exposure to hazardous substances;

(d) A copy of the information provided to the examining physician by the employer, with the exception of the standard and its appendices.

(g) Engineering control, work practices, and personal protective equipment for employee protection.

Engineering controls, work practices, personal protective equipment, or a combination of these shall be implemented in accordance with this paragraph to protect employees from exposure to hazardous substances and safety and health hazards.

(1) **Engineering controls, work practices and PPE for substances regulated in Subparts G and Z.**

(i) Engineering controls and work practices shall be instituted to reduce and maintain employee exposure to or below the permissible exposure limits for substances regulated by 29 CFR Part 1910, to the extent required by Subpart Z, except to the extent that such controls and practices are not feasible.

Note to (g)(1)(i): Engineering controls which may be feasible include the use of pressurized cabs or control booths on equipment, and/or the use of remotely operated material handling equipment. Work practices which may be feasible are removing all non-essential employees from potential exposure during opening of drum, wetting down dusty operations and locating employees upwind of possible hazards.

(v) Whenever engineering controls and work practices are not feasible, PPE shall be used to reduce and maintain employee exposures to or below the permissible exposure limits or dose limits for substances regulated by 29 CFR Part 1910, Subpart Z.

(vi) The employer shall not implement a schedule of employee rotation as a means of compliance with permissible exposure limits or dose limits except when there is no other feasible way of complying with the airborne or dermal dose limits for ionizing radiation.

(vii) The provisions of 29 CFR, Subpart G, shall be followed.

(2) **Engineering controls, work practices, and PPE for substances not regulated in Subparts G and Z.** An appropriate combination of engineering controls, work practices and personal protective equipment shall be used to reduce and maintain employee exposure to or below published exposure levels for hazardous substances and health hazards not regulated by 29 CFR Part 1910, Subparts G and Z. The

employer may use the published literature and MSDS as a guide in making the employer's determination as to what level of protection the employer believes is appropriate for hazardous substances and health hazards for which there is no permissible exposure limit or published exposure limit.

(3) **Personal protective equipment section.**

(i) Personal protective equipment (PPE) shall be selected and used which will protect employees from the hazards and potential hazards they are likely to encounter as identified during the site characterization and analysis.

(ii) Personal protective equipment selection shall be based on an evaluation of the performance characteristics of the PPE relative to the requirements and limitations of the site, the task-specific conditions and duration, and the hazards and potential hazards identified at the site.

(iii) Positive pressure self-contained breathing apparatus, or positive pressure air-line respirators equipped with an escape air supply, shall be used when chemical exposure levels present will create a substantial possibility of immediate death, immediate serious illness or injury, or impair the ability to escape.

(iv) Totally-encapsulating chemical protective suits (protection equivalent to Level A Protection as recommended in Appendix B) shall be used in conditions where skin absorption of a hazardous substance may result in a substantial possibility of immediate health, immediate serious illness or injury, or impair the ability to escape.

(v) The level of protection provided by PPE selection shall be increased when additional information on site conditions indicates that increased protection is necessary to reduce employee exposures below permissible exposure limits and published exposure levels for hazardous substances and health hazards. (See Appendix B for guidance on selecting PPE ensembles.)

Note to (g)(3): The level of employee protection provided may be decreased when additional information or site conditions show that decreased protection will not result in hazardous exposures to employees.

(vi) Personal protective equipment shall be selected and used to meet the requirements of 29 CFR Part 1910, Subpart I, and additional requirements specified in this section.

(4) **Totally-encapsulating chemical protective suits.**

(i) Totally-encapsulating suits shall protect employees from the particular hazards which are identified during site characterization and analysis.

(ii) Totally-encapsulating suits shall be capable of maintaining positive air pressure. (See Appendix A for a test method which may be used to evaluate this requirement.)

(iii) Totally-encapsulating suits shall be capable of preventing inward test gas leakage of more than 0.5 percent. (See Appendix A for a test method which may be used to evaluate this requirement.)

(5) **Personal protective equipment (PPE) program.** A written personal protective equipment program, which is part of the employer's safety and health program required in paragraph (b) of this section or required in paragraph (p)(1) of this section and which is also a part of the site-specific safety and health plan shall be established. The PPE program shall address the elements listed below. When elements, such as donning and doffing procedures, are provided by the manufacturer of a piece of equipment and are attachment to the plan, they need not be rewritten into the plan as long as they adequately address the procedure or element.

(i) PPE selection based upon site hazards,

(ii) PPE use and limitations of the equipment,

(iii) Work mission duration,

(iv) PPE maintenance and storage,

(v) PPE decontamination and disposal,

(vi) PPE training and proper fitting,

(vii) PPE donning and doffing procedures,

(viii) PPE inspection procedures prior to, during, and after use,

(ix) Evaluation of the effectiveness of the PPE program, and

(x) Limitations during temperature extremes, heat stress, and other appropriate medical considerations.

(h) Monitoring.

(1) **General.**

(i) Monitoring shall be performed in accordance with this paragraph where there may be a question of employee exposure to hazardous concentrations of hazardous substances in order to assure proper selection of engineering controls, work practices and personal protective equipment so that employees are not exposed to levels or published exposure levels for hazardous substances.

(ii) Air monitoring shall be used to identify and quantify airborne levels of hazardous substances and safety and health hazards in order to determine the appropriate level of employee protection needed on site.

(2) **Initial entry.** Upon initial entry, representative air monitoring shall be conducted to identify any IDLH condition, exposure over permissible exposure limits or published exposure levels, exposure over a radioactive material's dose limits or other dangerous condition such as the presence of flammable atmospheres or oxygen-deficient environments.

(3) **Periodic monitoring.** Periodic monitoring shall be conducted when the possibility of an IDLH condition or flammable atmosphere has developed or when there is indication that exposure may have risen over permissible exposure limits or published exposure levels since prior to monitoring. Situations where it shall be considered whether the possibility that exposures have risen are as follows:

(i) When work begins on a different portion of the site.

(ii) When contaminants other than those previously identified are being handled.

(iii) When a different type of operation is initiated (e.g., drum opening as opposed to exploratory well drilling).

(iv) When employees are handling leaking drums or containers or working in areas with obvious liquid contamination (e.g., a spill or lagoon).

(4) **Monitoring of high-risk employees.** After the actual clean-up phase of any hazardous waste operations commences: for example, when soil, surface water or containers are moved or disturbed the employer shall monitor those employees likely to have the highest exposure to hazardous substances and health hazards likely to be present above permissible exposure limits or published exposure levels by using personal sampling frequently enough to characterize employee exposures. If the employees likely to have the highest exposure are over permissible exposure limits or published exposure limits, then monitoring shall continue to determine all employees likely to be above these limits. The employer may utilize a representative sampling approach by documenting that the employees and chemicals chosen for monitoring are based on the criteria state above.

Note to (h): It is not required to monitor employees engaged in site characterization operations covered by paragraph (c) of this section.

(i) Informational programs.

Employers shall develop and implement a program, which is part of the employer's safety and health program required in paragraph (b) of this section, to inform employees, contractors, and subcontractors (or their representative) actually engaged in hazardous waste operations of the nature, level and degree of exposure likely as a result of participation in such hazardous waste operations. Employees, contractors and subcontractors working outside of the operations part of a site are not covered by this standard.

(j) Handling drums and containers.

(1) **General.**

(i) Hazardous substances and contaminated soils, liquids, and other residues shall be handled, transported, labeled, and disposed of in accordance with this paragraph.

(ii) Drums and containers used during the clean-up shall meet the appropriate DOT, OSHA, and EPA regulations for the wastes that they contain.

(iii) When practical, drums and containers shall be inspected and their integrity shall be assured prior to being moved. Drums or containers that

cannot be inspected before being moved because of storage conditions (i.e., buried beneath the earth, stacked behind other drums, stacked several tiers high in a pile, etc.) shall be moved to an accessible location and inspected prior to further handling.

(iv) Unlabeled drums and containers shall be considered to contain hazardous substances and handled accordingly until the contents are positively identified and labeled.

(v) Site operations shall be organized to minimize the amount of drum or container movement.

(vi) Prior to movement of drums or containers, all employees exposed to the transfer operation shall be warned of the potential hazards associated with the contents of the drums or containers.

(vii) U.S. Department of Transportation specified salvage drums or containers and suitable quantities of proper absorbent shall be kept available and used in areas where spills, leaks, or ruptures may occur.

(viii) Where major spills may occur, a spill containment program, which is part of the employer's safety and health program required in paragraph (b) of this section, shall be implemented to contain and isolate the entire volume of the hazardous substance being transferred.

(ix) Drums and containers that cannot be moved without rupture, leakage, or spillage shall be emptied into a sound container using a device classified for the material being transferred.

(x) A ground-penetrating system or other type of detection system or device shall be used to estimate the location and depth of buried drums or containers.

(xi) Soil or covering material shall be removed with caution to prevent drum or container rupture.

(xii) Fire-extinguishing equipment meeting the requirements of 29 CFR Part 1910, Subpart L, shall be on hand and ready for use to control incipient fires.

(2) **Opening drums and containers.** The following procedures shall be followed in areas where drums or containers are being opened:

(i) Where an airline respirator system is used, connections to the source of air supply shall be protected from contamination and the entire system shall be protected from physical damage.

(ii) Employees not actually involved in opening drums or containers shall be kept at a safe distance from the drums or containers being opened.

(iii) If employees must work near or adjacent to drums or containers being opened, a suitable shield that does not interfere with the work operations shall be placed between the employee and the drums or containers being opened to protect the employee in case of accidental explosion.

(iv) Controls for drum or container opening equipment, monitoring equipment, and fire suppression equipment shall be located behind the explosion-resistant barrier.

(v) When there is a reasonable possibility of flammable atmospheres being present, material handling equipment and hand tools shall be the type to prevent sources of ignition.

(vi) Drums and containers shall be opened in such a manner that excess interior pressure will be safely relieved. If pressure can not be relieved from a remote location, appropriate shielding shall be placed between the employee and the drums or containers to reduce the risk of employee injury.

(vii) Employees shall not stand upon or work from drums or containers.

(3) **Material handling equipment.** Material handling equipment used to transfer drums and containers shall be selected, positioned and operated to minimize sources of ignition related to the equipment from igniting vapors released from ruptured drums or containers.

(4) **Radioactive wastes.** Drums and containers containing radioactive wastes shall not be handled until such time as their hazard to employees is properly assessed.

(5) **Shock-sensitive wastes.** As a minimum, the following special precautions shall be taken when drums and containers containing or suspected of containing shock-sensitive wastes are handled:

(i) All non-essential employees shall be evacuated from the area of transfer.

(ii) Material handling equipment shall be provided with explosive containment devices or protective shields to protect equipment operator from exploding containers.

(iii) An employee alarm system capable of being perceived above surrounding light and noise condition shall be used to signal the commencement and completion of explosive waste handling activities.

(iv) Continuous communications (i.e., portable radios, hand signals, telephones, as appropriate) shall be maintained between the employee-in-charge of the immediate handling areas and both the site safety and health supervisor and the command post until such time as the handling operation is completed. Communication equipment or methods that could cause shock sensitive materials to explode shall not be used.

(v) Drums and containers under pressure, as evidenced by bulging or swelling, shall not be moved until such time as the cause for excess pressure is determined and appropriate containment procedures have been implemented to protect employees from explosive relief of the drum.

(vi) Drums and containers of packaged laboratory wastes shall be considered to contain shock-sensitive or explosive materials until they have been characterized.

Caution: Shipping of shock-sensitive wastes may be prohibited under U.S. Department of Transportation regulations. Employers and their shippers should refer to 49 CFR 173.21 and 173.50.

(6) **Laboratory waste packs.** In addition to the requirements of paragraph (j)(5) of this section, the following precautions shall be taken, as a minimum, in handling laboratory waste packs (lab packs):

(i) Lab packs shall be opened only when necessary and then only by an individual knowledgeable in the inspection, classification, and segregation of the containers within the pack according to the hazards of the wastes.

(ii) If crystalline material is noted on any container, the contents shall be handled as a shock-sensitive waste until the contents are identified.

(7) **Sampling of drum and container contents.** Sampling of containers and drums shall be done in accordance with a sampling procedure, which is part of the site safety and health plan developed for and available to employees and others at the specific worksite.

(8) **Shipping and transport.**

(i) Drums and containers shall be identified and classified prior to packaging for shipment.

(ii) Drum or container staging areas shall be kept to the minimum number necessary to identify and classify materials safely and prepare them for transport.

(iii) Staging areas shall be provided with adequate access and egress routes.

(iv) Bulking of hazardous wastes shall be permitted only after the thorough characterization of the materials has been completed.

(9) **Tank and vault procedures.**

(i) Tanks and vaults containing hazardous substances shall be handled in a manner similar to that for drums and containers, taking into consideration the size of the tank or vault.

(ii) Appropriate tank or vault entry procedures as described in the employer's safety and health plan shall be followed whenever employees must enter a tank or vault.

(k) Decontamination

(1) **General.** Procedures for all phases of decontamination shall be developed and implemented in accordance with this paragraph.

(2) **Decontamination procedures.**

(i) A decontamination procedure shall be developed, communicated to employees and implemented before any employees or equipment

may enter areas on-site where potential for exposure to hazardous substances exists.

(ii) Standard operating procedures shall be developed to minimize employee contact with hazardous substances or with equipment that has contacted hazardous substances.

(iii) All employees leaving a contaminated area shall be appropriately decontaminated: all contaminated clothing and equipment leaving a contaminated area shall be appropriately disposed of or decontaminated.

(iv) Decontamination procedures shall be monitored by the site safety and health supervisor to determine their effectiveness. When such procedures are found to be ineffective, appropriate steps shall be taken to correct any deficiencies.

(3) **Location.** Decontamination shall be performed in geographical areas that will minimize the exposure of uncontaminated employees or equipment to contaminated employees or equipment.

(4) **Equipment and solvents.** All equipment and solvents used for decontamination shall be decontaminated or disposed of properly.

(5) **Personal protective clothing and equipment.**

(i) Protective clothing and equipment shall be decontaminated, cleaned, laundered, maintained or replaced as needed to maintain their effectiveness.

(ii) Employees whose non-impermeable clothing becomes wetted with hazardous substances shall immediately remove that clothing and proceed to shower. The clothing shall be disposed of or decontaminated before it is removed from the work zone.

(6) **Unauthorized employees.** Unauthorized employees shall not remove protective clothing or equipment from change rooms.

(7) **Commercial laundries or cleaning establishments.** Commercial laundries or cleaning establishments that decontaminate protective clothing or equipment shall be informed of the potentially harmful effects of exposures to hazardous substances.

(8) **Showers and change rooms.** Where the decontamination procedures indicate a need for regular showers and change rooms outside of a contaminated area, they shall be provided and meet the requirements of 29 CFR 1910.141. If temperature conditions prevent the effective use of water, then other effective means for cleansing shall be provided and used.

(l) Emergency response by employees at uncontrolled hazardous waste sites.

(1) **Emergency response plan.**

(i) An emergency response plan shall be developed and implemented by all employers within the scope of this section to handle anticipated emergencies prior to the commencement of hazardous waste operations. The plan shall be in writing and available for inspection and copying by employees, their representatives, OSHA personnel and other governmental agencies with relevant responsibilities.

(ii) Employers who will evacuate their employees from the workplace when an emergency occurs, and who do not permit any of their employees to assist in handling the emergency, are exempt from the requirements of the paragraph if they provide an emergency action plan complying with section 1910.38(a) of this part.

(2) **Elements of an emergency response plan.** The employer shall develop an emergency response plan for emergencies which shall address, as a minimum the following:

(i) Pre-emergency planning.

(ii) Personnel roles, lines of authority, and communication.

(iii) Emergency recognition and prevention.

(iv) Safe distances and places of refuge.

(v) Site security and control.

(vi) Evacuation routes and procedures.

(vii) Decontamination procedures which are not covered by the site safety and health plan.

(viii) Emergency medical treatment and first aid.

(ix) Emergency alerting and response procedures.

(x) Critique of response and follow-up.

(xi) PPE and emergency equipment.

(3) **Procedures for handling emergency incidents.**

(i) In addition to the elements for the emergency response plan required in paragraph (1)(2) of this section, the following elements shall be included for emergency response plans:

(a) Site topography, layout, and prevailing weather conditions.

(b) Procedures for reporting incidents to local, state, and federal governmental agencies.

(ii) The emergency response plan shall be a separate section of the Site Safety and Health Plan.

(iii) The emergency response plan shall be compatible and integrated with the disaster, fire and/or emergency response plans of local, state and federal agencies.

(iv) The emergency response plan shall be rehearsed regularly as part of the overall training program for site operations.

(v) The site emergency response plan shall be reviewed periodically and, as necessary, be amended to keep it current with new or changing site conditions or information.

(vi) An employee alarm system shall be installed in accordance with 29 CFR 1910.165 to notify employees of an emergency situation; to stop work activities if necessary; to lower background noise in order to speed communication; and to begin emergency procedures.

(vii) Based upon the information available at the time of the emergency, the employer shall evaluate the incident and the site response capabilities and proceed with the appropriate steps to implement the site emergency response plan.

(m) Illumination.

Areas accessible to employees shall be lighted to not less than the minimum illumination intensities listed in the following Table H-120.1 while any work is in progress.

Table H-120.1 – Minimum Illumination Intensities in Foot-Candles

Foot-Candles	Area or operations
5	General site areas.
3	Excavation and waste areas, accessways, active storage areas, loading platforms, refueling, and field maintenance areas.
5	Indoors: Warehouses, corridors, hallways, and exitways.
5	Tunnels, shafts, and general underground work areas. (Exception: Minimum of 10 foot-candles is required at tunnel and shaft heading during drilling mucking, and scaling. Mine Safety and Health Administration approved cap lights shall be acceptable for use in the tunnel heading).
10	General shops (e.g., mechanical and electric equipment rooms, active storerooms, barracks or living quarters, locker or dressing rooms, dining areas, and indoor toilets and workrooms.)
30	First aid stations, infirmaries, and offices.

(n) Sanitation at temporary workplaces.

(1) **Potable water.**

(i) An adequate supply of potable water shall be provided on the site.

(ii) Portable containers used to dispense drinking water shall be capable of being tightly closed, and equipped with a tap. Water shall not be dipped from containers.

(iii) Any container used to distribute drinking water shall be clearly marked as to the nature of its contents and not used for any other purpose.

(iv) Where single service cups (to be used but once) are supplied, both a sanitary container for the unused cups and a receptacle for disposing of the used cups shall be provided.

(2) **Nonpotable water.**

(i) Outlets for nonpotable water, such as water for firefighting purposes, shall be identified to indicate clearly that the water is unsafe and is not to be used for drinking, washing, or cooking purposes.

(ii) There shall be no cross-connection, open or potential, between a system furnishing potable water and a system furnishing nonpotable water.

(3) **Toilet facilities.**

(i) Toilets shall be provided for employees according to the following Table H-120.2.

Table H-1202.2 – Toilet Facilities

Number of employees	Minimum number of facilities
20 or fewer……...	One.
More than 20, fewer than 200……...	One toilet seat and one urinal / 40 employees.
More than 200……...	One toilet seat and one urinal / 50 employees.

(ii) Under temporary field conditions, provisions shall be made to assure that at least one toilet facility is available.

(iii) Hazardous waste sites not provided with a sanitary sewer shall be provided with the following toilet facilities unless prohibited by local codes:

(a) Chemical toilets;

(b) Recirculating toilets;

(c) Combustion toilets; or

(d) Flush toilets.

(iv) The requirements of this paragraph for sanitation facilities shall not apply to mobile crews having transportation readily available to nearby toilet facilities.

(v) Doors entering toilet facilities shall be provided with entrance locks controlled from inside the facility.

(4) **Food handling.** All food service facilities and operations for employees shall meet the applicable laws, ordinances, and regulations of the jurisdictions in which they are located.

(5) **Temporary sleeping quarters.** When temporary sleeping quarters are provided, they shall be heated, ventilated, and lighted.

(6) **Washing facilities.** The employer shall provide adequate washing facilities for employees engaged in operations where hazardous substances may be harmful to employees. Such facilities shall be in near proximity to the worksite; in areas where exposures are below permissible exposure limits and published exposure levels and which are under the controls of the employer; and shall be so equipped as to enable employees to remove hazardous substances from themselves.

(7) **Showers and change rooms.** When hazardous waste clean-up or removal operations commence on a site and the duration of the work will require six months or greater time to complete, the employer shall provide showers and change rooms for all employees exposed to hazardous substances and health hazards involved in a hazardous waste clean-up or removal operations.

(i) Showers shall be provided and shall meet the requirements of 29 CFR 1910.141(d)(3).

(ii) Change rooms shall be provided and shall meet the requirements of 29 CFR 1910.141(e). Change rooms shall consist of two separate change areas separated by the shower area required in paragraph (n)(7)(i) of this section. One change area, with an exit leading off the worksite, shall provide employees with a clean area where they can remove, store, and put on street clothing. The second area, with an exit to the worksite, shall provide employees with an area where they can put on, remove and store work clothing and personal protective equipment.

(iii) Showers and change rooms shall be located in areas where exposures are below the permissible exposure limits and published exposure levels. If this cannot be accomplished, then a ventilation system shall be provided that will supply air that is below the permissible exposure limits and published exposure levels.

(iv) Employers shall assure that employees shower at the end of their work shift and when leaving the hazardous waste site.

(o) New Technology programs.

(1) The employer shall develop and implement procedures for the introduction of effective new technologies and equipment developed for the improved protection of employees working with hazardous waste clean-up operations, and the same shall be implemented as part of the site safety and health program to assure that employee protection is being maintained.

(2) New technologies, equipment or control measures available to the industry, such as the use of foams, absorbents, adsorbents, neutralizers, or other means to suppress the level of air contaminants while excavating the site or for spill control, shall be evaluated by employers or their representatives. Such an evaluation shall be done to determine the effectiveness of the new methods, materials, or equipment before implementing their use on a large scale for enhancing employee protection. Information and data from manufacturers or suppliers may be used as part of the employer's evaluation effort. Such evaluations shall be made available to OSHA upon request.

(p) Certain Operations Conducted Under the Resource Conservation and Recovery Act of 1976 (RCRA).

Employers conducting operations at treatment, storage, and disposal (TSD) facilities specified in paragraph (a)(1)(iv) of this section not exempted by paragraph (a)(2)(iii) of this section shall provide and implement the programs specified in this paragraph.

(1) **Safety and health program.** The employer shall develop and implement a written safety and health program for employees involved in hazardous waste operations that shall be available for inspection by employees, their representatives and OSHA personnel. The program shall be designed to identify, evaluate and control safety and health hazards in their facilities for the purpose of employee protection to provide for emergency response, meeting the requirements of paragraph (p)(8) of this section and to address as appropriate site analysis, engineering controls, maximum exposure limits, hazardous waste handling procedures and use of new technologies.

(2) **Hazard communication program.** The employer shall implement a hazard communication program meeting the requirements of 29 CFR 1910.1200 as part of the employer's safety and health program.

Note to 1910.120. – The exemption for hazardous waste provided in §1910.1200 is applicable to this section.

(3) **Medical surveillance program.** The employer shall develop and implement a medical surveillance program meeting the requirements of paragraph (f) of this section.

(4) **Decontamination program.** The employer shall develop and implement a decontamination procedure meeting the requirements of paragraph (k) of this section.

(5) **New Technology program.** The employer shall develop and implement procedures meeting the requirements of paragraph (o) of this section for introducing new and innovative equipment into the workplace.

(6) **Material handling program.** Where employees will be handling drums or containers, the employer shall develop and implement procedures meeting the requirements of paragraphs (j)(1)(ii) through (viii) and (xi) of this section, as well as (j)(3) and (j)(8) of this section prior to starting such work.

(7) **Training Program.**

(i) **New employees.** The employer shall develop and implement a training program, which is part of the employer's safety and health program, for employees involved with hazardous waste operations to enable employees to perform their assigned duties and functions in a safe and healthful manner so as not to endanger themselves or other employees. The initial training shall be for 24 hours and refresher training shall be for eight hours annually. Employees who have received the initial training required by this paragraph shall be given a written certificate attesting that they have successfully completed the necessary training.

(ii) **Current employees.** Employers who can show by an employee's previous work experience and/or training that the employee has had training equivalent to the initial training required by this paragraph, shall be considered as meeting the initial training requirements of this paragraph as to that employee. Equivalent training includes the training that existing employees might have already received from actual site work experience. Current employees shall receive eight hours of refresher training annually.

(iii) **Trainers.** Trainers who teach initial training shall have satisfactorily completed a training course for teaching the subjects they are expected to teach or they shall have the academic credentials and instruction experience necessary to demonstrate a good command of the subject matter of the courses and competent instructional skills.

(8) **Emergency response.**

(i) **Emergency response plan.** An emergency response plan shall be developed and implemented by all employers. Such plans need not duplicate any of the subjects fully addressed in the employer's contingency planning required by permits, such as those issued by the U.S. Environmental Protection Agency, provided that the contingency plan is made part of the emergency response plan shall be a written portion of the employers safety and health program required in paragraph (p)(1) of this section. Employers who will evacuate their employees from the worksite location when an emergency occurs and who do not permit any of their employees to assist in handling the emergency are exempt from the requirements of paragraph (p)(8) if they provide an emergency action plan complying with §1910.38(a) of this part.

(ii) **Elements of an emergency response plan.** The employer shall develop an emergency response plan for emergencies which shall address, as a minimum, the following areas to the extent that they are not addressed in any specific program required in this paragraph:

(a) Pre-emergency planning and coordination with outside parties.

(b) Personnel roles, lines of authority, and communication.

(c) Emergency recognition and prevention.

(d) Safe distances and places of refuge.

(e) Site security and control.

(f) Evacuation routes and procedures.

(g) Decontamination procedures.

(h) Emergency medical treatment and first aid.

(i) Emergency alerting and response procedures.

(j) Critique of response and follow-up.

(k) PPE and emergency equipment.

(iii) **Training.**

(a) Training for emergency response employees shall be completed before they are called upon to perform in real emergencies. Such training shall include the elements of the emergency response plan, standard operating procedures the employer has established for the job, the personal protective equipment to be worn and procedures for handling emergency incidents.

Exemption #1: An employer need not train all employees to the degree specified if the employer divides the work force in a manner such that a sufficient number of employees who have responsibility to control emergencies have the training specified, and all other employees, who may first respond to an emergency incident, have sufficient awareness training to recognize that an emergency response situation exists and that they are instructed in that case to summon the fully trained employees and not attempt to control activities for which they are not trained.

Exemption #2: An employer need not train all employees to the degree specified if arrangements have been made in advance for an outside fully-trained emergency response team to respond in a reasonable period and all employees, who may come to the incident first, have sufficient awareness training to recognize that an emergency response situation exists and they have been instructed to call the designated outside fully-trained emergency response team for assistance.

(b) Employee members of TSD facility emergency response organizations shall be trained to a level of competence in the recognition of health and safety hazards to protect themselves and other employees. This would include training in the methods used to minimize the risk from safety and health hazards; in the safe use of control

equipment; in the selection and use of control equipment; in the selection and use of appropriate personal protective equipment; in the safe operating procedures to be used at the incident scene; in the techniques of coordination with other employees to minimize risks; in the appropriate responses to over exposure from health hazards or injury to themselves and other employees; and in the recognition of subsequent symptoms which may result from over-exposures.

(c) The employer shall certify that each covered employee has attended and successfully completed the training required in paragraph (p)(8)(iii) of this section, or shall certify the employee's competency at least yearly. The method used to demonstrate competency for certification of training shall be recorded and maintained by the employer.

(iv) **Procedures for handling emergency incidents.**

(a) In addition to the elements for the emergency response plan required in paragraph (p)(8)(ii) of this section, the following elements shall be included for emergency response plans to the extent that they do not repeat any information already contained in the emergency response plan:

(1) Site topography, layout, and prevailing weather conditions.

(2) Procedures for reporting incidents to local, state, and federal governmental agencies.

(b) The emergency response plan shall be compatible and integrated with the disaster, fire and/or emergency response plans of local, state, and federal agencies.

(c) The emergency response plan shall be rehearsed regularly as part of the overall training program for site operations.

(d) The site emergency response plan shall be reviewed periodically and, as necessary, be amended to keep it current with new or changing site conditions or information.

(e) An employee alarm system shall be installed in accordance with 29 CFR 1910.165 to notify employees of an emergency situation; to stop work activities if necessary; to lower background noise in order to speed communication; and to begin emergency procedures.

(f) Based upon the information available at time of the emergency, the employer shall evaluate the incident and the site response capabilities and proceed with the appropriate steps to implement the site emergency response plan.

(q) Emergency response to hazardous substance releases.

This paragraph covers employers whose employees are engaged in emergency response no matter where it occurs except that it does not cover employees engaged in operations specified in paragraphs (a)(1)(i) through (a)(1)(iv) of this section. Those emergency response organizations who have developed and implemented programs equivalent to this paragraph for handling releases of hazardous substances pursuant to section 303 of the Superfund Amendments and Reauthorization Act of 1986 (Emergency Planning and Community Right-to-Know Act of 1986, 42 U.S.C. 11003) shall be deemed to have met the requirements of this paragraph.

(1) **Emergency response plan.** An emergency response plan shall be developed and implemented to handle anticipated emergencies prior to the commencement of emergency response operations. The plan shall be in writing and available for inspection and copying by employee, their representatives and OSHA personnel. Employers who will evacuate their employees from the workplace when an emergency occurs, and who do not permit any of their employees to assist in handling the emergency, are exempt from the requirements of this paragraph if they provide an emergency action plan in accordance with §1910.38(a) of this part.

(2) **Elements of an emergency response plan.** The employer shall develop an emergency response plan for emergencies which shall address, as a minimum, the following to the extent that they are not addressed elsewhere:

(i) Pre-emergency planning and coordination with outside parties.

(ii) Personnel roles, lines of authority, training, and communication.

(iii) Emergency recognition and prevention.

(iv) Safe distances and places of refuge.

(v) Site security and control.

(vi) Evacuation routes and procedures.

(vii) Decontamination.

(viii) Emergency medical treatments and first aid.

(ix) Emergency alerting and response procedures.

(x) Critique of response and follow-up.

(xi) PPE and Emergency equipment.

(xii) Emergency response organizations may use the local emergency response plan or the state emergency response plan or both, as part of their emergency response plan to avoid duplication. Those items of the emergency response plan that are being properly addressed by the SARA Title III plans may be substituted into their emergency plan or otherwise kept together for the employer and employee's use.

(3) **Procedures for handling emergency response.**

(i) The senior emergency response official responding to an emergency shall become the individual in charge of a site-specific Incident Command System (ICS). All emergency responders and their communications shall be coordinated and controlled through the individual in charge of the ICS assisted by the senior official present for each employer.

Note to (q)(3)(i). – The "senior official" at an emergency response is the most senior official on the site who has the responsibility for controlling the operations at the site. Initially it is the senior officer on the first-due piece of responding emergency apparatus to arrive on the incident scene. As more senior officers arrive (i.e., battalion chief, fire chief, state law enforcement official, site coordinator, etc.) the position is passed up the line of authority which has been previously established.

(ii) The individual in charge of the ICS shall identify, to the extent possible, all hazardous substances or conditions present and shall address as appropriate site analysis, use of engineering controls, maximum exposure limits, hazardous substance handling procedures, and use of any new technologies.

(iii) Based on the hazardous substances and/or conditions present, the individual in charge of the ICS shall implement appropriate emergency operations, and assure that the personal protective equipment worn is appropriate for the hazards to be encountered. However, personal protective equipment shall meet, at a minimum, the criteria contained in 29 CFR 1910.156(e) when worn while performing fire fighting operations beyond the incipient stage for any incident or site.

(iv) Employees engaged in emergency response and exposed to hazardous substances presenting an inhalation hazard or potential inhalation hazard shall wear positive pressure self-contained breathing apparatus while engaged in emergency response, until such time that the individual in charge of the ICS determines through the use of air monitoring that a decreased level of respiratory protection will not result in hazardous exposures to employees.

(v) The individual in charge of the ICS shall limit the number of emergency response personnel at the emergency site, in those areas of potential or actual exposure to incident or site hazards, to those who are actively performing emergency operations. However, operations in hazardous areas shall be performed using the buddy system in groups of two or more.

(vi) Back-up personnel shall stand by with equipment ready to provide assistance or rescue. Advanced first aid support personnel, as a minimum, shall also stand by with medical equipment and transportation capability.

(vii) The individual in charge of the ICS shall designate a safety official, who is knowledgeable in the operations being implemented at the emergency response site, with specific responsibility to identify and evaluate hazards and to provide direction with respect to the safety of operations for the emergency at hand.

(viii) When activities are judged by the safety official to be an IDLH condition and/or to involve an imminent danger condition, the safety official shall have the authority to alter, suspend, or terminate those activities. The safety official shall immediately inform the individual in charge of the ICS of any actions needed to be

taken to correct these hazards at an emergency scene.

(ix) After emergency operations have terminated, the individual in charge of the ICS shall implement appropriate decontamination procedures.

(x) When deemed necessary for meeting the tasks at hand, approved self-contained compressed air breathing apparatus may be used with approved cylinders from other approved self-contained compressed air breathing apparatus provided that such cylinders are of the same capacity and pressure rating. All compressed air cylinders used with self-contained breathing apparatus shall meet U.S. Department of Transportation and National Institute for Occupational Safety and Health criteria.

(4) **Skilled support personnel.** Personnel, not necessarily an employer's own employees, who are skilled in the operation of certain equipment, such as mechanized earth moving or digging equipment or crane and hoisting equipment, and who are needed temporarily to perform immediate emergency support work that cannot reasonably be performed in a timely fashion by an employer's own employees and who will be or may be exposed to the hazards at an emergency response scene, are not required to meet the training required in this paragraph for the employer's regular employees. However, these personnel shall be given an initial briefing at the site prior to their participation in any emergency response. The initial briefing shall include instruction in the wearing of appropriate personal protective equipment, what chemical hazards are involved, and what duties are to be performed. All other appropriate safety and health precautions provided to the employer's own employees shall be used to assure the safety and health of these personnel.

(5) **Specialist employees.** Employees who, in the course of their regular job duties, work with and are trained in the hazards of specific hazardous substances, and who will be called upon to provide technical advice or assistance at a hazardous substance release incident to the individual in charge, shall receive training or demonstrate competency in the area of their specialization annually.

(6) **Training.** Training shall be based on the duties and function to be performed by each responder of an emergency response organization. The skill and knowledge levels required for all new responders, those hired after the effective date of this standard, shall be conveyed to them through training before they are permitted to take part in actual emergency operations on an incident. Employees who participate, or are expected to participate, in emergency response, shall be given training in accordance with the following paragraphs:

(i) **First responder awareness level.** First responders of the awareness level are individuals who are likely to witness or discover a hazardous substance release and who have been training to initiate an emergency response sequence by notifying the proper authorities of the release. They would take no further action beyond notifying the authorities of the release. First responders at the awareness level shall have sufficient training to have had sufficient experience to objectively demonstrate competency in the following areas:

(a) An understanding of what hazardous materials are, and the risks associated with them in an incident.

(b) An understanding of the potential outcomes associated with an emergency created when hazardous materials are present.

(c) The ability to recognize the presence of hazardous materials in an emergency.

(d) The ability to identify the hazardous materials, if possible.

(e) An understanding of the role of the first responder awareness individual in the employer's emergency response plan including the site security and control and the U.S. Department of Transportation's Emergency Response Guidebook.

(f) The ability to realize the need for additional resources, and to make appropriate notifications to the communication center.

(ii) **First responder at operations level.** First responders at the operations level are individuals who respond to releases or potential releases of hazardous substances as part of the initial response to the site for the purpose of protecting nearby persons, property, or the environment from the effects of the release. They are trained to respond in a defensive fashion without actually trying to stop the release. Their function

is to contain the release from a safe distance, keep it from spreading, and prevent exposures. First responders at the operational level shall have received at least eight hours of training or have had sufficient experience to objectively demonstrate competency in the following areas in addition to those listed for the awareness level and the employer shall so certify:

(a) Knowledge of the basic hazard and risk assessment techniques.

(b) Know how to select and use proper personal protective equipment provided to the first responder operation level.

(c) An understanding of basic hazardous materials terms.

(d) Know how to perform basic control, containment and/or confinement operations within the capabilities of the resources and personal protective equipment available with their unit.

(e) Know how to implement basic decontamination procedures.

(f) An understanding of the relevant standard operating procedures and termination procedures.

(iii) **Hazardous materials technician.** Hazardous materials technicians are individuals who respond to releases or potential releases for the purpose of stopping the release. They assume a more aggressive role than a first responder at the operations level in that they will approach the point of release in order to plug, patch or otherwise stop the release of a hazardous substance. Hazardous materials technicians shall have received at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas and the employer shall so certify:

(iv) **Hazardous materials specialist.** Hazardous specialists are individuals who respond with and provide support to hazardous materials technicians. Their duties parallel those of the hazardous materials technician; however, those duties require a more directed or specific knowledge of the various substances they may be called upon to contain. The hazardous materials specialist would also act as the site liaison with Federal, state, local and other government authorities in regard to site activities. Hazardous materials specialists shall have received at least 24 hours of training equal to the technician level and in addition have competency in the following areas and the employer shall so certify:

(a) Know how to implement the local emergency response plan.

(b) Understand classification, identification and verification of known and unknown materials by using advanced survey instruments and equipment.

(c) Know of the state emergency response plan.

(d) Be able to select and use proper specialized chemical personal protective equipment provided to the hazardous materials specialist.

(e) Understand in-depth hazard and risk techniques.

(f) Be able to perform specialized control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available.

(g) Be able to determine and implement decontamination procedures.

(h) Have the ability to develop a site safety and control plan.

(i) Understand chemical, radiological and toxicological terminology and behavior.

(v) **On scene incident commander.** Incident commanders, who will assume control of the incident scene beyond the first responder awareness level, shall receive at least 24 hours of training equal to the first responder operations level and in addition, have competency in the following areas and the employer shall so certify:

(a) Know and be able to implement the employer's incident commander system.

(b) Know how to implement the employer's emergency response plan.

(c) Know and understand the hazards and risks associated with employees working in chemical protective clothing.

(d) Know how to implement the local emergency response plan.

(e) Know of the state emergency response and of the Federal Regional Response Team.

(f) Know and understand the importance of decontamination procedures.

(7) **Trainers**. Trainers who teach any of the above training subjects shall have satisfactorily completed a training course for teaching the subjects they are expected to teach, such as the courses offered by the U.S. Fire Academy, or they shall have the training and/or academic credentials and instructional experience necessary to demonstrate competent instructional skills and a good command of the subject matter of the courses they are to teach.

(8) **Refresher training**.

(i) Those employees who are trained in accordance with paragraph (q)(6) of this section shall receive annual refresher training or sufficient content and duration to maintain their competencies, or shall demonstrate competency in those areas at least yearly.

(ii) A statement shall be made of the training or competency, and if a statement of competency is made, the employer shall keep a record of the methodology used to demonstrate competency.

(9) **Medical surveillance and consultation**.

(i) Members of an organized and designated HAZMAT team and hazardous materials specialists shall receive a baseline physical examination and be provided with medical surveillance as required in paragraph (f) of this section.

(ii) Any emergency response employees who exhibit signs or symptoms which may have resulted from exposure to hazardous substances during the course of an emergency incident, either immediately or subsequently, shall be provided with medical consultation as required in paragraph (f)(3)(ii) of this section.

(10) **Chemical protective clothing**. Chemical protective clothing and equipment to be used by organized and designated HAZMAT team members, or to be used by hazardous materials specialists, shall meet the requirements of paragraphs (g)(3) through (5) of this section.

(11) **Post-emergency response operations**. Upon completion of the emergency response, if it is determined that it is necessary to remove hazardous substances, health hazards, and materials contaminated with them (such as contaminated soil or other elements of the natural environment) from the site of the incident, the employer conducting the clean-up shall comply with one of the following:

(i) Meet all of the requirements of paragraphs (b) through (o) of this section; or

(ii) Where the clean-up is done on plant property using plant or workplace employees, such employees shall have completed the training requirements of the following: 29 CFR 1910.38 (a); 1910.134; 1910.1200, and other appropriate safety and health training made necessary by the tasks that they are expected to be performed such as personal protective equipment and decontamination procedures. All equipment to be used in the performance of the clean-up work shall be in serviceable condition and shall have been inspected prior to use.

APPENDICES TO 1910.120 – HAZARDOUS WASTE OPERATIONS AND EMERGENCY RESPONSE

Note: The following appendices serve as non-mandatory guidelines to assist employees and employers in complying with the appropriate requirements of this section. However, paragraph 1910.120(g) makes mandatory in certain circumstances the use of Level A and Level B PPE protection.

Appendix A – Personal Protective Equipment Test Methods

This appendix sets forth the nonmandatory examples of tests, which may be used to evaluate compliance with §1910.120 (g)(4)(ii) and (iii). Other tests and other challenge agents may be used to evaluate compliance.

A. Totally-encapsulating chemical protective suit pressure test.

1.0 – **Scope**

1.1 This practice measures the ability of a gas-tight, totally encapsulating chemical protective suit material, seams, and closures to maintain a fixed positive pressure. The results of this practice allow the gas-tight integrity of a totally-encapsulating chemical protective suit to be evaluated.

1.2 Resistance of the suit materials to permeation, penetration, and degradation by specific hazardous substances is not determined by this test method.

2.0 – **Definition of terms**

2.1 "Totally-encapsulating chemical protective suit (TECP suit)" means a full-body garment which is constructed of protective clothing materials; covers the wearer's torso, head, arms, legs and respirator; may cover the wearer's hands and feet with tightly attached gloves and boots; completely encloses the wearer and respirator by itself or in combination with the wearer's gloves and boots.

2.2 "Protective clothing material" means any material or combination of materials used in a item of clothing for the purpose of isolating parts of the body from direct contact with a potentially hazardous liquid or gaseous chemicals.

2.3 "Gas-tight" means, for the purpose of this test method, the limited flow of a gas under pressure from the inside of a TECP suit to atmosphere at a prescribed pressure and time interval.

3.0 – **Summary of test method**

3.1 The TECP suit is visually inspected and modified for the test. The test apparatus is attached to the suit to permit inflation to the pre-test suit expansion pressure for removal of suit wrinkles and creases. The pressure is lowered to the test pressure and monitored for three minutes. If the pressure drop is excessive, the TECP suit fails the test and is removed from service. The test is repeated after leak location and repair.

4.0 – **Required Supplies**

4.1 Source of compressed air.

4.2 Test apparatus for suit testing, including a pressure measurement device with a sensitivity of at least ¼ inch water gauge.

4.3 Vent valve closure plugs or sealing tape.

4.4 Soapy water solution and soft brush.

4.5 Stop watch or appropriate timing device.

5.0 – **Safety Precautions**

5.1 Care shall be taken to provide the correct pressure safety devices required for the source of compressed air used.

6.0 – **Test Procedure**

6.1 – Prior to each test, the tester shall perform a visual inspection of the suit. Check the suit for seam integrity by visually examining the seams and gently pulling on the seams. Ensure that all air supply lines, fittings, visor, zippers, and valves are secure and show no signs of deterioration.

6.1.1 Seal off the vent valves along with any other normal inlet or exhaust points (such as umbilical air line fittings or face piece opening) with tape or other appropriate means (caps, plugs, fixture, etc). Care should be exercised in the sealing process not to damage any of the suit components.

6.1.2 Close all closure assemblies.

6.1.3 Prepare the suit for inflation by providing an improvised connection point on the suit for connecting an airline. Attach the pressure test apparatus to the suit to permit suit inflation from a compressed air source equipped with a pressure indicating regulator. The leak tightness of the pressure test apparatus should be tested before and after each test by closing off the end of the tubing attached to the suit and assuring a pressure of three inches water gauge for three minutes can be maintained. If a component is removed for the test, that component shall be replaced and a second test conducted with another component removed to permit a complete test of the ensemble.

6.1.4 The pre-test expansion pressure (a) and the suit test pressure (b) shall be supplied by the suit manufacturer, but in no case shall they be less than: (A) = three inches water gauge; and (B) = two inches water gauge. The ending suit pressure (C) shall be no less than 80 percent of the test pressure (B); i.e., the pressure drop shall not exceed 20 percent of the test pressure (B).

6.1.5 Inflate the suit until the pressure inside is equal to pressure (A), the pre-test expansion suit pressure. Allow at least one

minute to fill out the wrinkles in the suit. Release sufficient air to reduce the suit pressure to pressure (B), the suit test pressure. Begin timing. At the end of three minutes, record the suit pressure as pressure (C), the ending suit pressure. The difference between the suit test pressure and the ending suit test pressure (B-C) shall be defined as the suit pressure drop.

6.1.6 If the suit pressure drop is more than 20 percent of the suit test pressure (B) during the three-minute test period, the suit fails the test and shall be removed from service.

7.0 – **Retest Procedure**

7.1 If the suit fails the test, check for leaks by inflating the suit to pressure (A) and brushing or wiping the entire suit (including seams, closures, lens gaskets, glove-to-sleeve joints, etc.) with a mild soap and water solution. Observe the suit for the formation of soap bubbles, which is an indication of a leak. Repair all identified leaks.

7.2 Retest the TECP suit as outlined in Test Procedures 6.0.

8.0 – **Report**

8.1 Each TECP suit tested by this practice shall have the following information recorded:

8.1.1 Unique identification number, identifying brand name, date of purchase, material of construction, and unique fit features, e.g., special breathing apparatus.

8.1.2 The actual values for test pressures (A), (B), and (C) shall be recorded along with the specific observation times. If the ending pressure (C) is less than 80 percent of the test pressure (B), the suit shall be identified as failing the test. When possible, the specific leak location shall be identified in the test records. Retest pressure data shall be recorded as an additional test.

8.1.3 The source of the test apparatus used shall be identified and the sensitivity of the pressure gauge shall be recorded.

8.1.4 Records shall be kept for each pressure test even if repairs are being made at the test location.

Caution

Visually inspect all parts of the suit to be sure they are positioned correctly and secured tightly before putting the suit back into service. Special care should be taken to examine each exhaust valve to make sure it is not blocked.

Care should also be exercised to assure that the inside and outside of the suit is completely dry before it is put into storage.

B. Totally-encapsulating chemical protective suit qualitative leak test.

1.0 – **Scope**

1.1 This practice semi-qualitatively tests gas-tight totally–encapsulating chemical protective suit integrity by detecting inward leakage of ammonia vapor. Since no modifications are made to the suit to carry out this test, the results from this practice provide a realistic test for the integrity of the entire suit.

1.2 Resistance of the suit materials to permeation, penetration, and degradation is not determined by this test method. ASTM test methods are available to test suit materials for these characteristics and the tests are usually conducted by the manufacturers of the suits.

2.0 – **Definition of terms**

2.1 "Totally-encapsulated chemical protective suit (TECP suit)" means a full body garment which is constructed of protective clothing materials; covers the wearer's torso, head, arms, legs and respirator, may cover the wearer's hands and feet with tightly attached gloves and boots; completely encloses the wearer and respirator by itself or in combination with the wearer's gloves and boots.

2.2 "Protective clothing material" means any material or combination of materials used in an item of clothing for the purpose of isolating parts of the body from direct contact with a potentially hazardous liquid or gaseous chemicals.

2.3 "Gas-tight" means, for the purpose of this test method, the limited flow of a gas under pressure from the inside of the TECP suit to

atmosphere at a prescribed pressure and time interval.

2.4 "Intrusion Coefficient" means a number expressing the level of protection provided by a gas-tight totally-encapsulating chemical protective suit. The intrusion coefficient is calculated by dividing the test room challenge agent concentration by the concentration of challenge agent found inside the suit. The accuracy of the intrusion coefficient is dependent on the challenge agent monitoring methods. The larger the intrusion coefficient, the greater the protection provided by the TECP suit.

3.0 – **Summary of recommended practice**

3.1 The volume of concentrated aqueous ammonia solution (ammonia hydroxide NH_4OH) required to generate the test atmosphere is determined using the directions outlined in 6.1. The suit is donned by a person wearing the appropriate respiratory equipment (either a positive pressure self-contained breathing apparatus or a positive pressure supplied air respirator) and worn inside the enclosed test room. The concentrated aqueous ammonia solution is taken by the suited individual into the test room and poured into an open plastic pan. A two-minute evaporation period is observed before the test room concentration is measured, using a high range ammonia length of stain detector tube. When the ammonia vapor reaches a concentration of between 1000 and 1200 ppm, the suited individual starts a standardized exercise protocol to stress and flex the suit. After this protocol is completed, the test room concentration is measured again. The suited individual exits the test room and his stand-by person measures the ammonia concentration inside the suit using a low range ammonia length of stain detector tube or other more sensitive ammonia detector. A stand-by person is required to observe the test individual during the test procedure; aid the person in donning and doffing the TECP suit; and monitor the suit interior. The intrusion coefficient of the suit can be calculated by dividing the average test area concentration by the interior suit concentration. A colorimetric ammonia indicator strip of bromophenol blue or equivalent is placed on the inside of the suit face piece lens so that the suited individual is able to detect a color change and determine if it has a significant leak. If a color change is observed, the individual shall leave the test room immediately.

4.0 – **Required supplies**

4.1 A supply of concentrated aqueous (58 percent ammonium hydroxide by weight).

4.2 A supply of bromophenol/blue indicating the paper or equivalent, sensitive to 5-10 ppm ammonia or greater over a two-minute period of exposure. [pH 3.0 (yellow) to pH 4.6 (blue)]

4.3 A supply of high range (0.5-10 volume percent) and low range (5-700 ppm) detector tubes for ammonia and the corresponding sampling pump. More sensitive ammonia detectors can be substituted for the low range detector tubes to improve the sensitivity of this practice.

4.4 A shallow plastic pan (PVC) at least 12":14":1" and a half pint plastic container (PVC) with tightly closing lid.

4.5 A graduated cylinder or other volumetric measuring device of at least 50 milliliters in volume with an accuracy of at least ±1 milliliters.

5.0 – **Safety precautions**

5.1 Concentrated aqueous ammonium hydroxide, NH_4OH is a corrosive volatile liquid requiring eye, skin, and respiratory protection. The person conducting the test shall review the MSDS for aqueous ammonia.

5.2 Since the established permissible exposure limit for ammonia is 50 ppm, only persons wearing a positive pressure self-contained breathing apparatus or a positive pressure supplied air respirator shall be in the chamber. Normally only the person wearing the totally-encapsulating suit will be inside the chamber. A stand-by person shall have a positive pressure self-contained breathing apparatus, or a positive pressure supplied air respirator available to enter the test area should the suited individual need assistance.

5.3 A method to monitor the suited individual must be used during this test. Visual contact is the simplest, but other methods using communication devices are acceptable.

5.4 The test room shall be large enough to allow the exercise protocol to be carried out and then to be ventilated to allow for easy exhaust of the

ammonia test atmosphere after the test(s) are completed.

5.5 Individuals shall be medically screened for the use of respiratory protection and checked for allergies to ammonia before participating in this test procedure.

6.0 – **Test procedure**

6.1.1 Measure the test area to the nearest foot and calculate its volume in cubic feet. Multiply the test area volume by 0.2 milliliters of concentrated aqueous ammonia solution per cubic foot of test area volume to determine the approximate volume of concentrated aqueous ammonia required to generate 1000 ppm in the test area.

6.1.2 Measure this volume from the supply of concentrated aqueous ammonia and place it into a closed plastic container.

6.1.3 Place the container, several high range ammonia detector tubes, and the pump in the clean test pan and locate it near the test area entry door so that the suited individual has easy access to these supplies.

6.2.1 In a non-contaminated atmosphere, open a pre-sealed ammonia indicator strip and fasten one end of the strip to the inside of the suit face shield lens where it can be seen by the wearer. Moisten the indicator strip with distilled water. Care shall be taken not to contaminate the detector part of the indicator paper by touching it. A small piece of masking tape or equivalent should be used to attach the indicator strip to the interior of the suit face shield.

6.2.2 If problems are encountered with this method of attachment, the indicator strip can be attached to the outside of the respirator face piece lens being used during the test.

6.3 Don the respiratory protective device normally used with the suit, and then don the TECP suit to be tested. Check to be sure all openings which are intended to be sealed (zippers, gloves, etc.) are completely sealed. DO NOT, however, plug off any venting valves.

6.4 Step into the enclosed test room such as a closet, bathroom, or test booth, equipped with an exhaust fan. No air should be exhausted from the chamber during the test because this will dilute the ammonia challenge concentrations.

6.5 Open the container with the premeasured volume of concentrated aqueous ammonia within the enclosed test room, and pour the liquid into the empty plastic test pan. Wait two minutes to allow for adequate volatilization of the concentrated aqueous ammonia. A small mixing fan can be used near the evaporation pan to increase the evaporation rate of the ammonia solution.

6.6 After two minutes a determination of ammonia concentration within the chamber should be made using the high range colorimetric detector tube. A concentration of 1000 ppm ammonia or greater shall be generated before the exercises are started.

6.7 To test the integrity of the suit, the following four-minute exercise protocol should be followed:

6.7.1 Raising the arms above the head with at least 15 raising motions completed in one minute.

6.7.2 Walking in place for one minute with at least 15 raising motions of each leg in a one-minute period.

6.7.3 Touching the toes with at least 10 complete motions of the arms from above the head to touching of the toes in a one-minute period.

6.7.4 Knee bends with at least 10 complete standing and squatting motions in a one-minute period.

6.8 If at any time during the test the colorimetric indicating paper should change colors, the test should be stopped and section 6.10 and 6.12 initiated (See §4.2).

6.9 After completion of the test exercise, the test area concentration should be measured again using the high range colorimetric detector tube.

6.10 Exit the test area.

6.11 The opening created by the suit zipper or other appropriate suit penetration should be used to determine the ammonia concentration in the suit with the low range length of stain detector tube or other ammonia monitor. The internal TECP suit air should be sampled far enough

from the enclosed test area to prevent a false ammonia reading.

6.12 After the completion of the measurement of the suit interior ammonia concentration, the test is concluded and the suit is doffed and the respirator removed.

6.13 The ventilating fan for the test room should be turned on and allowed to run for enough time to remove the ammonia gas. The fan shall be vented to the outside of the building.

6.14 Any detectable ammonia in the suit interior (five ppm ammonia [NH_3] or more for the length of stain detector tube) indicates that the suit has failed the test. When other ammonia detectors are used, a lower level of detection is possible, and it should be specified as the pass/fail criteria.

6.15 By following this test method, an intrusion coefficient of approximately 200 or more can be measured with the suit in a completely operational condition. If the intrusion coefficient is 200 or more, then the suit is suitable for emergency response and field use.

7.0 **– Retest procedures**

7.1 If the suit fails this test, check for leaks by following the pressure test in test (A) above.

7.2 Retest the TECP suit as outlined in the test procedures 6.0.

8.0 – **Report**

8.1 Each gas-tight totally-encapsulating chemical protective suit tested by this practice shall have the following information recorded.

8.1.1 Unique identification number, identifying brand name, date of purchase, material of construction, and unique suit features; e.g., special breathing apparatus.

8.1.2 General description of test room used for test.

8.1.3 Brand name and purchase data of ammonia detector strips and color change data.

8.1.4 Brand name, sampling range, and expiration date of the length of stain ammonia detector tubes. The brand name and model of the sampling pump should also be recorded. If another type of ammonia detector is used, it should be identified along with its minimum detection limit for ammonia.

8.1.5 Actual test results shall list the two area concentrations, their average, the interior suit concentration, and the calculated intrusion coefficient. Retest data shall be recorded as an additional test.

8.2 The evaluation of the data shall be specified as “suit passed” or “suit failed,” and the date of the test. Any detectable ammonia (five ppm or greater for the length of stain detector tube) in the suit interior indicates the suit has failed this test. When other ammonia detectors are used, a lower level of detection is possible and it should be specified as the pass/fail criteria.

Caution

Visually inspect all parts of the suit to be sure they are positioned correctly and secured tightly before putting the suit back into service. Special care should be taken to examine each exhaust valve to make sure it is not blocked.

Care should also be exercised to assure that the inside and outside of the suit is completely dry before it is put into storage.

Appendix B – General Description and Discussion of the Levels of Protection and Protective Gear

This appendix sets forth information about personal protective equipment (PPE) protection levels which may be used to assist employer in complying with the PPE requirements of this section.

As required by the standard, PPE must be selected which will protect employees from the specific hazards which they are likely to encounter during their work on-site.

Selection of the appropriate PPE is a complex process which should take into consideration a variety of factors. Key factors involved in this process are identification of the hazards, or suspected hazards; their routes of potential hazard to employees (inhalation, skin absorption, ingestion, and eye or skin contact): and the performance of the PPE materials (and seams) in providing a barrier to these hazards. The amount of protection provided by PPE is material-hazard specific. That is, protective equipment materials will protect well against some hazardous substances and poorly, or not at all, against others. In many instances, protective

equipment materials cannot be found which will provide continuous protection from the particular hazardous substance. In these cases the breakthrough time of the protective material should exceed the work durations, or the exposure after breakthrough may not pose a hazardous level.

Other factors in this selection process to be considered are matching the PPE to the employee's work requirements and task-specific conditions. The durability of PPE materials, such as tear strength and seam strength, should be considered in relation to the employee's tasks. The effects of PPE in relation to heat stress and task duration are a factor in selecting and using PPE. In some cases layers of PPE may be necessary to provide sufficient protection, or to protect expensive PPE inner garments, suits, or equipment.

The more that is known about the hazards at the site, the easier the job of PPE selection becomes. As more information about the hazards and conditions at the site becomes available, the site supervisor must make decisions to up-grade or down-grade the level of protection to match the tasks at hand.

The following are guidelines which an employer can use to begin the selection of the appropriate PPE. As noted above, the site information may suggest the use of combinations of PPE selected from the different protection levels (i.e., A, B, C, or D) as being more suitable to the hazards of the work. It should be cautioned that the listing below does not fully address the performance of the specific PPE material in relation to the specific hazards at the job site, and that PPE selection, evaluation and re-selection is an ongoing process until sufficient information about the hazards and PPE performance is obtained.

Part A. Personal protective equipment is divided into four categories based on the degree of protection afforded. (See Part B of this appendix for further explanation of Levels A, B, C, and D hazards.)

I. Level A – To be selected when the greatest level of skin, respiratory, and eye protection is required.

The following constitute Level A equipment; it may be used as appropriate:

1. Positive pressure, full face-piece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA, approved by the National Institute for Occupational Safety and Health (NIOSH).

2. Totally-encapsulating chemical-protective suit.

3. Coveralls.[1]

4. Long underwear.[1]

5. Gloves, outer, chemical-resistant.

6. Gloves, inner, chemical-resistant.

7. Boots, chemical-resistant, steel toe and shank.

8. Hard hat (under suit)[1].

9. Disposable protective suit, gloves and boots (depending on suit construction, may be worn over totally-encapsulating suit).

Note: [1]Optional, as applicable.

II. Level B – The highest level of respiratory protection is necessary but a lesser level of skin protection is needed.

The following constitute Level B equipment; it may be used as appropriate.

1. Positive pressure, full-facepiece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA (NIOSH approved).

2. Hooded chemical-resistance clothing (overalls and long-sleeved jacket; coveralls; one or two-piece chemical-splash suit; disposable chemical-resistant overalls).

3. Coveralls.[1]

4. Gloves, outer, chemical-resistant.

5. Gloves, inner, chemical-resistant.

6. Boots, outer, chemical-resistant steel toe and shank.

7. Boot-covers, outer, chemical-resistant (disposable).[1]

8. Hard hat.[1]

9. [Reserved]

10. Face shield.[1]

III. Level C – The concentration(s) and type(s) of airborne substance(s) is known and the criteria for using air purifying respirators are met.

1. Full-face or half-mask, air purifying respirators (NIOSH approved).

2. Hooded chemical-resistant clothing (overalls; two-piece chemical-splash suit; disposable chemical-resistant overalls).

3. Coveralls.

4. Gloves, outer, chemical-resistant.

5. Gloves, inner, chemical-resistant.

6. Boots (outer), chemical-resistant, steel toe and shank. [1]

7. Boot-covers, outer, chemical-resistant (disposable). [1]

8. Hard hat. [1]

9. Escape mask. [1]

10. Face shield. [1]

IV. Level D – A work uniform affording minimal protection used for nuisance contamination only.

The following constitute Level D equipment; it may be used as appropriate:

1. Coveralls.

2. Gloves. [1]

3. Boots/shoes, chemical-resistant, steel toe and shank.

4. Boot-covers, outer, chemical-resistant (disposable). [1]

5. Safety glasses or chemical splash goggles*.

6. Hard hat. [1]

7. Escape mask. [1]

8. Face shield. [1]

Part B. The types of hazards for which levels A, B, C, and D protection are appropriate are described below:

I. Level A – Level A protection should be used when:

1. The hazardous substance has been identified and requires the highest level of protection for skin, eyes, and the respiratory system based on either the measured (or potential for) high concentration of atmospheric vapors, gases, or particulates; or the site operations and work functions involve a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates or materials that are harmful to skin or capable of being absorbed through the skin;

2. Substances with a high degree of hazard to the skin are known or suspected to be present, and skin contact is possible; or

3. Operations are being conducted in confined, poorly ventilated areas, and the absence of conditions requiring Level A have not yet been determined.

II. Level B – Level B protection should be used when:

1. The type and atmospheric concentrations of substances have been identified and require a high level of respiratory protection, but less skin protection;

2. The atmosphere contains less than 19.5 percent oxygen; or

3. The presence of incompletely identified vapors or gases is indicated by a direct-reading organic vapor detection instrument, but vapors and gases are not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through the skin.

Note: This involves atmospheres with IDLH concentrations of specific substances that present severe inhalation hazards and that do not represent a severe skin hazard; or that do not meet the criteria for use of air-purifying respirators.

III. Level C – Level C protection should be used when:

1. The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect or be absorbed through any exposed skin:

2. The types of air contaminants have been identified, concentrations measured, and an air-purifying respirator is available that can remove the contaminants; and

3. All criteria for the use of air-purifying respirators are met.

IV. Level D – Level D protection should be used when:

1. The atmosphere contains no known hazard; and

2. Work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals.

Note: As stated before, combinations of personal protective equipment other than those described for Levels A, B, C, and D protection may be more appropriate and may be used to provide the proper level of protection.

As an aid in selecting suitable chemical protective clothing, it should be noted that the National Fire Protection Association is developing standards on chemical protective clothing. These standards are currently undergoing public review prior to adoption, including:

NFPA 1991 – Standard on Vapor-Protective Suits for Hazardous Chemical Emergencies (EPA Level A Protective Clothing)

NFPA 1991 – Standard on Liquid Splash-Protective Suits for Hazardous Chemical Emergencies (EPA Level B Protective Clothing)

NFPA 1993 – Standard on Liquid Splash-Protective Suits for Non-emergency, Non-flammable Hazardous Chemical Situations (EPA Level B Protective Clothing)

These standards would apply documentation and performance requirements to the manufacture of chemical protective suits. Chemical protective suits meeting these requirements would be labeled as compliant with the appropriate standard. When these standards are adopted by the National Fire Protection Association, it is recommended that chemical protective suits which meet these standards be used.

Appendix C – Compliance Guidelines

1. **Occupational Safety and Health Program.** Each hazardous waste site clean-up effort will require an occupational safety and health program headed by the site coordinator or the employer's representative. The purpose of the program will be the protection of employees at the site and will be an extension of the employer's overall safety and health program. The program will need to be developed before work begins on the site and implemented as work proceeds as stated in paragraph (b). The program is to facilitate coordination and communication of safety and health issues among personnel responsible for the various activities which will take place at the site. It will provide the overall means for planning and implementing the needed safety and health training and job orientation of employees who will be working at the site. The program will provide the means for identifying and controlling worksite hazards and the means for monitoring program effectiveness. The program will need to cover the responsibilities and authority of the site coordinator or the employer's manager on the site for the safety and health of employees at the site, and the relationships with contractors or support services as to what each employer's safety and health responsibilities are for their employees on the site. Each contractor on the site needs to have his or her own safety and health program so structured that it will smoothly interface with the program of the site coordinator or principal contractor.

Also those employers involved with treating, storing, or disposal of hazardous waste as covered in paragraph (p) must have implemented a safety and health program for their employees. This program is to include the hazard communication program required in paragraph (p)(1) and the training required in paragraphs (p)(7) and (p)(8) as parts of the employer's comprehensive overall safety and health program. This program is to be in writing.

Each site or workplace safety and health program will need to include the following: (1) Policy statements of the line of authority and accountability for implementing the program, the objectives of the program and the role of the site safety and health supervisor or manager and staff; (2) means or methods for the development of procedures for identifying and controlling workplace hazards at the site; (3) means or methods for the development and communication to employees of the various plans, work rules, standard operating procedures and practices that pertain to individual employees and supervisors; (4) means for the training of supervisors and employees to develop the needed skills and knowledge to perform their work in a safe and healthful manner; (5) means for obtaining information feedback to aid in

evaluating the program and for improving the effectiveness of the program. The management and employees should be trying continually to improve the effectiveness of the program thereby enhancing the protection being afforded those working on the site.

Accidents on the site or workplace should be investigated to provide information on how such occurrences can be avoided in the future. When injuries or illnesses occur on the site or workplace, they will need to be investigated to determine what needs to be done to prevent this incident from occurring again. Such information will need to be used as feedback on the effectiveness of the program and the information turned into positive steps to prevent any reoccurrence. Receipt of employee suggestions or complaints relating to safety and health issues involved with site or workplace activities is also a feedback mechanism that can be used effectively to improve the program and may serve in part as an evaluative tool(s).

For the development and implementation of the program to be the most effective, professional safety and health personnel should be used. Certified Safety Professional, Board Certified Industrial Hygienists or Registered Professional Safety Engineers are good examples of professional stature for safety and health managers who will administer the employer's program.

2. **Training.** The training programs for employees subject to the requirements of paragraph (e) of this standard should address: the safety and health hazards employees should expect to find on hazardous waste clean-up sites: what monitoring procedures are effective in characterizing exposure levels; what makes an effective employer's safety and health program; what a site safety and health plan should include; hands on training with personal protective equipment and clothing they may be expected to use; the contents of the OSHA standard relevant to the employee's duties and function; and, employee's responsibilities under OSHA and other regulations. Supervisors will need training in their responsibilities under the safety and health program and its subject areas such as the spill containment program, the personal protective equipment program, the medical surveillance program, the emergency response plan and other areas.

The training programs for employees subject to the requirements of paragraph (p) of this standard should address: the employer's safety and health program elements impacting employees; the hazard communication program; the medical surveillance program; the hazards and the controls for such hazards that employees need to know for their job duties and functions. All require annual refresher training.

The training programs for employees covered by the requirements of paragraph (q) of this standard should address those competencies required for the various levels of response such as the hazards associated with hazardous substances; hazard identification and awareness; notification of appropriate persons; the need for and use of personal protective equipment including the emergency response plan; company standard operating procedures for hazardous substance emergency responses; the use of the incident command system and other subjects. Hands-on training should be stressed whenever possible. Critiques done after an incident which include an evaluation of what worked and what did not and how the incident could be better handled the next time may be counted as training time.

For hazardous materials specialists (usually members of hazardous materials teams), the training should address the care, use and/or testing of chemical protective clothing including totally encapsulating suits, the medical surveillance program, the standard operating procedures for the hazardous materials team including the use of plugging and patching equipment and other subject areas.

Officers and leaders who may be expected to be in charge at an incident should be fully knowledgeable of their company's incident command system. They should know where and how to obtain additional assistance and be familiar with local district's emergency response plan and the State emergency response plan.

Specialist employees such as technical experts, medical experts or environmental experts that work with hazardous materials in their regular jobs, who may be sent to the incident scene by the shipper, manufacturer or governmental agency to advise and assist the person in charge of the incident should have training on an annual basis. Their training should include the care and use of personal protective equipment including respirators; knowledge of the incident command system and how they are to relate to it; and those areas needed to keep them current in their respective field as it relates to safety and health involving specific hazardous substances.

Those skilled support personnel, such as employees who work for public departments or equipment operators who operate bulldozers, sand trucks, backhoes, etc., who may be called to the incident scene to provide emergency support assistance, should have at least a safety and health briefing before entering the area of potential or actual exposure. These skilled support personnel, who have not been a part of the emergency response plan and do not meet the training requirements, should be made aware of the hazards they face and should be provided all necessary protective clothing and equipment required for their tasks.

3. **Decontamination.** Decontamination procedures should be tailored to the specific hazards of the site, and may vary in complexity and number of steps, depending on the level of hazard and the employee's exposure to the hazard. Decontamination procedures and PPE decontamination methods will vary depending upon the specific substance, since one procedure or method may not work for all substances. Evaluation of decontamination methods and procedures should be performed, as necessary, to assure that employees are not exposed to hazards by re-using PPE. References in Appendix F may be used for guidance in establishing and effective decontamination program. In addition, the U.S. Coast Guard's Manual, "Policy Guidance for Response to Hazardous Chemical Releases." U.S. Department of Transportation, Washington, D.C. (COMDTINST M16465.30) is a good reference for establishing an effective decontamination program.

4. **Emergency response plans**. States, along with designated districts within the states, will be developing or having developed local emergency response plans. These state and district plans should be utilized in the emergency response plans called for in the standard. Each employer should assure that its emergency response plan is compatible with the local plan. The major reference being used to aid in developing the state and local district plans is the Hazardous Materials Emergency Planning Guide, NFT – 1. The current Emergency Response Guidebook from the U.S. Department of Transportation, CMA's CHEMTREC and the Fire Service Emergency Management Handbook may also be used as resources.

Employers involved with treatment, storage, and disposal facilities for hazardous waste, which have the required contingency plan called for by their permit, would not need to duplicate the same planning elements. Those items of the emergency response plan that are properly addressed in the contingency plan may be substituted into the emergency response plan required in 1910.120 or otherwise kept together for employer and employee use.

5. **Personal protective equipment programs.** The purpose of personal protective clothing and equipment (PPE) is to shield or isolate individuals from the chemical, physical, and biologic hazards that may be encountered at a hazardous substance site.

As discussed in Appendix B, no single combination of protective equipment and clothing is capable of protecting against all hazards. This PPE should be used in conjunction with other protective methods and its effectiveness evaluated periodically.

The use of PPE can itself create significant worker hazards such as heat stress, physical and psychological stress, and impaired vision, mobility, and communication. For any given situation, equipment and clothing should be selected that provide an adequate level of protection. However, overprotection, as well as under-protection, can be hazardous and should be avoided where possible.

Two basic objectives of any PPE program should be to protect the wearer from safety and health hazards, and to prevent injury to the wearer from incorrect use and/or malfunction of the PPE. To accomplish these goals, a comprehensive PPE program should include hazard identification, medical monitoring, environmental surveillance, election, use, maintenance, and decontamination of PPE and its associated training.

The written PPE program should include policy statements, procedures, and guidelines. Copies should be made available to all employees, and a reference copy should be made available at the worksite. Technical data on equipment, maintenance manuals, relevant regulations, and other essential information should also be collected and maintained.

6. **Incident command system (ICS).** Paragraph 1910.120(q)(3)(ii) requires the implementation of an ICS. The ICS is an organized approach to effectively control and manage operations at an emergency incident. The individual in charge of the ICS is the senior official responding to the incident. The ICS is not much different than the "command post" approach used for many years by the fire service. During large complex fires involving several companies and many pieces of apparatus, a command post would be established. This enables one individual to be in charge of managing the incident, rather than having several officers from different companies making separate, and sometimes conflicting, decisions. The individual in charge of the command post would delegate responsibility for performing various tasks to subordinate officers. Additionally, all communications are routed through the command post to reduce the number of radio transmissions and eliminate confusion. However, strategy, tactics, and all decisions are made by one individual.

The ICS is a very similar system, except it is implemented for emergency response to all incidents, both large and small, that involve hazardous substances.

For a small incident, the individual in charge of the ICS may perform many tasks of the ICS. There may not be any or little delegation of tasks to subordinates. For example, in response to a small incident, the individual in charge of the ICS, in addition to normal command activities, may become the safety officer and may designate only one employee (with proper equipment) as

a backup to provide assistance if needed. OSHA does recommend, however, that at least two employees be designated as backup personnel since the assistance needed may include rescue.

To illustrate the operation of the ICS, the following scenario might develop during a small incident, such as an overturned tank truck with a small leak of flammable liquid.

The first responding senior officer would implement and take command of the ICS. That person would size-up the incident and determine if additional personnel and apparatus were necessary; would determine what actions to take to control the leak; and, determine the proper level of personal protective equipment. If additional assistance is not needed, the individual in charge of the ICS would implement actions to stop and control the leak using the fewest number of personnel that can effectively accomplish the tasks. The individual in charge of the ICS then would designate himself as the safety officer and two other employees as a back-up in case rescue may become necessary. In this scenario, decontamination procedures would not be necessary.

A large complex incident may require many employees and difficult, time-consuming efforts to control. In these situations, the individual in charge of the ICS will want to delegate different tasks to subordinates in order to maintain a space of control that will keep the number of subordinates, that are reporting, to a manageable level.

Delegation of tasks can also be by function. Some of the functions that the individual in charge of the ICS may want to delegate at a large incident are: medical services; evaluation; water supply; resources (equipment, apparatus); media relations; safety; and, site control (integrate activities with police for crowd and traffic control). Also for a large incident, the individual in charge of the ICS will designate several employees as back-up personnel and a number of safety officers to monitor conditions and recommend safety precautions.

Therefore, no matter what size or complexity an incident may be, by implementing an ICS there will be *one individual in charge* who makes the decisions and gives directions; and, all actions and communications are coordinated through one central point of command. Such a system should reduce confusion, improve safety, organize and coordinate actions, and should facilitate effective management of the incident.

7. **Site Safety and Control Plans.** The safety and security of response personnel and others in the area of an emergency response incident site should be a primary concern to the incident commander. The use of a site safety and control plan could greatly assist those in charge of assuring the safety and health of employees on the site.

A comprehensive site safety and control plan should include the following: summary analysis of hazards on the site and a risk analysis of those hazards; site map or sketch; site work zones (clean zone, transition or decontamination zone, work or hot zone); use of the buddy system; site communications, command post or command center; standard operating procedures and safe work practices; medical assistance and triage area; hazard monitoring plan (air contaminate monitoring, etc.); decontamination procedures and area; and other relevant areas. This plan should be a part of the employer's emergency response plan or an extension of it to the specific site.

8. **Medical surveillance programs.** Workers handling hazardous substances may be exposed to toxic chemicals, safety hazards, biologic hazards, and radiation. Therefore, a medical surveillance program is essential to assess and monitor worker's health and fitness for employment in hazardous waste operations and during the course of work; to provide emergency and other treatment as needed; and to keep accurate records for future reference.

The Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities developed by the National Institute for Occupational Safety and Health (NIOSH), the Occupational Safety and Health Administration (OSHA), the U.S. Coast Guard (USCG), and the Environmental Protection Agency (EPA) October 1985, provides an excellent example of the types of medical testing that should be done as part of a medical surveillance program.

Appendix D – References

The following references may be consulted for further information on the subject of this standard:

1. OSHA Instruction DFO CPL 2.70 – January 29, 1986, *Special Emphasis Program: Hazardous Waste Sites.*

2. OSHA Instruction DFO CPL 2-2.37A – January 29, 1986, *Technical Assistance and Guidelines for Superfund and Other Hazardous Waste Site Activities.*

3. OSHA Instruction DFO CPL 2.74 – January 29, 1986, *Hazardous Waste Activity Form, OSHA 175.*

4. Hazardous Waste Inspections Reference Manual, U.S. Department of Labor, Occupational Safety and Health Administration, 1986.

5. Memorandum of Understanding Among the National Institute for Occupational Safety and Health, the Occupational Safety and Health Administration, the United States Coast Guard, and the United States Environmental Protection Agency, *Guidance for Worker Protection During Hazardous Waste Site Investigations and Clean-up and Hazardous Substance Emergencies,* December 18, 1980.

6. National Priorities List, 1st Edition, October 1984; U.S. Environmental Protection Agency, Revised periodically.

7. The Decontamination of Response Personnel, Field Standard Operating Procedures (F.S.O.P.) 7; U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Hazardous Response Support Division, December 1984.

8. Preparation of a Site Safety Plan, Field Standard Operating Procedures (F.S.O.P.) 9; U.S. Environmental Protection Agency, Office of Equipment and Remedial Response, Hazardous Response, 1985.

9. Standard Operating Safety Guidelines; U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Hazardous Response Support Division, Environmental Response Team, November 1984.

10. Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Coast Guard (USCG), and Environmental Protection Agency (EPA), October 1985.

11. Protecting Health and Safety at Hazardous Waste Site; An Overview, U.S. Environmental Protection Agency, EPA/625/9 – 85/005, September 1985.

12. Hazardous Waste Sites and Hazardous Substance Emergencies, NIOSH Worker Bulletin, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, December 1982.

13. Personal Protective Equipment for Hazardous Materials Incidents: A Selection Guide; U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, October 1984.

14. Fire Service Emergency Management Handbook, International Association of Fire Chiefs Foundation, 101 East Holly Avenue, Unit 10B, Sterling, VA 22170, January 1985.

15. Emergency Response Guidebook, U.S. Department of Transportation, Washington, DC, 1987.

16. Report to the Congress on Hazardous Materials Training, Planning and Preparedness, Federal Emergency Management Agency, Washington, DC, July 1986.

17. Workbook for Fire Command, Alan V. Brunacini and J. David Beageron, National Fire Protection Association, Batterymarch Park, Quincy MA 02269, 1985.

18. Fire Command, Alan V. Brunacini, National Fire Protection, Batterymarch Park, Quincy MA 02269, 1985.

19. Incident Command System, Fire Protection Publications, Oklahoma State University, Stillwater, OK 74078, 1983.

20. Site Emergency Response Planning, Chemical Manufacturers Association, Washington, DC 20037, 1986.

21. Hazardous Materials Emergency Planning Guide, NRT-1, Environmental Protection Agency, Washington, DC, March 1987.

22. Community Teamwork: Working Together to Promote Hazardous Materials Transportation Safety, U.S. Department of Transportation, Washington, DC, May 1983.

23. Disaster Planning Guide for Business and Industry, Federal Emergency Management Agency, Publication No. FEMA 141, August 1987.

(The Office of Management and Budget has approved the information collection requirements in this section under control number 1218-0129).

- **Adoption of OSHA's Final Standard**

OSHA's final standard on Hazardous Waste Operations took effect in March, 1990. This standard was effective until the Michigan Hazwoper was implemented.

- **EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT (from SARA, Title III)**

In passing SARA, Title III, the Emergency Planning and Community Right-to-Know Act, Congress directed the Environmental Protection Agency (EPA) to develop regulations for various sections of the Act. EPA was also given primary responsibility for enforcing the law. The major provisions are:

- **Emergency Planning (Sections 301-303)**

Under this law, the governor or each state is responsible for appointing members to a State Emergency Response Commission (SERC). The Michigan SERC, which was appointed by Governor Blanchard in 1987, is responsible for establishing emergency districts and for appointing, supervising and coordinating Local Emergency Planning Committees. The LEPC for each district must include members from a variety of occupations, including firefighting.

In Michigan, counties and several major cities have been designated as emergency planning districts. For each of these districts, the LEPC is responsible for developing comprehensive emergency response plans for any facilities, which could release dangerous amounts of certain extremely hazardous substances.

Facilities which use or store these extremely hazardous substances above the "threshold planning quantities" must notify the SERC and the LEPC. In addition, the LEPC may request any additional information needed for the development of its emergency plan, such as safety audits, internal hazard analyses, etc.

❑ REQUIRED ELEMENTS OF A LOCAL EMERGENCY RESPONSE PLAN

1. Identification of facilities and transportation routes where hazardous materials are present.
2. Emergency response procedures, including evacuation plans, for dealing with accidental chemical releases.
3. Notification procedures for those who will respond to an emergency.
4. Methods for determining the occurrence of and severity of a release and the areas of populations likely to be affected.
5. Methods for notification of the public in the event of a chemical release.
6. Identification of emergency equipment available in the community, including equipment at facilities.
7. A program and schedule for training local emergency response and medical workers to respond to chemical emergencies.
8. Methods and schedules for conducting exercises to test elements of the plan.
9. Designation of a community coordinator and facility coordinators to carry out the plan.

Emergency Release Notification (Section 304)

Facilities must immediately notify the SERC and LEPC of any accidental releases of hazardous substances in excess of "reportable quantities" and provide written follow-up reports on actions taken and medical effects. The SERC and LEP must make accidental release information available to the public.

Hazardous Chemical Reporting (Sections 311-312)

Facilities must submit material safety data sheets (MSDS's) or lists of hazardous chemicals to the SERC, LEPC and to **local fire departments.** *(See Attachments E & F)*

HOW TO READ AND UNDERSTAND

A MATERIAL SAFETY DATA SHEET

A sample of a complete MSDS is attached on page 55. This sample will be referred to in explaining how to use the MSDS in your hazard communication program. Unfortunately, some MSDS's may not be as complete or accurate as the example. If you have any questions on a particular MSDS, you should contact the originator the Bureau of Safety Education and Training, Indiana Department of Labor, 1013 State Office Building, Indianapolis, IN 46204 or call the Occupational Health Consultation Office: 317-232-4129 or 317-232-4135.

GUIDELINES FOR READING AND UNDERSTANDING AN MSDS

Not all Material Safety Data Sheets will contain all of the information discussed in this article and the information will vary depending upon the degree to which the material is hazardous. But this will give you an idea of the kind of information you should expect to find when you read an MSDS.

If the MSDS is blank or has only a trade name and a lot of N.A.'s ("not applicable") on it, it is not going to be useful. Most MSDS have at least some of the information filled in. By cross-checking the information in various sections, you can determine what you need to know about the hazards of the material.

I. PRODUCT IDENTIFICATION

The manufacturer or distributor listed should be able to provide detailed information on the hazards of the material(s) covered by the MSDS.

Does the trade name on the MSDS agree with the one on the label on the container?

The synonyms should be those most commonly used for the product.

Make sure the chemical name, and the formula, are listed for single substances and that the trade or brand name and the chemical family is listed if the substance is a mixture. You will find ingredient information in Section II.

II. HAZARDOUS INGREDIENTS

The materials listed should be those in the product which are individually listed in:

(i) 29 CFR Part 1910, Subpart Z, Toxic and Hazardous Substances;
(ii) Threshold Limit Values for Substances and Physical Agents in the Work Environment, American Conference of Government Industrial Hygienists (ACGIH) (latest edition).

One component of a multicomponent product might be listed because of its toxicity (the health hazards it poses), another because of its flammability, and a third for its toxicity and its reactivity.

Toxic hazard data should be stated in terms of concentration, mode of exposure or text, and animal use; i.e., 100ppm LC_{50} (lethal concentration) rat, 25 mg/M^3 LD_{50} (lethal dose) oral mouse or permissible exposure limits from published sources such as:

(i) National Toxicology Program (NTP), Annual Report on Carcinogens (latest edition);
(ii) International Agency for Research on Cancer (IARC), Monographs (latest editions);

(iii) National Institute for Occupational Safety and Health (NIOSH), The Registry of Toxic Effects of Chemical Substances. Note – This publication indicates whether a chemical has been found by NTP or IARC to be a potential carcinogen.

Flammable or reactive data should be included as well as flash point, check sensitivity, or brief data to indicate the nature of the hazard.

If the concentration of the material in the mixture is 1% or greater and/or has a TLV (Threshold Limit Value) or a PEL (Permissible Exposure Limit) – check it against:

1. Section III – Physical Hazard Data. All of this section should be filled in if the substance is a solvent, catalyst or vehicle.

2. Section IV – Fire and Explosion Data. All of this section should be filled in with either numbers or procedures if the substance is either a solvent, catalyst, vehicle, oxidizer, or explosive metal.

3. Section V – Health Hazard Information. If a substance has a TLV, it most likely presents a health hazard(s). Be sure the "effects of overexposure" line lists both the long term (chronic) and short term (acute) consequences of exposure. This is especially true for substances which have some sort of toxic rating, such as LD_{50}, either in Section I or Section II.

4. Section VI – Reactivity Data. This section should be filled out if the substance is a catalyst, a polymer, a copolymer, a concentrated acid, base or other reactive substance. Also, a chemical may be incompatible with some-other-substance(s). That some other substance(s) should be listed on the "incompatibility" line.

5. Section VII – Spill, Leak, and Disposal Procedures. If the chemical has a TLV, procedures to follow in the event of a spill or leak should be specified.

6. Section VIII – Special Protection. If the substance has a TLV, this section should always have some information in it no matter what kind of substance it is, because it will either pose a breathing hazard or a skin or eye hazard. This section must give information on protection against any or all of these kinds of exposures.

7. Section IX – Special Precautions. If the substance is flammable, highly reactive, corrosive, explosive, or has some other dangerous properties, this section must have information on special handling and storage.

III. PHYSICAL DATA

This section is one of the most important and useful sections on the MSDS both for assessing how hazardous the substance is and how completely the MSDS is filled out. This is especially true for solvents, and that is why solvents are used as an example throughout this article.

The data in this section should be for the total mixture or product. Don't be put off by the terms. Once you know the definitions of the terms, you can make cross checks.

TERMS:

Boiling Point is the temperature in degrees Fahrenheit or Celsius at which liquid boils (or becomes gas). Ranges are given for mixtures.

Vapor Pressure. A high vapor pressure indicates that a liquid will evaporate easily.

The term "volatile" is used to describe a liquid that evaporates easily. This is important to know because it indicates that air concentrations can build up quickly when the material is worked with in its liquid form. Materials with high vapor pressures can be especially hazardous if you are working with them in an enclosed area or in an area with poor air circulation. Vapor pressures are measured in torr units or millimeters of mercury (mm Hg) at a certain temperature. Xylene with a vapor pressure of 10 mm Hg at 27-32 degrees C and toluene with a vapor pressure of 36 mm Hg at 30 degrees C are two solvents, for instance, the use of which can lead to hazardous air concentrations. However, even materials with lower vapor pressures may pose an inhalation hazard because the method of handling (for example, spraying versus brushing) also affects the concentration in air.

Vapor Density is the relative density or weight of a vapor or gas compared with an equal volume of air. If the vapor density of a substance is less than one, it will tend to rise in air; if the vapor density is greater than one, it will fall in air. Substances with high vapor densities pose a particular problem because they will collect in the bottom of tanks.

Solubility in water refers to the percentage by weight of the substance which can be dissolved in water. Less than 0.1% is considered negligible; 0.1-1% is slight; 1-10% is moderate; more than 10% is appreciable; and if it can be dissolved in all proportions, it has complete solubility.

Appearance & Odor may help you identify the substance you are working with. Do not rely on odor to indicate whether there is a hazardous concentration of the substance in the air. Some substances can reach hazardous levels and not have a noticeable odor.

Specific Gravity refers to the ratio of the weight of a volume of liquid to the weight of an equal volume of water at a specified temperature. If a substance has a specific gravity greater than one, it will sink in water; if it has a specific gravity less than one, it will float in water.

Percent Volatile by Volume refers to the percentage of a liquid or solid that evaporates at room temperature. The higher the percentage, the faster the substance will evaporate.

Evaporation Rate is the rate at which the material evaporates compared to either ether, which evaporates very quickly or to butyl acetate, which evaporates very slowly. The chemical which is used for comparison (ether or butyl acetate) should be listed. If a substance has an evaporation rate greater than one, it evaporates more easily than the chemical it is compared to; if the rate is less than one, it evaporates more slowly than the chemical it is compared to.

The information in the Physical Data section is useful for the control of toxic vapors. Boiling point, vapor density, percent volatile, vapor pressure and evaporation are all useful for designing proper ventilation systems. This information is also useful for design and use of adequate fire and spill containment equipment and procedures.

Make these checks. The boiling point, vapor pressure, % volatile, and evaporation rate are all characteristics of a substance which gives off vapors into the air. If one of these characteristics have been listed, all of them should be filled out.

If a material has a % volatile greater than 10 %, a boiling point below 100 degrees C, and a vapor pressure over 5 or 6 millimeters of mercury (mm Hg), check the following sections to make sure they are filled out and for information:

1. Check the TLV in Section II. A low TLV (i.e., less than 10) means that the material can be very hazardous. You may be better off using a highly volatile substance, like acetone, with a high TLV, than a less volatile substance like benzene with a low TLV. In fact, a useful way to compare the hazards of solvents when selecting a solvent to use is to divide the evaporation rate by the TLV and see which one is higher and therefore more hazardous.

2. In Section IV, check to see that the Flash Point and Flammable Limits are filled out. A substance with a vapor pressure of over 5 mm Hg at room temperature and an evaporation rate of greater than 1 and a flash point of less than 140 degrees F and low LEL (less than 2%), can be a dangerous fire hazard, especially if the % volatile is also high.

3. Check Section V, Effects of Overexposure, to see if breathing the vapors of the substance can be harmful.

4. Check Section VIII, Special Protection Information, to see whether there are recommendations for respiratory protection and/or ventilation controls. If the substance has a TLV and is volatile, this section must be filled out.

5. Make sure that there are some recommendations for storage and handling in Section IX, Special Precautions, especially if the substance has a vapor density that is heavier than air.

IV. FIRE AND EXPLOSION DATA

If you're working with flammables, solvents, peroxides, explosives, metal dusts and other unstable substances, this section is important. If the product does not pose a fire hazard, that should be stated in this section.

Some terms you need to know are:

Flash Point is the lowest temperature at which a liquid gives off enough vapor to make an ignitable mixture of vapor in air in a test container. Flash Point and autoignition should be listed in temperature degrees Fahrenheit or Centigrade, or both. Liquids with flash points below 140 degrees F are especially classified liquids by OSHA and require special precautions. Check Section IX, Special Precautions, to see what they are.

Flammable Liquids – LEL (lower explosive limit) and UEL (upper explosive limit) are the lower and upper limits of vapor and air concentration, given as percent, which can cause an explosion. The flash point and flammable limits are the most important when related to the boiling point, vapor pressure, % volatile and evaporation rate in Section III. If any one of these items are listed, all of the items should be listed in order to provide enough information about the hazards of the material.

Extinguishing Media means what kind of fire extinguisher to use. If the substance is not flammable and/or is completely inert, the MSDS should say so. Otherwise this line must always be filled out.

Special Fire Fighting Procedures and Unusual Fire and Explosion Hazards would need to be described for any combustible material. Some concentrated corrosives, calcium carbide or reactive metals, must not have water applied in case of fire. Check Section II to see if the material is a catalyst, and check Section VI for reactivity with water and polymerization in water or air.

V. HEALTH HAZARD INFORMATION

Health Hazard Data should be the combined estimate of the hazard of the total product. This might be stated as a time weighted average concentration, permissible exposure limit (PEL) or TLV. Other data such as LD_{50} might be used.

Routes of Exposure should contain information about the potential hazard from absorption of the product, the severity of the effect, and the basis for that determination. The basis might be animal studies, analogy with similar products, or human exposure.

Typical comments might be:

> Skin contact, single short contact-no adverse effects likely; prolonged or repeated skin contact-mild irritation and possibly some blistering; eye contact-some pain and mild transient irritation; no corneal scarring.

Check Section II to see if TLVs are listed for any of the ingredients. If TLVs are listed there, they should also be listed in this section; make sure the numbers are the same. If the substance is a mixture of several compounds and a TLV for the mixture is listed in this section, this is only appropriate if all of the ingredients in the mixture contributing to the TLV have the same harmful health effects, such as petroleum solvent vapors which cause drowsiness and unconsciousness. Check Section I and VI for this information.

Routes of Exposure should list common effects by route of exposure, usually inhalation or absorption by skin contact. It should include chronic and acute effects, as well as information on carcinogenicity, teratogenicity, or mutagenicity. Many MSDS lack information on chronic effects.

If inhalation is a primary route of exposure, check the following sections:

Section III because this section can help you determine how great the hazard might be. Chemicals with high vapor pressure and high volatility usually pose more of an inhalation problem than chemicals with low vapor pressure and low volatility.

Section VIII because this section should give information on proper respiratory protective devices (with type specified and/or necessary ventilation requirements).

If skin contact or absorption is a problem, Section VIII should list proper protective equipment (gloves and eye and skin protection).

Effects of Overexposure should indicate relevant signs, symptoms and diseases that could result from acute and chronic exposure to the hazardous substances.

Emergency and First Aid Procedures should contain treatment information that could be used by paramedics and individuals trained in first aid.

Any substance with a TLV should have emergency first aid procedures listed for acute exposures, especially if the material has a low TLV. Check Section IV to see if the chemical presents any unusual fire or explosive hazards.

Note to Physician should include special information which would be important to a doctor including required or recommended replacement and periodic medical examinations, diagnostic procedures, and medical management of overexposed employees.

VI. REACTIVITY DATA

The information in this section will assist in determining safe storage and handling of hazardous, unstable substances. Instability or incompatibility of the product to common substances such as water, direct sunlight, metals used in piping or containers, acids, alkalies, etc., should be listed here.

Stability - Cross check with other sections:

1. Section II: A mixture may be unstable if the ingredients include catalysts and vehicles, peroxides, explosives, and other unstable or highly reactive substances.

2. Section IV: Are there unusual fire and explosive hazards?

3. Section IX: If there are very specific instructions in this section regarding precautions to take in handling and storage, it may indicate that the material is unstable.

Incompatibility - Common materials or contaminants which the specific material could be expected to come into contact with and which could produce a reaction, should be listed here. Conditions to avoid should also be listed. Sections IV and IX may contain information on incompatibility not listed in Section VI.

Hazardous Decomposition Products should list products released if the substance is exposed to aging, heating, burning, oxidation, or allowed to react. The product's shelf life should also be listed in this section when applicable. Although some materials are innocuous in their original form, when they are exposed to the conditions such as aging, burning, etc., they may form hazardous products.

MATERIAL SAFETY DATA SHEET

OCCUPATIONAL HEALTH SERVICES, INC.
450 SEVENTH AVENUE, SUITE 2407
NEW YORK, NEW YORK 10123
(800) 445-MSDS
(212) 967-1100

EMERGENCY CONTACT:
JOHN S. BRANSFORD, JR.
(615) 292 – 1180

SUBSTANCE IDENTIFICATION

Substance: Methyl Chloroform CAS – Number 71-55-6

Trade Names/Synonyms:
1,1,1-Trichloroethane; Alpha-Trichloroethane; Aerothene TT; Methyltrichloromethane; Methychloroform, Trichloromethylmethane; Trichloroethane; ethane, 1,1,1-Trichloroethane; Chlorten; 1,1,1-Trichlorethane; Trichloroethane 111 degrease cold/vapor (ashland); STCC 4941176; RCRA U226; UN 2831; C2H3CL3; OHS14370

Chemical Family:
Halogen compound, Aliphatic

Molecular Formula: C-H3-C-CL3

Molecular Weight: 133.40

Cercla Ratings (scale 0-3): Health-2 Fire-1 Reactivity-0 Persistence-3
NFPA Ratings (scale 0-4): Health-2 Fire-1 Reactivity-0

COMPONENTS AND CONTAMINANTS

Component: Methyl Chloroform Percent 100.0

Other Contaminants: None

Exposure Limits:
Methyl Chloroform (1,1,1-Trichloroethane):
350 ppm (1900 MG/M3) OSHA TWA; 450 ppm (2450 MG/M3) OSHA STEL
350 ppm (1900 MG/M3) ACGIH TWA; 450 ppm (2450 MG/M3) ACGIH STEL
350 ppm NIOSH Recommended 15 minute ceiling

1000 pounds Cercla section 103 reportable quantity
Subject to SARA section 313 annual toxic chemical release reporting

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PHYSICAL DATA

Description: Clear, colorless liquid with a mild chloroform-like odor.

Boiling Point:	165 F (74 C)	Melting Point:	-26 F (-32 C)
Specific Gravity:	1.3390	Vapor Pressure:	100 MMHG @ 20 C
Evaporation Rate:	(Butyl Acetate-1) 5.0	Solubility in water:	0.078% @ 25 C
Odor Threshold:	44-100 ppm	Vapor Density:	4.55

Solvent solubility: Soluble in Acetone, Benzene, Chloroform, Methanol, Ethanol, Carbon Disulfide, Ether, Carbon Tetrachloride, N-Heptane.

Viscosity: 0.858 CPS @ 20C

FIRE AND EXPLOSION DATA

Fire and explosion hazard:
Slight fire hazard when exposed to heat or flame.

Upper explosive limit: 12.5% Lower explosive limit: 7.5%

Autoignition Temp. 998 F (537 C)

Firefighting Media:
Dry chemical, carbon dioxide or halon
(1987 Emergency Response Guidebook, DOT p 5800.4).

For larger fires, use water spray, or standard foam
(1987 Emergency Response Guidebook, DOT p 5800.4).

Firefighting:
Stay away from storage tank ends. Cool containers exposed to flames with water from side until well after fire is out (1987 Emergency Response Guidebook, DOT p 5800.4, guide page 74).

Extinguish using agents for surrounding fire. Cool fire-exposed containers with flooding amount of water applied from as far a distance as possible. Do not allow run-off water into sewers and water sources. Avoid breathing vapors.

TRANSPORTATION DATA

Department of Transportation hazard classification 49CFR172.101: ORM-A

Department of Transportation labeling requirements 49CFR172.101 and 172.402: none

Department of Transportation packaging requirements: 49CFR173.605 exceptions: 49CFR173.505

TOXICITY

Methyl Chloroform (1,1,1-Trchloroethane):
Irritation Data: 450 ppm/8 hours eye-man; 5 GM/12 days intermittent skin-rabbit mild; 20 MG/24 hours skin-rabbit moderate; 100MG eye-rabbit mild; 2 MG/24 hours eye-rabbit severe.
Toxicity Data: 27 GM/M3 10 minutes inhalation-man LCLO; 350 ppm inhalation-man TCLO; 200 ppm/4 hours inhalation-man TCLO; 920 ppm/70 minutes Inhalation-human TCLO; 670 MG/KG oral-human TDLO; 18000 ppm/4 hours Inhalation-rat LC50; 3911 ppm/2 hours inhalation-mouse LC50; 24400 MG/M3 Inhalation-cat LC50; 10300 MG/KG oral-rat LD50; 11240 MG/KG oral-mouse LD50; 5660 MG/KG oral-rabbit LD50; 750 MG/KG oral-dog LD50; 9470 MG/KG Oral-guinea pig LD50; 95 MG/KG intravenous-dog LDLO; 3593 MG/Kg Intraperitoneal-rat LD50; 3636 MG/KG intraperitoneal-mouse LD50; 3100 MG/KG Intraperitoneal-dog LD50; 16 GM/KG subcutaneous-mouse LD50; 500 MG/KG Subcutaneous-rabbit LDLO; 15800 MG/KG skin-rabbit Ld50 (EPA-600/8-82-003F, 194); Mutagenic data (RTECS); reproductive effects data (RTECS).
Carcinogen status: animal inadequate evidence (IARC CLASS-3).
Local effects: irritant – inhalation, skin, eye
Acute toxicity level: slightly toxic by inhalation, dermal absorption and ingestion.
Target effects: central nervous system depressant. Poisoning may also affect the heart and possibly liver and kidneys.
An increased risk from exposure: persons with pre-existing skin disorders, liver disease or cardiovascular disease.
Additional data: alcohol may potentiate both cardiac and hepatic toxicity. Epinephrine or other stimulants may induce ventricular arrhythmia's.

HEALTH EFFECTS AND FIRST AID

Inhalation:
Methyl chloroform (1,1,1-Trichloroethane):
Irritant/Narcotic: 1000 ppm immediately dangerous to life or health.

Acute exposure – may cause irritation, sore throat, nausea, vomiting, central nervous system depression with headache, dizziness, weakness, dullness, fatigue, drowsiness, convulsions to gait disturbances, decreased reaction time, impaired manual dexterity, positive romberg test, unconsciousness, respiratory depression, fall of blood pressure, liver and kidney damage, anesthesia, and death due to cardiac and respiratory failure. Exposure to excessive concentrations may cause myocardial sensitization to epinephrine and subsequent death due to cardiac arrest. Pathological findings include petechial hemorrhaging in the lungs and brain.

Chronic exposure – A study of industrial workers exposed to concentrations of up to 200 ppm for several months to 6 years showed no adverse effects related to exposure. Exposure to 500 ppm for 7 hours a day, 5 days a week for 6 months caused no toxic changes in several animal species, however exposure of animals for 3 months at concentrations from 1000 to 10,000 ppm caused symptoms of central nervous system depression and some pathological changes in the livers and lungs of some species. Effects on the embryo or fetus have been reported following exposure of female rats prior to mating and during gestation.

First Aid – Remove from exposure area to fresh air immediately. If breathing has stopped, give artificial respiration. Maintain airway and blood pressure and administer oxygen if available. Keep affected person warm and at rest. Treat symptomatically and supportively. Administration of oxygen should be performed by qualified personnel. Get medical attention immediately.

Skin contact:
Methyl Chloroform (1,1,1-Trichloroethane):
Irritant:

Acute exposure – Direct contact may cause irritation and redness. Vapors are poorly absorbed, but the liquid, especially if confined under an impermeable barrier may be absorbed to some extent. This alone is unlikely to result in toxic effects, but may add to the effects of inhalation exposure.

Chronic exposure – Repeated skin contact may produce a dry, scaly, fissured dermatitis due to the defatting properties of the liquid.

First Aid – Remove contaminated clothing and shoes immediately. Wash affected area with soap or mild detergent and large amounts of water until no evidence of chemical remains (approximately 15-20 minutes). Get medical attention immediately.

Eye Contact:
Methyl Chloroform (1,1,1-Trichloroethane):
Irritant:

Acute exposure – Vapors may cause irritation and redness. Direct contact of the liquid may cause temporary injury with complete recovery expected in 48 hours. Direct application to the eyes of rabbits has caused conjunctival irritation, but no corneal damage.

Chronic exposure – Repeated or prolonged contact may cause conjunctivitis.

First Aid – Wash eyes immediately with large amounts of water or normal saline, occasionally lifting upper and lower lids, until no evidence of chemical remains (approximately 15-20 minutes). Get medical attention immediately.

Ingestion:
Methyl Chloroform (1,1,1-Trichloroethane):
Narcotic:

Acute exposure – May cause nausea, vomiting, diarrhea, gastrointestinal disturbances and abdominal pain followed by central nervous system depression with headache, dizziness, weakness, uncoordination, mental confusion and unconsciousness. Death may occur from chronic respiratory failure. Myocardial sensitization to epinephrine and subsequent death due to cardiac arrest may occur. Organic solvents of this nature present an aspiration hazard with possible pulmonary edema or chemical pneumonitis.

Chronic exposure – Effects on offspring have been reported following administration to female rats during gestation and lactation.

First Aid – Remove by gastric lavage or emesis. Maintain blood pressure and airway. Give oxygen if respiration is depressed. Do not perform gastric lavage or emesis if victim is unconscious. Get medical attention immediately. (Dreisback, Handbook of Poisoning, 11th ed.) Administration of gastric lavage or oxygen should be performed by qualified medical personnel.

Antidote:
No specific antidote. Treat symptomatically and supportively.

REACTIVITY

Reactivity:
Slowly decomposes over time yielding hydrogen chloride. An inhibitor may be added to scavenge the acid that is formed and prevent corrosion to metals. Water may react with the inhibitor and allow the natural decomposition to occur.

Incompatibilities:
Methyl Chloroform (1,1,1-Trichloroethane):

- Acetone: exothermic reaction.
- Alkali (strong): possible violent reaction.
- Aluminum and alloys: may decompose violently.
- Barium: fire and explosion hazard.
- Magnesium: violent decomposition with evolution of hydrogen chloride.
- Metals (powdered): fire and explosion hazard.
- Nitrogen Tetroxide: forms explosive mixture.
- Oxidizers (strong): possible violent reaction.
- Oxygen (gas): possible explosion when heated @ 100 C.
- Oxygen (liquid): possible violent explosion.
- Potash: forms flammable or explosive product.
- Potassium and alloys: forms shock-sensitive mixture.
- Potassium hydroxide: formation of spontaneously flammable product.
- Rubber, plastics, coatings: may be attacked.
- Sodium and alloys: fire and explosion hazard.
- Sodium hydroxide: forms spontaneously flammable product.
- Sodium-potassium alloy: possible explosion.
- Tin and alloys: incompatible.
- Zinc and alloys: incompatible.

Decomposition:
Thermal decomposition products may include toxic and corrosive fumes of chlorides, toxic fumes of phosgene and chloroacetylenes, and oxides of carbon.

Polymerization:
Hazardous polymerization has not been reported to occur under normal temperature and pressures.

STORAGE AND DISPOSAL

Observe all federal, state and local regulations when storing or disposing of this substance. For assistance, contact the district director of the Environmental Protection Agency.

STORAGE

Store in a cool, dry, well-ventilated location, away from any area where the fire hazard may be acute (NFPA 49, hazardous chemicals data, 1975).

Store away from incompatible substances.

DISPOSAL

Disposal must be in accordance with standard applicable to generators of hazardous waste (40CFR 262, EPA hazardous waste number U226).

CONDITIONS TO AVOID

May burn but does not ignite readily. Container may explode in heat of fire.

SPILL AND LEAK PROCEDURES

Soil Spill:
Dig a holding area such as a pit, pond or lagoon to contain spill and dike.

Surface flow using barrier of soil, sandbags, foamed polyurethane or foamed concrete. Absorb liquid mass with fly ash or cement powder.

Water Spill:
Limit spill motion and dispersion with natural barriers or oil spill control booms.

Trap spilled material at bottom in deep water pockets, excavated holding areas or within sand bag barriers.

Use suction hoses to remove trapped spill material.

Occupational Spill:
Shut off ignition sources. Stop leak if you can do it without risk. For small liquid spills, take up with sand, earth or other absorbent material. For larger spills, dike far ahead of spill for later disposal. No smoking, flames or flares in hazard area, keep unnecessary people away.

Reportable Quantity (RQ): 1000 pounds
The Superfund Amendments and Reauthorization Act (SARA) section 304 requires that a release equal to or greater than the reportable quantity for this substance be immediately reported to the Local Emergency Planning Committee and the State Emergency Response Commission (40 CFR 355.40). If the release of this substance is reportable under CERCLA Section 103, the National Response Center must be notified immediately at (800) 424-8802 or (202) 426-2675 in the metropolitan Washington, D.C. area (40 CFR 302.6).

PROTECTIVE EQUIPMENT

Ventilation:
Provide local exhaust or process enclosure ventilation to meet published exposure limits..

Respirator:
The following respirators and maximum use concentrations are recommendations by the U.S. Department of Health and Human Services, NIOSH Pocket Guide to chemical hazards or NIOSH criteria documents; or Department of Labor, 229CFR1910 subpart 2.
The specific respirator selected must be based on contamination levels found in the work place and be jointly approved by the National Institute of Occupational Safety and Health and the Mine Safety and Health Administration.

Methyl Chloroform (1,1,1-Trichloroethane):

1000 ppm – Any supplied-air respirator with full facepiece.
Any self-contained breathing apparatus with full facepiece.

Escape – Any air-purifying full facepiece respirator (gas mask) with a chin-style or front or back-mounted organic vapor canister. Any appropriate escape-type self-contained breathing apparatus.

For firefighting and other immediately dangerous to life or health conditions:

Self-contained breathing apparatus with full facepiece operated in pressure demand or other positive pressure mode.

Supplied-air respirator with full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.

Clothing:
Employees must wear appropriate protective (impervious) clothing and equipment to prevent any possibility of skin contact with this substance.

Gloves:
Employees must wear appropriate protective gloves to prevent contact with this substance.

Eye protection:
Employees must wear splash-proof or dust-resistant safety goggles and a faceshield to prevent contact with this substance. Contact lenses should not be worn.

Emergency wash facilities:
Where there is any possibility that an employee's eyes and/or skin may be exposed to this substance, the employer should provide an eye wash fountain and quick drench shower within the immediate work area for emergency use.

Authorized by – Occupational Health Services, Inc.
Creation Date: 10/25/84 Revision Date: 02/01/89

Presently, MSDS's must be filed only for those substances above a 10,000 pound threshold. For substances for which emergency plans must be prepared, MSDS's must be provided for any above the threshold planning quantity. Michigan's SERC has recommended that facilities submit a chemical list rather than MSDS's because of the flood of paper and lack of easy use in an emergency; fire departments can then request the MSDS at a later date if desired.

Facilities must also submit hazardous chemical inventory forms for the chemicals noted above to the SERC, LEPC, and local fire departments. A Tier I inventory form must be submitted by facilities to the SERC, LEPC and fire departments. A Tier I provides quantity, hazards, location and storage information on general categories of substances. A Tier II form must be provided upon request. This form provides more specific information on individual substances used or stored at the facility. A Tier II can be submitted instead of a Tier I.

- **Toxic Chemical Release Reporting (Section 313)**

Employers engaged in manufacturing must submit annual reports on yearly releases to air, water, or waste disposal of 328 toxic chemicals. These reports must be filed with the SERC and EPA. EPA must establish a national toxic chemical release data base using the facility reports. This information must be available to members of the public.

- **Public Information and Fire Department Access**

Fire departments have the right to conduct on-site inspections of any facility that must submit chemical inventory information. All information submitted to the SERC and to LEPC's must be made available to members of the public. Many communities now require the filing of a freedom of information request form for the public to obtain this information.

- **Penalties and Citizen Suits**

The EPA may assess civil and administrative penalties up to $75,000 per day against facilities that fail to comply with reporting requirements. On December 19, 1988, EPA announced fines totaling nearly $1.5 million against 25 companies in 13 states for failing to report chemical emissions under Section 313. The EPA issued a $99,000 fine against a Springfield, Massachusetts company that failed to make an immediate emergency notification after a serious chlorine fire in it facility.

The SERC, LEPC or state and local governments may begin local actions against facility operators that fail to comply with Title III. However, the state cannot issue fines until a state law has been adopted which grants that authority.

Citizens may file lawsuits against facilities, the SERC, and the EPA for failure to comply with provisions of the law.

- **Emergency Training Funds (Section 305)**

Congress appropriated $5 million over four years to enable state and local governments to conduct training programs for improving emergency planning, preparedness, mitigation, response, and recovery capabilities. In Michigan, the training money is coordinated by the Emergency Management Division of the Michigan Department of State Police.

❑ MICHIGAN HAZARDOUS WASTE OPERATIONS AND EMERGENCY RESPONSE STANDARD

In October 1991, the Michigan Department of Public Health's Occupational Health Standards Commission made effective what is known as the Michigan Hazwoper Standard. This standard is very similar to SARA Title I and stipulates the same planning, training, and response requirements as the federal standard. Since Michigan has its own OSHA, the state statute is one that is enforceable. *(See Attachment G)*

DEPARTMENT OF PUBLIC HEALTH

OCCUPATIONAL HEALTH STANDARDS COMMISSION

Filed with the Secretary of State on October 15, 1991

These rules take effect 15 days after filing with the Secretary of State

(By authority conferred on the Occupational Health Standards Commission by Section 24 of Act. No. 154 of the Public Act of 1974, as amended, being §408.1024 of the Michigan Compiled Laws)

HAZARDOUS WASTE OPERATIONS AND EMERGENCY RESPONSE

R 325.52101 Scope.

Rule 1. These rules prescribe the requirements for safety and health programs, training, medical surveillance, control methods, sanitation, and personal protective equipment for employees who are involved in hazardous waste operations and response to chemical emergencies.

R 325.52102 Application.

Rule 2. (1) These rules apply to all of the following operations when employees are exposed, or have a reasonable possibility of exposure, to safety or health hazards:

(a) Clean-up operations, which are required by a governmental body, whether a federal, state, local, or other body, which involve hazardous substances, and which are conducted at uncontrolled hazardous waste sites. Such sites include any of the following:

(i) Sites on the Environmental Protection Agency's (EPA) national priority site list (NPL)

(ii) Sites on state priority site lists.

(iii) Sites recommended for the EPA NPL.

(iv) Sites that are government-identified and are undergoing initial investigation conducted before the presence or absence of hazardous substances has been determined.

(b) Corrective actions that involve clean-up operations at sites covered by the provisions of the Resource Conservation and Recovery Act of 1976 (RCRA), as amended, 42 U.S.C. §6901 et seq.

(c) Voluntary clean-up operations at sites recognized by federal, state, local, or other governmental bodies as uncontrolled hazardous waste sites.

(d) Operations which involve hazardous wastes and which are conducted at treatments, storage, and disposal (TSD) facilities regulated by the provisions of 40 CFR parts 264 and 265 pursuant to RCRA, by agencies under agreement with EPA to implement RCRA regulations, or by the provisions of sections 5, 11, 13, 13a, 15a, 19, 22a, 30, 30a, 32a, 32b, and 32c of Act. No. 641 of the Public Acts of 1978, as amended, being §§299.405, 299.411, 299.413, 299.413a, 299.419, 299.422a, 299.430, 299.430a, 299.432a, 299.432b, and 299.432c of the Michigan Compiled Laws.

(e) An emergency response operation that involves the release of, or a substantial threat of the release of, hazardous substances, without regard to the location of the hazard.

(2) All of the requirements of the Michigan Occupational Health and Safety Act (MIOSHA) occupation health rules and occupational safety rules for both general industry and construction apply, pursuant to their terms, to operations specified in subrule (1) of this rule, whether mentioned in these rules or not. Where there is a conflict or overlap between these and other rules, the requirement that is more protective of employee health and safety shall apply without regard to O.H. rule 1106(3)(a).

(3) All of these rules, except for R 325.52135, apply to hazardous substance clean-up operations covered by the provisions of subrule (1)(a), (b), and (c) of this rule.

(4) Only the provisions of R 325.52129 apply to operations at TSD facilities covered by the provisions of subrule (1)(d) of this rule. All of the following provisions apply to this subrule:

(a) All of the provisions of R 325.52129 apply to any TSD operation which is regulated by the provisions of 40 CFR parts 264 and 265 or by Michigan law authorized under RCRA and which is required to have a permit or interim status from EPA

pursuant to the provisions of 40 CFR §270.1 or from a Michigan agency pursuant to the provisions of RCRA.

(b) Employers who are not required to have a permit or interim status because they are conditionally exempt small quantity generators under the provisions of 40 CFR §261.5 or are generators who qualify under the provisions of 40 C.F.R §262.34 for exemptions from regulation under the provision of 40 CFR parts 264, 265, and 270 need not comply with the provisions of subrules R 325.52129 (1) to (8). Excepted employers who are required by the EPA or a Michigan agency to have their employees engage in emergency response or who direct their employees to engage in emergency response shall comply with the provisions of R 325.52129. Excepted employers who are not required to have employees engage in emergency response, who direct their employees to evacuate in the case of emergencies, and who meet the requirements of R 325.52129 (9)(a) and (b) are exempt from the rest of the provisions of R 325.52129.

(c) If an area is used primarily for treatment, storage, or disposal, any emergency response operation in that area shall be in compliance with the requirements of R 325.52129(9). In other areas that are not used primarily for treatment, storage, or disposal, any emergency response operation shall be in compliance with the requirements of R 325.52130 to R 325.52135 shall be deemed to be in compliance with the requirements of R 325.52129(9).

(5) An emergency response operation which involves the release of, or a substantial threat of a release of, hazardous substances and which is not covered by subrule (1)(a) to (d) of this rule shall be in compliance with only the requirements of R 325.52130 to R 325.52135.

R 325.52013 Definitions.

Rule 3. As used in these rules:

(a) "Buddy system" means a system of organizing employees into work groups in such a manner that each employee of the work group is designated to be observed by at least 1 other employee in the work group. The purpose of the buddy system is to provide rapid assistance to employees in the event of an emergency.

(b) "Clean-up operation" means an operation where hazardous substances are removed, contained, incinerated, neutralized, stabilized, cleared up, or in any other manner processed or handled with the ultimate goal of making the site safer for people and the environment.

(c) "Decontamination" means the removal of hazardous substances from employees and their equipment to the extent necessary to prevent the occurrence of foreseeable adverse health effects.

(d) "Emergency response" or "responding to emergencies" means a response effort by employees from outside the immediate release area or by other designated responders, for example, multi-aid groups or local fire departments, to an occurrence which results, or is likely to result in an uncontrolled release of a hazardous substance. Responses to incidental releases of hazardous substances where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area or by maintenance personnel are not considered to be emergency responses within the scope of these rules. Responses to releases of hazardous substances where there is no potential safety or health hazards, such as, fire, explosion, or chemical exposure, are not considered to be emergency responses.

(e) "Facility" means any of the following:

(i) A building.

(ii) A structure.

(iii) An installation.

(iv) Equipment.

(v) A pipe or pipeline, including a pipe into a sewer or publicly owned treatment works.

(vi) A well.

(vii) A pit.

(viii) A pond.

(ix) A lagoon.

(x) An impoundment.

(xi) A ditch.

(xii) A storage container.

(xiii) A motor vehicle.

(xiv) Rolling stock.

(xv) Aircraft.

(xvi) A site or area where a hazardous substance has been deposited, stored, disposed of, placed, or otherwise caused to be located.

(xvii) Facility does not mean any consumer product in consumer use or any waterborne vessel.

(f) "Hazardous material response (HAZMAT) team" means an organized group of employees which is designated by the employer and which is expected to perform work to handle and control actual or potential leaks or spills of hazardous substances that may require coming into close proximity to the substance. The team

members perform responses to releases or potential releases of hazardous substances to control or stabilize a release or potential release. A HAZMAT team is not a fire brigade nor is a typical fire brigade a HAZMAT team. A HAZMAT team, however, may be a separate component of a fire brigade or fire department.

(g) "Hazardous substance" means any of the following substances, exposure to which results or may result in adverse effects on the health and safety of employees:

(i) Any substance defined under section 101(14) of the comprehensive environmental response, compensation, and liability act, 42 U.S.C. §9601(14).

(ii) Any biological agent and other disease-causing agent which, after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any person, either directly from the environment or indirectly by ingestion through food chains, will, or may reasonably be anticipated to, cause any of the following in such person or their offspring:

(A) Death.
(B) Disease.
(C) Behavioral abnormalities.
(D) Cancer.
(E) Genetic mutation.
(F) Physiological malfunctions, including malfunctions in reproduction.
(G) Physical deformations in such persons or their offspring.

(iii) Any substance that is listed by the United States Department of Transportation as a hazardous material under the provisions of 49 CFR §172.101 and appendices, which are adopted herein by reference. The provisions of 49 CFR §172.101 and appendices are available from the Superintendent of Documents, United States Government Printing Office, Washington, D.C. 20402, at a cost at the time of adoption of these rules of $27.00 or from the Michigan Department of Public Health, Division of Occupational Health, P.O. Box 30195, Lansing, Michigan 48909, at a cost at the time of adoption of these rules of $10.00

(iv) Hazardous waste.

(h) "Hazardous waste" means either of the following:

(i) A waste or combination of wastes as defined in the provisions of 40 CFR §261.3, which are adopted herein by reference. The provisions of 40 CFR §261.3 are available from the Superintendent of Documents, United States Government Printing Office, Washington, D.C. 20402, at a cost at the time of adoption of these rules of $22.00, or from the Michigan Department of Public Health, Division of Occupational Health, P.O. Box 30195, Lansing, Michigan 48909, at a cost at the time of adoption of these rules of $2.00.

(ii) Those substances defined as hazardous waste in the provisions of 49 CFR §171.8, which are adopted herein by reference. The provisions of 49 CFR §171.8 are available from the Superintendent of Documents, United States Government Printing Office, Washington, D.C. 20402, at a cost at the time of adoption of these rules of $27.00, or from the Michigan Department of Public Health, Division of Occupational Health, P.O. Box 30195, Lansing, Michigan 48909, at a cost at the time of adoption of these rules of $1.00.

(i) "Hazardous waste operations" means any operation to which these rules apply according with the provisions of R 325.52102.

(j) "Hazardous waste site" or "site" means any facility or location at which hazardous waste operations take place and to which these rules apply.

(k) "Health hazard" means a stress due to a physical condition, chemical exposure, or a pathogen for which there is statistically significant evidence, based on at least 1 study conducted in accordance with established scientific principles, that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes all of the following:

(i) Chemicals that are carcinogens.
(ii) Toxic or highly toxic agents.
(iii) Reproductive toxins.
(iv) Irritants.
(v) Corrosives.
(vi) Sensitizers.
(vii) Hepatotoxins.
(viii) Nephrotoxins.
(ix) Neurotoxins.
(x) Agents which act on the hemotaopoietic system.
(xi) Agents that damage the lungs, skin, eyes, or mucous membranes.
(xii) High or low body temperatures.
(xiii) High noise levels.
(xiv) Ionizing or nonionizing radiation.

Further definition of terms used in this subdivision can be found in appendix A to 29 CFR §1910.1200, which was incorporated by reference in section 14a

of Act No. 154 of the Public Acts of 1974, as amended, being §408.1014a of the Michigan Compiled Laws.

(l) "IDLH" or "immediately dangerous to life or health" means an atmospheric concentration of any toxic, corrosive, or asphyxiant substance that poses an immediate threat to life, would cause irreversible or delayed adverse health effects, or would interfere with a person's ability to escape from a dangerous atmosphere.

(m) "Oxygen deficiency" means that concentration of oxygen, by volume, in the atmosphere below which air-supplying respiratory protection shall be provided. An oxygen deficiency exists in atmospheres where the percentage of oxygen, by volume, is less than 19.5%.

(n) "Permissible exposure limit" or "PEL" means the inhalation or dermal permissible exposure limits of chemical substances specified or referenced in tables G-1-A, G-2, an dG-3 of R 325.51108.

(o) "Post-emergency response" means that portion of an emergency response that is performed after the immediate threat of a release has been stabilized or eliminated and clean-up of the site has begun. If post-emergency response is performed by an employer's own employees as a continuation of initial emergency response, it is considered to be part of the initial response and not post-emergency response. However, if a group of an employer's own employees that is separate from the group that provides the initial response performs the clean-up operation, the separate group of employees is considered to be performing post-emergency response and is subject to the provisions of R 325.52135.

(p) "Published exposure level" means the exposure limits specified in the publication entitled "NIOSH Recommendations for Occupational Health Standards," 1986, which are adopted in these rules by reference, or, if no limit is specified, the threshold limit values published by the American Conference of Governmental Industrial Hygienist (ACGIH) in the publication entitled "Threshold Limit Values and Biological Exposure Indices for 1990-1991," 1990, which are adopted in these rules by reference. These 2 documents may be inspected at the Lansing office of the Department. The NIOSH publication may be obtained from the National Institute for Occupational Safety and Health, Publications Dissemination Division, Cincinnati, Ohio 45226, or from the Michigan Department of Public Health, Division of Occupational Health, P.O. Box 30195, Lansing, Michigan 48909, at no cost. The ACGIH publication is available from the American Conference of Governmental Industrial Hygienist, 6500 Glenway Avenue, Bldg. D-7, Cincinnati, Ohio 45211-4438, or from the Michigan Department of Public Health, Division of Occupational Health, P.O. Box 30195, Lansing, Michigan 48909. The cost at the time of adoption of these rules is $6.00

(q) "Qualified person" means a person who has specific training, knowledge, and experience in the area for which the person has responsibility and the authority to control operations.

(r) "Site safety and health supervisor" or "official" means an individual who is located on a hazardous waste site, who is responsible to the employer, and who has the authority and knowledge necessary to implement the site safety and health plan and verify compliance with applicable safety and health requirements.

(s) "Small quantity generator" means a generator of hazardous waste who, in any calendar month, generates not more than 1,000 kilograms (2,205 pounds) of hazardous waste.

(t) "Uncontrolled hazardous waste site" means an area where an accumulation of hazardous wastes creates a threat to the health and safety of individuals or the environment, or both. Such sites can be on public lands or on privately owned property. Normal operations at TSD sites are not included in this definition.

R 325.52104 Safety and health program.

Rule 4. (1) An employer shall develop and implement a written safety and health program for its employees who are involved in hazardous waste operations. The program shall be designed to identify, evaluate, and control safety and health hazards and provide for emergency responses for hazardous waste operations.

(2) A safety and health program that is developed and implemented to meet other federal, state, or local regulations is acceptable to meet the requirements of subrule (1) of this rule if the program includes, or is modified to include, the topics required by this rule.

(3) The written safety and health program shall include all of the following topics:

(a) An organizational structure.

(b) A comprehensive work plan.

(c) A site-specific safety and health plan which need not repeat the standard operating

procedures required by subdivision (f) of this subrule.

(d) The safety and health training program.

(e) The medical surveillance program.

(f) The employer's standard operating procedures for safety and health.

(g) Any necessary interface between the general program and site-specific activities.

(4) All of the following provisions apply to the organizational structure section of the program:

(a) The organizational structure section shall establish the specific chain of command and specify the overall responsibilities of supervisors and employees. It shall provide for all of the following:

(i) A general supervisor who has the responsibility and authority to direct all hazardous waste operations.

(ii) A site safety and health supervisor who has the responsibility and authority to develop and implement the site safety and health plan and verify compliance.

(iii) All other personnel needed for hazardous waste site operations and emergency response and their general functions and responsibilities.

(iv) The lines of authority, responsibility, and communication.

(b) The organizational structure section shall be reviewed and updated as necessary to reflect the current status of waste site operations.

(c) The original organizational structure section and any changes shall be made available to all affected employees.

(5) The comprehensive work plan section of the program shall address the tasks and objectives of site operations and the logistics and resources required to accomplish those tasks and objectives and shall provide for all of the following:

(a) Address anticipated clean-up activities, as well as normal operating procedures.

(b) Define work tasks and objectives and identify the methods for accomplishing those tasks and objectives.

(c) Establish personnel requirements for implementing the plan.

(d) Provide for the implementation of the training required in the provision of R 325.52109 to R 325.52112.

(e) Provide for the implementation of the required informational programs required in the provisions of R 325.52112.

(f) Provide for the implementation of the medical surveillance program described in the provisions of R 325.52113 to R 325.52116.

(6) The site-specific safety and health plan section of the safety and health program shall be available on the site for inspection by employees, their designated representatives, and Michigan Occupational Safety and Health program (MIOSHA) personnel. The plan section shall address the safety and health hazards of each phase of site operation and include the requirements and procedures for employee protection. The site-specific safety and health plan shall provide for all of the following:

(a) The names and key personnel and alternates who are responsible for site safety and health, including a site safety and health supervisor.

(b) A safety and health risk or hazard analysis for each site task and operation found in the work plan.

(c) Employee training assignments to assure compliance with the provisions of R 325.52109 to R 325.52112.

(d) Personal protective equipment to be used by employees for each of the site tasks and operations being conducted as required by the personal protective equipment program in the provisions of R 325.52118.

(e) Medical surveillance requirements in accordance with the program in the provisions of R 325.52113 to R 325.52116.

(f) The frequency and types of air monitoring, personal monitoring and the environmental sampling techniques and instrumentation to be used, including the methods and schedule of maintenance and calibration of monitoring and sampling equipment.

(g) Site control procedures in accordance with the site control program required in the provisions of R 325.52108.

(h) Decontamination procedures in accordance with the provisions of R 325.52124.

(i) An emergency response plan that meets the requirements of R 325.52125 for safe and effective response to emergencies, including the necessary personal protective equipment and other equipment.

(j) Confined space entry procedures.

(k) A spill containment program which meets the requirements of R 325.52121(2)(g) shall be included where appropriate.

(l) Pre-entry briefings to be held before initiating any site activity and at such other times as necessary to ensure that employees are apprised of the site safety and health plan and that this plan is being followed. The information and data from site characterization and analysis work required pursuant to the provisions of R 325.52107 shall be used to prepare and update the site safety and health plan and pre-entry briefings.

(m) Inspections conducted by the site safety and health supervisor, or designee, as necessary to determine the effectiveness of the site safety and health plan. Any deficiencies in the effectiveness of the site safety and health plan shall be corrected by the employer.

(7) The written safety and health program required by this rule shall be made available to employees and their representatives, to contractors and subcontractors involved in the hazardous waste operation, and to Michigan Occupational Safety and Health program (MIOSHA) personnel.

R 325.52105 Site excavation

Rule 5. Site excavations that are created during initial site preparation or during hazardous waste operations shall be shored or sloped to prevent accidental collapse and shall be conducted in accordance with the provisions of R 408.40901 et seq. of the Michigan Administrative Code (construction safety rules).

R 325.52106 Contractors and subcontractors; notification by employer of procedures and hazards.

Rule 6. An employer who retains contractor or subcontractor services for work in hazardous waste operations shall, before commencement of those services, inform the contractors, subcontractors, or their representatives, of the site emergency response procedures and any potential fire, explosion, health, safety, or other hazards of the hazardous waste operation that have been identified by the employer, including those identified in the employer's information program.

R 325.52107 Site characterization and analysis.

Rule 7. (1) Hazardous waste sites shall be evaluated in accordance with the provisions of this rule to identify specific site hazards and to determine the appropriate safety and health control procedures needed to protect employees from the identified hazards.

(2) A preliminary evaluation of the site's characteristics shall be performed before site entry by a qualified person to aid in the selection of appropriate employee protection methods. Immediately after initial site entry, a more detailed evaluation of the site's characteristics shall be performed by a qualified person to further identify hazards and to further aid in the selection of appropriate engineering controls and personal protective equipment for the tasks to be performed.

(3) All suspected conditions that may pose inhalation or skin absorption hazards that are immediately dangerous to life or health (IDLH) or other conditions that may cause death or serious harm shall be identified during the preliminary survey and evaluated during the detailed survey. Examples of such conditions include the following:

(a) Potential confined space entry.

(b) Potential explosive or fire situations.

(c) Visible vapor clouds.

(d) Areas where biological indicators, such as dead animals or vegetation, are located.

(4) All of the following information, to the extent available, shall be obtained by the employer before allowing employees to enter a site:

(a) The location and approximate size of the site.

(b) A description of the response activity or job task to be performed.

(c) The planned duration of employee activity.

(d) Site topography.

(e) Site accessibility by air and roads.

(f) Pathways for hazardous substance dispersion.

(g) The status and capabilities of emergency response teams that would provide assistance to on-site employees at the time of an emergency.

(h) The hazardous substances that are expected at the site and their health hazards and chemical and physical properties.

(5) Personal protective equipment (PPE) shall be provided and used during initial site entry in accordance with all of the following requirements:

(a) Based upon the results of the preliminary site evaluation, PPE which will provide protection to a level of exposure below permissible exposure limits and published exposure levels for known or suspected hazardous substances and health and

safety hazards shall be selected and used during initial site entry.

(b) If positive-pressure, self-contained breathing apparatus is not used as part of the initial entry ensemble, an escape, self-contained breathing apparatus with not less than a 5 minute supply of air shall be carried by employees or kept available at their immediate work stations.

(c) If the preliminary site evaluation does not produce sufficient information to identify the hazards or suspected hazards of the site, then both of the following shall be used:

(i) PPE that provides protection to level B shall be provided as a minimum protection (See R 325.52137 for availability of appendix B to these rules pertaining to level B protective equipment).

(ii) Direct reading instruments shall be used as appropriate for identifying IDLH conditions.

(d) PPE which is appropriate to protect employees from identified site hazards shall be selected and used in accordance with the provisions of R 325.52118.

(6) All of the following monitoring shall be conducted during initial site entry when the site evaluation produces information that shows the potential for ionizing radiation of IDLH conditions or when the site information is not sufficient to rule out such conditions:

(a) Monitoring for hazardous levels of ionizing radiation with direct-reading instruments.

(b) Monitoring the air with appropriate direct-reading test equipment for IDLH and other conditions that may cause death or serious harm, such as combustible or explosive atmospheres, oxygen deficiency, or toxic substances.

(c) Visually observe for signs of actual or potential IDLH or other dangerous conditions.

(7) Once the presence and concentrations of specific hazardous substances and health hazards have been established, the risks associated with these substances and hazards shall be identified. Employees who will be working on the site shall be informed of any risks that have been identified. In situations covered by the hazard communication standard incorporated pursuant to the provisions of section 14a of Act No, 15 of the Public Acts of 1974, as amended, being §408.1014a of the Michigan Compiled Laws, training required by that standard need not be duplicated. All of the following risks shall be considered:

(a) Exposures greater than a permissible exposure limit or a published exposure level.

(b) IDLH concentrations.

(c) Potential skin absorption and irritation sources.

(d) Potential eye irritation sources.

(e) Explosion sensitivity and flammability ranges.

(8) Any information concerning the chemical, physical, and toxicological properties of each substance known or expected to be present on-site that is available to the employer and relevant to the duties of an employee shall be made available to all affected employees before the commencement of their work activities.

(9) An ongoing air monitoring program that is in compliance with the provisions of R 325.52119 shall be implemented after site characterization has determined that the site is safe for the start-up of operations.

R 325.52108 Site Control.

Rule 8. (1) Appropriate site control procedures to control employee exposure to hazardous substances shall be implemented before clean-up work begins.

(2) The site control procedures required as an element of the site-specific safety and health plan for protecting employees shall be developed during the planning stages of a hazardous waste operation and modified as necessary when new information becomes available.

(3) The site control procedures shall include all of the following:

(a) A site map.

(b) Site work zones.

(c) A buddy system.

(d) Site communications, including emergency alerting.

(e) Standard operating procedures or safe work practices.

(f) Identification of the nearest medical assistance.

R 325.52109 Training generally.

Rule 9. (1) All employees, supervisors, and management personnel who work at a hazardous waste site where clean-up operations are underway shall be trained and have supervised on-the-job field experience as required by this rule, R 325.52110, and R 325.52111 before they are permitted to engage in hazardous waste operations that could expose them to hazardous substances or safety or health hazards. All personnel shall also receive

refresher training as required pursuant to the provisions of R 325.52112.

(2) Employees and supervisors shall not be permitted to participate in field activities until they have been training at the level required by their job functions and responsibilities.

(3) Training shall cover all of the following topics:

(a) The names of personnel and alternates who are responsible for site safety and health.

(b) Safety, health, and other hazards present on the site.

(c) Use of personal protective equipment.

(d) Work practices that will minimize the risks of hazards.

(e) The safe use of engineering controls and equipment on the site.

(f) Medical surveillance requirements, including the recognition of symptoms and signs which might indicate overexposure to hazards.

(g) The contents of the site-specific safety and health plan required pursuant to the provisions of R 325.52104(6)(h) to (k).

(4) Employees who may respond to emergency situations at hazardous waste sites shall be trained in the proper response procedures for, and protection from, hazardous exposures.

R 325.52110 Initial training.

Rule 10. (1) General site workers and supervisory personnel who are assigned to tasks that involve exposure or potential exposure to hazardous substances, health hazards, or safety hazards shall receive the training specified in both of the following provisions:

(a) Forty hours of training conducted away from the hazardous waste site.

(b) Three days of field experience under the direct supervision of a trained and experienced supervisor.

(2) Workers who are on a site only occasionally for a specific and limited task and who are unlikely to be exposed above permissible and published exposure limits shall receive the training specified in both of the following provisions:

(a) Twenty-four hours of off-site training.

(b) One day of field experience under the direct supervision of a trained and experienced supervisor.

(3) Regular site workers who work in areas which have been monitored and fully characterized as indicating that exposures are below permissible exposure limits and published exposure levels, in areas where respirators are not required, or in areas where the site characterization indicates that health hazards do not exist or that the possibility of an emergency developing does not exist shall receive the training specified in both of the following provisions:

(a) Twenty-four hours of off-site training.

(b) One day of field experience under the direct supervision of a trained and experienced supervisor.

(4) Workers who have received 24 hours of training, who are covered by the provisions of subrules (2) and (3) of this rule, and who become general site workers or who are required to wear respirators shall receive an additional 16 hours of training and 2 days of supervised field experience to equal the requirements of subrule (1) of this rule.

(5) Management and supervisory personnel who work on-site shall receive the same amount of training and supervised field experience as their subordinates as specified in subrules (1), (2), and (3) of this rule, plus, at the time of job assignment, not less than 8 additional hours of specialized training on appropriate topics, such as the following:

(a) Employer's safety and health program.

(b) Employee training programs.

(c) Personal protective equipment program.

(d) Spill containment.

(e) Health hazard monitoring procedures and techniques.

R 325.52111 Training qualifications and certification.

Rule 11. (1) Trainers shall be qualified to instruct employees about the subject matter that is being presented in training. Such trainers shall have satisfactorily completed a training program for teaching the subjects they teach or shall possess the academic credentials and instructional experience necessary for teaching the subjects. Instructors shall demonstrate competent instructional skills and knowledge of the applicable subject matter.

(2) Employees and supervisors who have received and successfully completed the training and field experience specified in R 325.52109 and R 325.52110 shall be certified by their instructors or training supervisors as having successfully completed the necessary training. A written certificate shall be given to each person who is certified. Any person who has not been certified or

who does not meet the requirements of R 325.52112(2) shall be prohibited from engaging in hazardous waste operations.

R 325.52112 Refresher and equivalent training.

Rule 12. (1) All employees who are required to be trained pursuant to the provisions of R 325.52109(1) shall also receive 8 hours of refresher training annually on the topics specified in R 325.52109(3) and R 325.52110(5). Refresher training shall also include a critique of the past year's incidents that can serve as training examples for future work situations.

(2) An employer who can show, by documentation or certification, that an employee's work experience or training has resulted in training equivalent to the training required by the provisions of R 325.52109 and R 325.52110 shall not be required to provide the initial training requirements specified in R 325.52110 to such employee. However, certified employees or employees with equivalent training who are new to a site shall receive appropriate, site specific training before site entry and have appropriate supervised field experience at the new site. Equivalent training includes any academic training or the training that existing employees might have already received from actual hazardous waste site work experience.

R 325.52113 Medical surveillance

Rule 13. (1) Employers that are engaged in the operations described in R 325.52102(a) to (c) and employers with a hazardous material response (HAZMAT) team shall establish a medical surveillance program, in accordance with the provisions of this rule, for all of the following employees:

(a) All employees who are or may be exposed, for 30 days or more a year, to hazardous substances or health hazards at or above permissible exposure limits (PEL) or, if there is no PEL, above the published exposure levels for these substances without regard to the use of respirators.

(b) All employees who wear a respirator for 30 or more days a year or as required by O.H. rule 3502(1)(a).

(c) All employees who are injured, become ill, or develop signs or symptoms due to the possible overexposure to hazardous substances or health hazards from an emergency response or hazardous waste operation.

(d) All employees on a HAZMAT team.

(2) Medical examinations and consultations shall be made available by the employer at no cost to the employee, without a loss of pay, and at a reasonable time and place for each employee covered by the provisions of subrule (1) of this rule pursuant to the following provisions, as applicable:

(a) For employees who are covered under the provisions of subrule (1)(a), (b), and (d) of this rule, the following schedule applies:

(i) Before assignment to hazardous waste or emergency response operations.

(ii) At least once every 12 months for each covered employee, unless the responsible physician believes a longer interval is appropriate. The interval shall not be more than 2 years.

(iii) At termination of employment or reassignment to an area where the employee will not be covered, unless the employee has had an examination within the last 6 months.

(iv) As soon as possible upon notification by an employer that the employee has developed signs or symptoms indicating possible overexposure to hazardous substances or health hazards or that the employee has been injured or exposed above the permissible exposure limits or published exposure levels in an emergency situation.

(v) At more frequent times if the examining physician determines that an increased frequency of examination is medically necessary.

(b) For employees who are covered under the provision of subrule (1)(c) of this rule and for all employees including those employees who are covered by the provisions of R 325.52102(1)(e), who may have been injured, received a health impairment, developed signs or symptoms which may have resulted from exposure to hazardous substances resulting from an emergency incident, or been exposed during an emergency incident to hazardous substances at concentrations above the permissible exposure limits or the published exposure levels without the necessary personal protective equipment being used, the following schedule applies:

(i) As soon as possible after the emergency incident or development of signs or symptoms.

(ii) At additional times if the examining physician determines that follow-up examinations or consultations are medically necessary.

R 325.52114 Medical examinations, consultations, and procedures to be performed by or under supervision of physician; content of examinations and consultations; copies of rules and information to be provided by employer.

Rule 14. (1) All medical examinations, consultation, and procedures shall be performed by or under the supervision of a licensed physician, preferably a physician who is knowledgeable in occupational medicine.

(2) Medical examinations required by the provisions of R 325.52113(2) shall include a medical and work history if one is in the employee's filed, with a special emphasis on the symptoms related to the handling of hazardous substances and health hazards and on fitness for duty, including the ability to wear any required personal protective equipment (PPE) under conditions that may be expected at the work site.

(3) The content of medical examinations or consultations pursuant to the provisions of R 325.52113(2) shall be determined by the attending physician. (See R 325.52137 for availability of appendix D, reference no.10.)

(4) An employer shall provide a copy of these rules and appendices to the attending physician and all of the following information for each employee who is to be examined:

(a) A description of an employee's duties as they relate to the employee's exposures.

(b) The employee's exposure levels or anticipated levels. A description of any personal protective equipment used or to be used.

(c) A description of any personal protective equipment used or to be used.

(d) Information from previous medical examinations of the employee which is not readily available to the examining physician.

(e) Information required pursuant to the provisions of O.H. rule 3502.

R 325.52115 Physicians' written opinion; employer duty to obtain; content; prohibited disclosures.

Rule 15. (1) An employer shall obtain, and furnish an employee with a copy of the attending physician's written opinion following each examination or consultation required pursuant to the provisions of R 325.52113.

(2) The physician's written opinion shall contain all of the following:

(a) The physician's opinion as to whether the employee has any detected medical conditions which would place the employee at increased risk of material impairment of the employee's health from work in hazardous waste operations or emergency response or from respirator use.

(b) The physician's recommended limitations upon the employee's assigned work.

(c) The results of the medical examination and tests if requested by the employee.

(d) A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions which require further examination or treatment.

(3) The written opinion provided to the employer and the employee shall not reveal specific findings or diagnoses unrelated to the occupational environment.

R 325.52116 Medical surveillance recordkeeping.

Rule 16. (1) An accurate record of the medical surveillance required pursuant to the provisions of R 325.52113 shall be retained and provided to others in accordance with the provisions of R 325.3451 et seq. of the Michigan Administrative Code.

(2) The medical records required pursuant to the provisions of R 325.52115 and this rule shall include all of the following information:

(a) The name and social security number of the employee.

(b) A physician's written opinions, recommended limitations, and results of examinations and tests.

(c) Any employee medical complaints related to exposure to hazardous substances.

(d) A copy of the information provided to the examining physician by the employer, except for the copy of these rules and appendices.

R 325.52117 Control of hazards.

Rule 17. (1) Engineering control, work practices, personal protective equipment, or a combination of these shall be implemented in accordance with the provisions of this rule to protect employees from exposure to hazardous substances and safety and health hazards.

(2) Engineering controls, such as pressurized control cabs on the mobile equipment or remotely operated material handling equipment, and work practices, such as removing nonessential personnel from areas of high risk, shall be used to reduce and maintain employee exposures to or below permissible exposure limits, except to the extent that such controls and practices are not feasible.

(3) If engineering control and work practices are not feasible or not required, any reasonable and appropriate combination of controls, practices, and personal protective equipment (PPE) shall be used to reduce and maintain employee exposures to or below the permissible exposure limits or dose limits for substances with a permissible exposure limit.

(4) An employer shall not use a schedule of employee rotation as a means to comply with permissible exposure limits or dose limits, except when there is no other feasible way of complying with the airborne or dermal dose limits for ionizing radiation.

(5) An employer shall comply with all of the applicable provisions of O.H. rules 2410 to 3240 and R 325.60101 et. seq. of the Michigan Administrative Code.

(6) Any reasonable and appropriate combination of engineering controls, work practices, and PPE shall be used to reduce and maintain employee exposure to or below published exposure levels for hazardous substances and health hazards without exposure or dose-regulating rules. The employer shall use material safety data sheets (MSDS) and other published literature as a guide in making a determination as to the level of appropriate protection.

R 325.52118 Personal protective equipment (PPE).

Rule 18. (1) Personal protective equipment (PPE) shall be selected and used to protect employees from the hazards and potential hazards they are likely to encounter as identified during the site characterization and analysis.

(2) Personal protective equipment selection shall be based on an evaluation of the performance characteristics of the PPE relative to the requirements and limitations of the site, the task specific conditions and duration, and the hazards and potential hazards identified at the site.

(3) Positive-pressure, self-contained breathing apparatus or positive-pressure, air supply shall be used when chemical exposure levels will create a substantial possibility of immediate death or immediate serious illness or injury or will impair the ability to escape.

(4) Totally encapsulating chemical protective suits (protection equivalent to level A protection as recommended in appendix B) shall be used in conditions where skin absorption of a hazardous substance may result in a substantial possibility of immediate death or immediate serious illness or injury or may impair the ability to escape.

(5) The level of protection provided by PPE selection shall be increased when additional information on site conditions indicates that increased protection is necessary to reduce employee exposures below permissible exposure limits and published exposure levels for hazardous substances and health hazards. (See R 325.52137 for availability of appendix B pertaining to selecting PPE for ensembles.) The level of employee protection provided may be decreased when additional information or site conditions show that decreased protection will not result in hazardous exposures to employees.

(6) Personal protective equipment shall be selected, provided at no cost to the employee, and used in accordance with the requirements of O.H. rules 3501 and 3502 and R 408.13301 et seq. of the Michigan Administrative Code.

(7) All of the following provisions pertain to the use of totally encapsulating chemical protective suits.

(a) Totally encapsulating suits shall be capable of maintaining a positive air pressure. Appendix A, referenced in R 325.53137, shall be consulted for a test method to evaluate this air pressure requirement.

(b) Totally encapsulating suits shall be capable of maintaining a positive air pressure. Appendix A, referenced in R 325.53137, shall be consulted for a test method to evaluate this air pressure equipment.

(c) Totally encapsulating suits shall be capable of preventing inward test gas leakage of more than 0.5%. See appendix A for a test method.

(8) An employer shall establish a written personal protective equipment (PPE) program which is part of the safety and health program required by the provisions of R 325.52104 or R 325.52129. This program is also a part of the site-specific safety and health plan specified in R 325.52104. The personal protective equipment program shall address all of the following elements if applicable:

(a) PPE selection based on site hazards.
(b) PPE use and limitations.
(c) Work duration.
(d) PPE maintenance and storage.
(e) PPE decontamination and disposal.
(f) PPE training and proper fitting.
(g) PPE donning and doffing procedures.
(h) PPE inspection before and after use.
(i) PPE proper use.
(j) Evaluation of the effectiveness of the PPE program.

(k) Limitations during temperature extremes and other appropriate medical considerations. Manufacturer instructions relating to the subjects specified in subdivisions (d) to (h) of this subrule may be incorporated into the PPE program.

R 325.52119 Workplace monitoring.

Rule 19. (1) Monitoring shall be performed in accordance with the provisions of this rule where there may be employee exposure to hazardous concentrations of hazardous substances. Monitoring shall be performed to assure the proper selection of engineering controls, work practices, and personal protective equipment so that employees are not exposed to levels of hazardous substances which are greater than permissible exposure limits.

(2) Air monitoring shall be used to identify and quantify airborne levels of hazardous substances and safety and health hazards in order to determine an appropriate level of employee protection that is needed on-site.

(3) Upon initial workplace entry, representative air monitoring shall be conducted to identify all of the following:

(a) Any IDLH condition.

(b) Exposure above established permissible exposure limits.

(c) Exposure above a radioactive material's dose limits.

(d) Other dangerous conditions, such as the presence of flammable atmospheres or oxygen-deficient environments.

(4) Periodic monitoring shall be conducted when the possibility of an IDLH condition or flammable atmosphere has developed or when there is an indication that exposures may have risen above permissible exposure limits or published exposure levels since prior monitoring. All of the following are situations where the possibility that exposures have risen shall be considered:

(a) Work begins on a different area of the site.

(b) Contaminants other than those previously identified are being handled.

(c) A different type of operation is initiated (for example, drum opening as opposed to exploratory well drilling).

(d) Employees are handling leaking drums or containers or working in areas with obvious liquid contamination (for example, a spill or lagoon).

(e) A sufficient reasonable interval has passed so that exposures may have significantly increased.

(5) After hazardous waste clean-up operations commence, an employer shall monitor those employees likely to have the highest potential exposures to those hazardous substances and health hazards likely to be present above permissible exposure limits or published exposure levels by using personal sampling frequently enough to characterize employee exposure. If the employees likely to have the highest exposure are exposed above permissible exposure limits or published levels, monitoring shall continue to determine all employees likely to be above those levels. An employer may utilize a representative sampling approach by documenting that the employees and chemicals were chosen for monitoring based on the preceding criteria of this subrule. The monitoring of employees who are engaged in site characterization operations covered by the provisions of R 325.52107 is not required.

R 325.52120 Hazard information program.

Rule 20. An employer shall develop and implement a program, which is part of the employer's safety and health program required by the provisions of R 325.52104, to inform employees, contractors, and subcontractors and their representatives who are engaged in hazardous waste operations of the nature, level, and degree of exposure likely as a result of participation in such hazardous waste operations. Employees, contractors, and subcontractors who work outside of the operations area of a site are not covered by this rule.

R 325.52121 Handling, labeling, and disposing of hazardous substances, drums, and containers.

Rule 21. (1) Hazardous substances and contaminated soils, liquids, and other residues shall be handled, labeled, transported, and disposed of in accordance with the provisions of this rule, R 325.52122, and R 325.52123.

(2) All of the following provisions pertain to the use, handling, or movement of drums and other containers of hazardous substances.

(a) Drums and containers that are used during clean-up shall be appropriate for the wastes that they contain and the handling that is anticipated.

(b) When practical, drums and containers shall be inspected and their integrity shall be assured before being moved. Drums or containers that cannot be inspected before being moved because of storage conditions (for example, drums or containers that are buried, stacked behind other drums, or stacked several tiers high in a pile) shall be moved to an accessible location and inspected before further handling.

(c) Unlabeled drums and containers shall be considered to contain hazardous substances and handled accordingly until the contents are positively identified and labeled.

(d) The movement of drums and containers shall be minimized by preplanning and organization of site operations.

(e) Before moving drums or containers, all employees who are exposed to the transfer operations shall be warned of the potential hazards associated with the contents of the drum or containers.

(f) United States Department of Transportation –specified salvage drums or containers and suitable quantities of proper absorbents shall be kept available and used in area where spills, leaks, or ruptures may occur.

(g) Where spills of a hazardous substance from drums or containers may occur, a spill containment program which is part of the employer's safety and health program that is required pursuant to the provisions of R 325.52104 shall be implemented to contain and isolate the entire volume of the hazardous substance being transferred.

(h) Drums and containers that cannot be moved without rupture, leakage, or spillage shall be emptied into a sound container using equipment that is appropriate for the circumstances involved in the transfer of hazardous materials.

(i) A ground-penetrating system or other type of detection system or device shall be used to estimate the location and depth of buried drums or containers.

(j) Soil or covering material shall be removed with caution to prevent drum or container rupture.

(k) Fire extinguishing equipment that meets the requirement of R 408.10801 et. seq. of the Michigan Administrative Code shall be on hand and ready for use to control incipient fires.

(l) Material handling equipment that is used to transfer drums and containers shall be selected, positioned, and operated to minimize sources of ignition related to the equipment from igniting gases or vapors released from drums or containers.

(m) Drums and containers of radioactive wastes shall not be handled until their hazard to employees is properly assessed.

(3) All of the following procedures shall be used in areas where drums or containers are being opened:

(a) Where an air line respirator system is used, connections to the breathing air cylinders shall be protected from contamination and the entire system shall be protected from physical damage.

(b) Employees who are not actually involved in opening drums or containers shall be kept a safe distance from the operation.

(c) If employees are required to work near or adjacent to drums or containers being opened, a suitable shield that does not interfere with the work operations shall be placed between the employees and the drums or containers being opened to protect the employees in case of explosion.

(d) Controls for drum or container-opening equipment, monitoring equipment, and fire suppression equipment, shall be located behind an explosion-resistant barrier.

(e) When there is a reasonable possibility of flammable gases or vapors being present, material handling equipment and hand tools shall be types that will not produce sources of ignition.

(f) Drums and containers shall be opened in a manner that will safely relieve interior pressure. If pressure cannot be relieved from a remote location, appropriate shielding shall be placed between the employee and the drums or containers to reduce the risk of employee injury.

(g) Employees shall not stand upon or work from drums or containers.

(4) All of the following provisions apply to the handling or shipping of shock-sensitive wastes:

(a) The shipping of shock-sensitive wastes may be prohibited under United States Department of Transportation regulations. Employers and their shippers shall refer to the provisions of 49 CFR §§173.21 and 173.50.

(b) All nonessential employees shall be evacuated from the area of transfer.

(c) Material handling equipment shall be provided with explosion containment devices or protective shields to protect equipment operators from exploding containers.

(d) An alarm system that can be perceived by employees above surrounding light and noise conditions shall be used to signal the commencement and completion of explosive waste-handling activities.

(e) Continuous communications through appropriate means shall be maintained between the employee who is in charge of the immediate handling area and the site safety and health supervisor or command post until such time as the handling operation is completed. Communication equipment or methods that could cause shock-sensitive materials to explode shall not be used.

(f) Drums and containers that are under pressure, as evidenced by bulging or swelling, shall not be moved until such time as the cause of the internal pressure is determined and appropriate containment procedures have been implemented to protect employees from explosion due to relieving the pressure of the drum or container.

(5) In addition to the requirements of subrule (4) of this rule, all of the following precautions shall be taken when handling laboratory waste packs (lab packs):

(a) Lab packs shall be opened only when necessary and then only by an individual who is knowledgeable about the inspection, classification, and segregation of the containers within the pack according to the hazards of the waste.

(b) If crystalline material is noted on the outside of any container, the contents shall be handled as a shock-sensitive waste until the contents are identified.

(c) Drums and containers of packaged laboratory wastes shall be considered to contain shock-sensitive or explosive materials unless known not to contain such materials.

(6) Sampling of containers and drums shall be done in accordance with a sampling procedure, which is part of the site safety and health plan developed for, and available to, employees and others at the specific worksite.

R 325.52122 Shipping and transport of drums and containers of hazardous substances.

Rule 22. All of the following provisions apply to shipping and transporting drums and containers of hazardous substances:

(a) Drums and containers shall be identified, classified, and labeled before packaging for shipment.

(b) Drum or container staging areas shall be kept to the minimum number necessary to safely identify and classify materials and prepare them for transport.

(c) Staging areas shall have adequate access and egress routes.

(d) Bulking of hazardous waste is permitted only after a thorough characterization of the waste has been completed.

R 325.52123 Tank and vault operations.

Rule 23. (1) Tanks and vaults that contain a hazardous substance shall be handled in a manner similar to that for drums and containers by following the applicable provisions of R 325.52121.

(2) Appropriate tanks or vault entry (confined space entry) procedures which are in compliance with the provisions of O.H. rules 3301 and 3302 and which are addressed in the site safety and health plan covered by the provisions of R 325.52104(6) shall be followed in all cases where employees enter tanks, vaults, or other confined spaces.

R 325.52124 Decontamination.

Rule 24. (1) Procedures for all phases of decontamination shall be developed and implemented in accordance with this rule.

(2) All of the following provisions apply to decontamination procedures:

(a) A decontamination procedure shall be developed, communicated to employees, and implemented before any employees or equipment may enter areas on site where the potential for exposure to hazardous substances exists.

(b) Standard operating procedures shall be developed to minimize employee contact with hazardous substances or with equipment that has contacted hazardous substances.

(c) All employees who leave a contaminated area shall be appropriately decontaminated and all contaminated clothing and equipment that leaves a contaminated area shall be appropriately disposed of or decontaminated.

(d) Decontamination procedures shall be monitored by the site safety and health supervisor to

determine their effectiveness. When such procedures are found to be ineffective, appropriate steps shall be taken to correct any deficiencies.

(e) Decontamination shall be performed in geographical areas that will minimize the exposure of uncontaminated employees or equipment to contaminated employees or equipment.

(f) All equipment and solvents that are used for decontamination shall be decontaminated or disposed of properly.

(g) Protective clothing and equipment shall be decontaminated, cleaned, laundered, maintained, or replaced as needed to maintain the effectiveness of the clothing and equipment.

(h) Employees whose nonimpermeable clothing becomes wetted with hazardous substances shall immediately remove that clothing and proceed to a shower. The clothing shall be disposed of or decontaminated before it is removed from the work zone.

(i) Unauthorized employees shall not remove protective clothing or equipment from change rooms.

(j) Commercial laundries or cleaning establishments that decontaminate protective clothing or equipment shall be informed of the potentially harmful effects of exposure to hazardous substances.

(3) Where the decontamination procedure indicates a need for regular showers and change rooms outside of a contaminated area, such showers and change rooms shall be provided and shall be in compliance with the requirements of O.H. rule 4201 (4). If temperature conditions prevent the effective use of water, other effective means for cleansing shall be provided and used.

R 325.52125 Emergency operations at hazardous waste sites.

Rule 25. (1) An emergency response plan shall be developed and implemented by all employees within the scope of R 325.52102(1)(a) and (b) to handle anticipated emergencies before start-up of hazardous waste operations. The plans shall be in writing and available for inspection and copying by employees, their representatives, Michigan Occupational Safety and Health program personnel, and other federal and state government personnel with relevant responsibilities. An employer who will evacuate its employees from the danger areas when an emergency occurs and who does not permit any of its employees to respond to assist in handling the emergency, is exempt from the requirements of this rule if the employer provides an emergency action plan that is in compliance with the provisions of 29 CFR §1910.38(a), which are adopted in these rules by reference. The provisions of 29 CFR §1910.38(a) may be inspected and copies obtained at the Lansing office of the Michigan Department of Public Health, Division of Occupational Health, 3423 North Logan, P.O. Box 30195, Lansing, Michigan 48909, at no cost. Copies may also be obtained from OSHA Lansing Area Office, 801 S. Waverly, Suite 306, Lansing, Michigan 48917, at no cost.

(2) The emergency response plan shall address all of the following topics:

(a) Preemergency planning.

(b) Personnel roles, lines of authority, training, and communication.

(c) Emergency recognition and prevention.

(d) Safe distances and places of refuge.

(e) Site security and control.

(f) Evacuation routes and procedures.

(g) Decontamination.

(h) Emergency medical treatment and first aid.

(i) Emergency alerting and response procedures.

(j) A critique of response and follow-up.

(k) PPE and emergency equipment.

(3) In addition to the topics for the emergency response plan specified in subrule (2) of this rule, both of the following elements shall be included in an emergency response plan for a hazardous waste clean-up site:

(a) Site topography, layout, and prevailing weather conditions.

(b) Procedures for reporting incidents to local, state, and federal governmental agencies.

(4) The emergency response plan shall be a separate section of the site-specific safety and health plan and shall be compatible and integrated with disaster, fire, or emergency response plans of local, state, and federal agencies.

(5) The emergency response plan shall be rehearsed regularly as part of the overall training program for site operations and shall be reviewed periodically and amended, as necessary, to keep it current with new or changing site conditions or information.

(6) An employee alarm system shall be installed in accordance with the provisions of 29 CFR §1910.165, which are adopted in these rules by

reference, to notify employees of an emergency situation, to stop work activities if necessary, to lower background noise in order to enhance communication, and to begin emergency procedures. The provisions of 29 CFR §1910.165 may be inspected and copies obtained at the Lansing office of the Michigan Department of Public Health, 2423 North Logan, P.O. Box 30195, Lansing, Michigan 48909, at no cost. Copies may also be obtained from OSHA Lansing Area Office, 801 S. Waverly, Suite 306, Lansing, Michigan 48917, at no cost.

(7) Based upon the information available at time of an emergency, an employer shall evaluate the incident and site response capabilities and proceed with the appropriate steps to implement the site emergency response plan.

R 325.52126 Illumination of work areas.

Rule 26. (1) Work areas shall be lighted to not less than the minimum illumination intensities listed in Table 1 while any work is in progress. Approved wiring and electrical equipment, as specified in the provisions of R 408.41701 et seq. of the Michigan Administrative Code, shall be used.

(2) Table 1 reads as follows:

Table 1

Minimum Illumination Intensities in Footcandles

Area or operations	Footcandles
General site areas	5
Excavation and waste areas, accessways, active storage areas, loading platforms, refueling, and field maintenance areas.	3
Indoors: warehouses, corridors, hallways, and exitways.	5
Tunnels, shafts, and general underground work areas; exception: a minimum of 10 foot-candles is required at tunnel and shaft heading during drilling, mucking, and scaling. Bureau of Mines-approved cap lights are acceptable for use in the tunnel heading.	5
General shops, such as mechanical and electrical equipment rooms, active storerooms, barracks or living quarters, locker or dressing rooms, dining areas, and indoor toilets and workrooms.	10
First aid stations, infirmaries, and offices.	30

R 325.52127 Sanitation.

Rule 27. (1) All of the following provisions apply to potable water:

(a) An adequate supply of potable water shall be provided on the site.

(b) Portable containers that are used to dispense drinking water shall be capable of being tightly closed and shall be equipped with a tap. Water shall not be dipped from containers.

(c) Any container that is used to distribute drinking water shall be clearly marked as to its contents and shall not be used for any other purpose.

(d) Where single-service cups are supplied, a sanitary container for the unused cups shall be provided.

(2) Both of the following provisions apply to nonpotable water:

(a) Outlets for nonpotable water, such as water for industrial or fire fighting purposes, shall be identified to indicate clearly that the water is unsafe and is not to be used for drinking, washing, or cooking purposes.

(b) There shall not be a cross-connection, open or potential, between a potable water system and a nonpotable water system.

(3) All of the following provisions apply to toilet facilities:

(a) Toilets shall be provided for employees according to the provisions of the following table:

Table 2

Toilet Facilities

Number of Employees	Minimum number of facilities
20 or less	One
More than 20, less than 200	One toilet seat and 1 urinal per 40 employees.
200 or more	One toilet seat and 1 urinal per 50 employees.

(b) Under temporary field conditions, at least 1 toilet facility shall be available.

(c) Hazardous waste sites that are not provided with sanitary sewer shall be provided with any of the following toilet facilities, unless prohibited by local codes:

(i) Chemical toilets.

(ii) Recirculating toilets.

(iii) Combustion toilets.

(iv) Flush toilets.

(d) The requirements of this subrule shall not apply to mobile crews that have transportation readily available to nearby toilet facilities.

(e) Doors to toilet facilities shall be provided with locks that are controlled from inside.

(4) All employee food service facilities and operations shall meet the applicable laws, ordinances, and regulations of the jurisdictions in which they are located.

(5) When temporary sleeping quarters are provided, they shall be heated, ventilated, and lighted.

(6) An employer shall provide adequate washing facilities for employees who are engaged in operations where hazardous substances may be harmful to employees. Such facilities shall be near the worksite, in areas that are under the control of the employer, and where exposures are below permissible exposure limits. Such facilities shall be equipped to enable employees to remove hazardous substances from themselves.

(7) When hazardous waste clean-up or removal operations commence on a site and the duration of the work will require 6 or more months, an employer shall provide showers and change rooms for employees who are exposed to hazardous substances and health hazards involved in hazardous waste clean-up or removal operations. Showers shall be provided and shall meet the requirements of O.H. rule 4201 (4)(c). Change rooms shall consist of two separate change areas separated by the shower area required by the provisions of this subrule. One change area, with an exit leading off the worksite, shall provide employees with a clean area where they can remove, store, and put on street clothing. The second area, with an exit to the worksite, shall provide employees with an area where they can put on, remove and store work clothing and personal protective equipment. Showers and change rooms shall be located in areas where exposures are below the permissible exposure limits and published exposure levels. If this cannot be accomplished, then a ventilation system shall be provided that will supply air that is below the permissible exposure limits and published exposure levels. Employers shall assure that employees shower at the end of their work shift and when leaving the hazardous waste site.

Rule 325.52128 New technology programs.

Rule 28. (1) The employer shall develop and implement procedures for the introduction of effective new technologies and equipment developed for the improved protection of employees who work with hazardous waste clean-up operations. Such new technologies shall be implemented as part of the site safety and health program to assure that employee protection is being maintained.

(2) New technologies, equipment or control measures available to the industry, such as the use of foams, absorbents, adsorbents, neutralizers, or other means to suppress the level of air contaminants while excavating the site or for spill control, shall be evaluated by employers or their representatives. Such an evaluation shall be done to determine their effectiveness before using them on a large scale. Such evaluations shall be made available to the Michigan occupational safety and health program (MIOSHA) upon request. Manufacturers and suppliers' information and data may be used as part of this evaluation.

R 325.52129 Operations at treatment, storage, and disposal (TSD) facilities; establishment of written safety and health program, hazardous communication program, medical surveillance program, decontamination procedures, procedures for introduction of new and innovative equipment, procedures for handling drums or containers, training program, and emergency response program.

Rule 29. (1) All provisions of this rule apply to employers who conduct operations at treatment, storage, and disposal (TSD) facilities specified in R 325.52102(1)(d), except for employers that may be exempted in accordance with the provisions of R 325.52102(4)(a) to (c).

(2) An employer shall develop and implement a written safety and health program for employees who are involved in hazardous waste operations. This written program shall be available for inspection by employees, employees' representatives, and Michigan Occupational Safety and Health program (MIOSHA) personnel. The program shall be designed to identify, evaluate and control safety and health hazards in the employer's

facilities for the purpose of employee protection and shall provide for emergency response that is in compliance with the requirements of this rule. The program shall address, as appropriate, all of the following areas:

(a) Site analysis.

(b) Engineering controls.

(c) Maximum exposure limits.

(d) Hazardous waste handling procedures.

(e) Uses of new technologies.

(3) An employer shall implement a hazard communication program that is in compliance with the requirements of sections 14a to 14k of Act No. 154 of the Public Acts of 1974, as amended, being §§408.1014a to 408.1014k of the Michigan Compiled Laws.

(4) An employer shall develop and implement a medical surveillance program in accordance with the provisions of R 325.52113.

(5) The employer shall develop and implement decontamination procedures in accordance with the provisions of R 325.52124.

(6) The employer shall develop and implement procedures for the introduction of new and innovative equipment into the workplace in accordance with the provisions of R 325.52128.

(7) An employer shall develop and implement procedures for handling drums or containers in accordance with the provisions of R 325.52121 (2)(a) to (g) and R 325.52122 before starting work that involves the handling of drums or containers.

(8) The employer shall develop and implement, in accordance with all of the following provisions, a training program, which is part of the employer's safety and health program, for employees who are exposed to health hazards or hazardous substances of TSD operations to enable the employees to perform their assigned duties and functions in a safe and healthful manner so as not to endanger themselves or other employees:

(a) The initial training of new employees shall be a program of 24 hours of training. A certificate of such training will be issued to each employee who successfully completes this training.

(b) Initial training need not be provided for current employees for whom it can be shown that their previous work experience or training is equivalent to the training requirements of subdivision (a) of this subrule.

(c) All employees shall be given 8 hours of refresher training annually.

(d) Trainers who provide the initial training specified in subdivision (a) of this subrule shall have satisfactorily completed a program for teaching the subjects they teach or shall have academic credentials and instruction experience to demonstrate a satisfactory degree of competency in the subjects they teach.

(9) An employer shall develop and implement an emergency response program in accordance with all of the following provisions:

(a) An emergency response plan shall be developed and implemented. Such plan need not duplicate any of the subjects fully addressed in the employer's contingency planning required by permits, such as those issued by the United States Environmental Protection Agency, if the contingency plan is made part of the emergency response plan. The emergency response plan shall be a written portion of the safety and health program required by subrule (2) of this rule.

(b) An employer who will evacuate its employees from the worksite when an emergency occurs and who does not permit any of its employees to assist in handling the emergency is exempt from the requirements of this subrule if the employer provides an emergency action plan in accordance with the provisions of 29 C.F.R. §1910.38(a), which are adopted by reference in R 325.52125(1).

(c) The emergency response plan shall address all of the following topics to the extent that they are not addressed in any specific program required in this rule:

(i) Pre-emergency planning and coordination with outside parties.

(ii) Personnel roles, lines of authority, and communication.

(iii) Emergency recognition and prevention.

(iv) Safe distances and places of refuge.

(v) Site security and control.

(vi) Evacuation routes and procedures.

(vii) Decontamination procedures.

(viii) Emergency medical treatment and first aid.

(ix) Emergency alerting and response procedures.

(x) Critique of response and follow-up.

(xi) PPE and emergency equipment.

(d) An employer shall provide and complete training for emergency response employees before they become involved in actual emergency operations. Such training shall include all of the following:

(i) Elements of the emergency response plan.

(ii) Standard operating procedures for emergency response operations.

(iii) Personal protective equipment available and use and limitations of each.

(iv) Procedures for handling emergency incidents.

(v) Two exceptions to the training requirements of this subdivision are as follows:

(A) An employer need not train all employees to the degree specified if the employer divides the work force so that a sufficient number of employees who are responsible for controlling emergencies have the training specified and so that all other employees who might initially respond to an emergency incident have sufficient awareness training to recognize that an emergency response situation exists and that they are instructed in that case to summon the fully trained employees and not attempt control activities for which they are not trained.

(B) An employer need not train all employees to the degree specified if arrangements have been made in advance for an outside, fully trained emergency response team to respond in a reasonable period and all employees who might initially respond to the incident have sufficient awareness training to recognize that an emergency response situation exists and they have been instructed to call the designated outside, fully trained emergency response team for assistance.

(vi) Employee members of TSD facility emergency response organizations shall be trained to a level of competence in the recognition of health and safety hazards to protect themselves and other employees. This includes training in all of the following areas:

(A) The methods used to minimize the risk from safety and health hazards.

(B) The safe use of control equipment.

(C) Selection and use of appropriate PPE.

(D) Safe operating procedures to be used at the incident scene.

(E) Techniques of coordination with other employees to minimize risks.

(F) Appropriate response to overexposure to health hazards or injury to themselves or others.

(G) Recognition of subsequent symptoms which may result from overexposure.

(vii) An employer shall certify that each covered employee has attended and successfully completed the training required in this subdivision or shall certify the employee's competency at least yearly. The method used to demonstrate competency for certification of training shall be recorded and maintained by the employer.

(e) All of the following provisions pertain to the procedures for handling emergency incidents:

(i) In addition to the elements for the emergency response plan required by subdivision (c) of this subrule, the following elements shall be included in emergency response plans to the extent that they do not repeat any information already contained in the emergency response plan:

(A) Site topography, layout, and prevailing weather conditions.

(B) Procedures for reporting incidents to local, state, and federal governmental agencies.

(ii) The emergency response plan shall be compatible and integrated with the disaster, fire, and emergency response plans of local, state, and federal agencies.

(iii) The emergency response plan shall be rehearsed regularly as part of the overall training program for site operations.

(iv) The site emergency response plan shall be reviewed periodically and, as necessary, be amended to keep it current with new or changing site conditions or information.

(v) An employee alarm system shall be installed in accordance with the provisions of 29 C.F.R. §1910.165, which are adopted by reference in R 325.52125(6), to notify if necessary, to lower background noise to aid communication, and to begin emergency procedures.

(vi) Based upon the information available at the time of the emergency, an employer shall evaluate the incident and the site response capabilities and proceed with the appropriate steps to implement the site emergency response plan.

R 325.52130 Emergency response to hazardous substances releases; emergency response plan.

Rule 30. (1) This rule, and R 325.52131 to R 325.52135, apply to employers whose employees are engaged in emergency response wherever it occurs, except in operations specified in the provisions of R 325.52102(1)(a) to (d).

(2) Emergency response organizations that have developed and implemented programs equivalent to the requirements of this rule and R 325.52131 to R 325.52135 for handling releases of hazardous substances pursuant to the provisions of section 303 of the emergency planning and

community right-to-know act of 1986, 42 U.S.C. §11003, shall be deemed to have met the requirements of this rule and R 325.52131 to R 325.52135.

(3) An emergency response plan shall be developed and implemented to handle anticipated emergencies before the commencement of emergency response operations. The plan shall be in writing and available for inspection and copying by employees, their representatives, and Michigan Occupational Safety and Health program (MIOSHA) personnel. An employer who will evacuate its employees from the danger area when an emergency occurs and who does not permit any of its employees to assist in handling the emergency is exempt from the requirements of this subrule and subrule (4) of this rule if the employer provides an emergency action plan in accordance with the provisions of 29 C.F.R. §1910.38(a), which is adopted by reference in R 325.52125(1).

(4) An employer shall develop an emergency response plan which shall address all of the following to the extent that they are not addressed elsewhere:

(a) Pre-emergency planning and coordination with outside parties.

(b) Personnel roles, lines of authority, training, and communication.

(c) Emergency recognition and prevention.

(d) Safe distances and places of refuge.

(e) Site security and control.

(f) Evacuation routes and procedures.

(g) Decontamination.

(h) Emergency medical treatment and first aid.

(i) Emergency alerting and response procedures.

(j) Critique of response and follow-up.

(k) PPE and emergency equipment.

(5) Emergency response organizations may use the local emergency response plan or the state emergency response plan, or both, as part of their emergency response plan to avoid duplication. Those items of the emergency response plan that are properly addressed by the local and state emergency plans may be substituted into an employer's emergency plan or otherwise kept together for use by employers and employees.

R 325.52131 Emergency response procedures.

Rule 31. (1) The senior emergency response official who responds to an emergency shall become the individual in charge of a site-specific incident command system (ICS). All emergency responders and their communications shall be coordinated and controlled through the individual in charge of the ICS, and shall be assisted by the senior official present for each employer.

(2) The senior official at an emergency response is the most senior official on the site who is responsible for controlling the operation at the site. Initially, it is the senior officer on the first piece of responding emergency apparatus to arrive on the incident scene who is the senior official. As more senior officers arrive, such as the battalion chief, fire chief, state law enforcement official, or site coordinator, the position of senior official is passed up the line of authority which has been previously established.

(3) The individual in charge of the ICS shall identify, to the extent possible, all hazardous substances or conditions present and shall address, as appropriate, all of the following:

(a) Site analysis.

(b) Use of engineering limits.

(c) Maximum exposure limits.

(d) Hazardous substance handling procedures.

(e) The use of any new technologies.

(4) Based on the hazardous substances or conditions present, the individual in charge of the ICS shall implement appropriate emergency operations and assure that the personal protective equipment worn is appropriate for the hazards to be encountered. However, personal protective equipment shall meet the criteria contained in the occupational safety standards for general industry, Part 73, Fire Brigades, being R 408.17301 et seq. of the Michigan Administrative Code, when worn while performing fire fighting operations beyond the incipient stage for any incident.

(5) Employees who are engaged in emergency response and who are exposed to hazardous substances that present an inhalation hazard or potential inhalation hazard shall wear positive-pressure, self-contained breathing apparatus while engaged in emergency response and until such time that the individual in charge of the ICS determines, through the use of air monitoring, that a decreased level of respiratory protection will not result in a hazardous exposure to employees.

(6) The individual in charge of the ICS shall limit the number of emergency response personnel at the emergency site in those areas of potential or actual exposure to incident or site hazards to those

who are actively performing emergency operations. However, operations in hazardous areas shall be performed using the buddy system in groups of 2 or more.

(7) Back-up personnel shall stand by with equipment ready to provide assistance or rescue. Qualified emergency medical service personnel shall also stand by with medical equipment and transportation capability.

(8) The individual in charge of the ICS shall designate a safety official, who is knowledgeable in the operations being implemented at the emergency response site, with specific responsibility for identifying and evaluating hazards and for providing direction with respect to the safety of operations for the emergency.

(9) When activities are judged by the safety official to be an IDLH or imminent danger condition, the safety official shall have the authority to alter, suspend, or terminate those activities. The safety official shall immediately inform the individual in charge of the ICS of any actions taken to correct these hazards at an emergency scene.

(10) After emergency operations have terminated, the individual in charge of the ICS shall implement appropriate decontamination procedures.

(11) Approved self-contained, compressed-air breathing apparatus may, if necessary, be used with approved cylinders from other approved self-contained, compressed-air breathing apparatus if such cylinders are of the same capacity and pressure rating. All compressed air cylinders that are used with self-contained breathing apparatus shall meet the criteria of the United States Department of Transportation and National Institute for Occupational Safety and Health, which are adopted in these rules by reference. The criteria are set forth in the provisions of 30 C.F.R part 11 and 40 C.F.R. part 173 and 178, which may be inspected at the Lansing office of the Department of Public Health and may be purchased from the Superintendent of Documents, Government Printing Office, Washington, DC 20402, or from the Michigan Department of Public Health, 3423 N. Logan, P.O. Box 30195, Lansing, Michigan 48909, at a cost at the time of adoption of these rules of $20.00 for copies of 30 C.F.R part 11 and at a cost at the time of adoption of these $24.00 for copies of 40 C.F.R. parts 173 and 178.

R 325.52132 Emergency response personnel.

Rule 32. (1) Skilled support personnel who are skilled in the operation of certain equipment, such as mechanized earth-moving or digging equipment or crane and hoisting equipment, who are needed temporarily to perform immediate emergency support work that cannot reasonably be performed in a timely fashion by an employer's own employees, and who will be or may be exposed to the hazards at an emergency response scene are not required to receive the training required in the provisions of R 325.52133 for the employer's regular employees. However, these personnel shall be given an initial briefing at the site before participating in any emergency response. The initial briefing shall include instruction in the wearing of appropriate personal protective equipment, what chemical hazards are involved, and what duties are to be performed. The personnel referred to in this subrule need not be an employer's own employees. All other appropriate safety and health precautions provided to the employer's own employees shall be used to assure the safety and health of these personnel.

(2) Specialist employees who, in the course of their regular job duties, work with, and are trained in the hazards of, specific hazardous substances and who will be called upon to provide technical advice or assistance at a hazardous substance release incident to the individual in charge shall receive training annually or annually demonstrate competency in the area of their specialization.

R 325.52133 Emergency response training.

Rule 33. (1) Employees who participate or are expected to participate in emergency response shall be trained in accordance with the requirements of this rule. Training shall be based on the duties and functions to be performed by each responder of an emergency response organization. The skill and knowledge levels required for all new responders, those hired after the effective date of these rules, shall be conveyed to them through training before they are permitted to take part in actual emergency operations on an incident.

(2) First responders at the awareness level are individuals who are likely to witness or discover a hazardous substance release and who have been trained to initiate an emergency response sequence by notifying the proper authorities of the release. They would take no further action beyond notifying the authorities of the release. First responders at the awareness level shall have sufficient training or have

had sufficient experience to objectively demonstrate competency in all of the following areas:

(a) Understanding what hazardous substances are and the risks associated with them in an incident.

(b) Understanding the potential outcomes associated with an emergency created when hazardous substances are present.

(c) The ability to recognize the presence of hazardous substances in an emergency.

(d) The ability to identify the hazardous substances in an emergency, if possible.

(e) Understanding the role of the first responder awareness individual as specified in the employer's emergency response plan, including site security and control, and as specified in the United States Department Of Transportation's, Emergency Response Guidebook.

(f) The ability to realize the need for additional resources and to make appropriate notifications to the communication center.

(3) Fire responders at the operations level are individuals who respond to releases or potential releases of hazardous substances as part of the initial response to the site for the purpose of protecting nearby persons, property, or the environment from the effects of the release. Their function is to contain the release from a safe distance, keep it from spreading, and prevent exposures. First responders at the operational level shall have received not less than 8 hours of training or have had sufficient experience to objectively demonstrate competency in all of the following areas in addition to those listed for the awareness level in subrule (2) of this rule:

(a) Knowledge of the basic hazard and risk assessment techniques.

(b) Knowing how to select and use proper personal protective equipment provided to the first responder operational level.

(c) Understanding basic hazardous materials terms.

(d) Knowing how to perform basic control, containment, and confinement operations within the capabilities of the resources and personal protective equipment available to their unit.

(e) Knowing how to implement basic decontamination procedures.

(f) Understanding the relevant standard operating procedures and termination procedures. The employers shall certify demonstrated competency in the areas specified in this subrule.

(4) Hazardous materials technicians are individuals who respond to releases or potential releases for the purpose of stopping the release. They assume a more aggressive role than a first responder at the operations level in that they will approach the point of release in order to plug, patch, or otherwise stop the release of a hazardous substance. Hazardous materials technicians shall have received not less than 24 hours of training equal to the first responder operations level of subrule (3) of this rule and, in addition, be competent in all of the following areas:

(a) Knowing how to implement the employer's emergency response plan.

(b) Knowing the classification, identification, and verification of known and unknown materials by using field survey instruments and equipment.

(c) Being able to function within an assigned role in the incident command system.

(d) Knowing how to select and use proper specialized chemical personal protective equipment provided to the hazardous materials technician.

(e) Understanding hazard and risk assessment techniques.

(f) Being able to perform advance control, containment, and confinement operations within the capabilities of the resources and personal protective equipment available to the unit.

(g) Understanding and implementing decontamination procedures.

(h) Understanding termination procedures.

(i) Understanding basic chemical and toxicological terminology and behavior. The employer shall certify competency in the area specified in this subrule.

(5) Hazardous materials specialists are individuals who respond with, and provide support to, hazardous materials technicians. Their duties parallel those of the hazardous materials technician; however, those duties require a more directed or specific knowledge of the various substances they may be called upon to contain. The hazardous materials specialist would also act as the site liaison with federal, state, local, and other governmental authorities concerning site activities. Hazardous materials specialists shall have received not less than 24 hours of training equal to the technician level of subrule (4) of this rule and, in addition, be competent in all of the following areas:

(a) Knowing how to implement the local emergency response plan.

(b) Understanding the classification, identification, and verification of known and unknown materials by using advanced survey instruments and equipment.

(c) Being aware of the state emergency response plan.

(d) Being able to select and use proper specialized chemical personal protective equipment provided to the hazardous materials specialist.

(e) Understanding in-depth hazard and risk techniques.

(f) Be able to perform specialized control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available.

(g) Being able to determine and implement decontamination procedures.

(h) Having the ability to develop a site safety and control plan.

(i) Understanding chemical, radiological and toxicological terminology and behavior.

(6) On scene incident commanders who will assume control of the incident scene beyond the first responder awareness level shall receive not less than 24 hours of training equal to the first responder operations level of subrule (3) of this rule and, in addition, be competent in all of the following areas:

a) Knowing and being able to implement the employer's incident commander system.
b) Knowing how to implement the employer's emergency response plan.
c) Knowing and understanding the hazards and risks associated with employees working in chemical protective clothing.
d) Knowing how to implement the local emergency response plan.
e) Being aware of the state emergency response and of the Federal Regional Response Team.
f) Knowing and understanding the importance of decontamination procedures.

(7) Trainers who teach any of the training subjects specified in subrules (1) to (6) of this rule shall have satisfactorily completed a training course for teaching the subjects they are expected to teach, such as the courses offered by the U.S. National Fire Academy, or they shall have the training and/or academic credentials and instructional experience necessary to demonstrate competent instructional skills and a satisfactory command of the subject matter of the courses they are to teach.

(8) Both of the following provisions pertain to refresher training:

(a) Those employees who are trained in accordance with the provisions of this rule receive annual refresher training or sufficient content and duration to remain competent with respect to their duties and functions or shall demonstrate competency in those areas at least yearly.

(b) A statement shall be made of the training or competency, and if a statement of competency is made, the employer shall keep a record of the methodology used to demonstrate competency.

R 325.42134 Emergency response medical surveillance; chemical protective clothing.

Rule 34. (1) Members of an organized and designated HAZMAT team and hazardous materials specialists shall receive a baseline physical examination and be provided with medical surveillance as required pursuant to the provisions of R 325.52113 to R 325.52116 of these rules.

(2) Any emergency response employees who exhibit signs or symptoms that may have resulted from exposure to hazardous substances during the course of an emergency incident shall be provided with medical consultation as required pursuant to the provisions of R 325.52113(2)(b).

(3) Chemical protective clothing and equipment to be used by organized and designated HAZMAT team members, or to be used by hazardous materials specialists, shall be in compliance with the requirements of R 325.5 2118.

R 325.52135 Post-emergency response operations.

Rule 35. (1) Upon completion of the emergency response, if it is determined that it is necessary to remove hazardous substances, health hazards, and materials contaminated with them (such as contaminated soil or other elements of the natural environment) from the site of the incident, the employer who conducts the clean-up shall comply with one of the following provisions:

(a) Meet all of the requirements of R 325.52104 to R 325.52128.

(b) Where the clean-up is done on plant property using plant or workplace employees, such employees shall have completed the training requirements of the following:

(i) The provisions of 29 CFR §1910.38 (a), which are adopted by reference in R 325.52125(1).

(ii) The provisions of 29 CFR §1910.1200(h).

(iii) The provisions of O.H. rule 3502(2) and (5).

(iv) Other appropriate safety and health training appropriate to the tasks.

(v) All equipment that is to be used in the cleanup of the site of an incident shall be in serviceable condition and shall have been inspected before use.

R 324.52136 Appendices

Rule 36. Appendices A, B, C, and D to these rules are informational only and are not intended to create any additional obligations or requirements not otherwise imposed or to detract from any established obligations or requirements. They are identical to appendices A, B, C, and D to 29 C.F.R. §1910.120 from which these rules were derived.

R 325.52137 Availability of rules and appendices, permission to copy.

Rule 37. (1) Copies of these rules and related appendices are available, at no cost, from the Michigan Department of Public Health, Division of Occupational Health, 3423 North Logan, P.O. Box 30195, Lansing, Michigan 48909.

(2) Permission to copy any of these documents in full is granted by the director of the Department of Public Health.

APPENDICES TO MIOSHA STANDARD FOR HAZARDOUS WASTE OPERATIONS AND EMERGENCY RESPONSE (R 325.52101 – R 325.52137)

The following appendices serve as non-mandatory guidelines to assist employees and employers in complying with the appropriate requirements of this section. However, Rule 18 of this standard requires the use of Level A and Level B personal protective equipment protection in certain circumstances.

Appendix A – Personal Protective Equipment Test Methods

This appendix sets forth the non-mandatory examples of tests which may be used to evaluate compliance with Rule 18(7)(b) and (c). Other tests and other challenge agents may be used to evaluate compliance.

A. Totally-encapsulating chemical protective suit pressure test.

1.0 – Scope

1.1 This practice measures the ability of a gas-tight totally-encapsulating chemical protective suit material, seams, and closures to maintain a fixed positive pressure. The results of this practice allow the gas-tight integrity of a totally-encapsulating chemical protective suit to be evaluated.

1.2 Resistance of the suit materials to permeation, penetration, and degradation by specific hazardous substances is not determined by this test method.

2.0 – Definition of terms

2.1 "Totally-encapsulating chemical protective suit (TECP suit)" means a full body garment which is constructed of protective clothing materials; covers the wearer's torso, head, arms, legs and respirator; may cover the wearer's hands and feet with tightly attached gloves and boots; completely encloses the wearer and respirator by itself or in combination with the wearer's gloves and boots.

2.2 "Protective clothing material" means any material or combination of materials used in an item of clothing for the purpose of isolating parts of the body from direct contact with a potentially hazardous liquid or gaseous chemicals.

2.3 "Gas tight" means, for the purpose of this test method, the limited flow of a gas under pressure from the inside of a TECP suit to atmosphere at a prescribed pressure and time interval.

3.0 – Summary of test method

3.1 The TECP suit is visually inspected and modified for the test. The test apparatus is attached to the suit to permit inflation to the pre-test suit expansion pressure for removal of suit wrinkles and creases. The pressure is lowered to the test pressure and monitored for three minutes. If the pressure drop is excessive, the TECP suit fails the test and is removed from service. The test is repeated after leak location and repair.

4.0 – Required Supplies

4.1 Source of compressed air.

4.2 Test apparatus for suit testing, including a pressure measurement device with a sensitivity of at least ¼ inch water gauge.

4.3 Vent valve closure plugs or sealing tape.

4.4 Soapy water solution and soft brush.

4.5 Stop watch or appropriate timing device.

5.0 – Safety Precautions

5.1 Care shall be taken to provide the correct pressure safety devices required for the source of compressed air used.

6.0 – Test Procedure

6.1 – Prior to each test, the tester shall perform a visual inspection of the suit. Check the suit for seam integrity by visually examining the seams and gently pulling on the seams. Ensure that all air supply lines, fittings, visor, zippers, and valves are secure and show no signs of deterioration.

6.1.1 Seal off the vent valves along with any other normal inlet or exhaust points (such as umbilical air line fittings or face piece opening) with tape or other appropriate means (caps, plugs, fixture, etc). Care should be exercised in the sealing process not to damage any of the suit components.

6.1.2 Close all closure assemblies.

6.1.3 Prepare the suit for inflation by providing an improvised connection point on the suit for connecting an airline. Attach the pressure test

apparatus to the suit to permit suit inflation from a compressed air source equipped with a pressure indicating regulator. The leak tightness of the pressure test apparatus should be tested before and after each test by closing off the end of the tubing attached to the suit and assuring a pressure of three inches water gauge for three minutes can be maintained. If a component is removed for the test, that component shall be replaced and a second test conducted with another component removed to permit a complete test of the ensemble.

6.1.4 The pre-test expansion pressure (a) and the suit test pressure (b) shall be supplied by the suit manufacturer, but in no case shall they be less than: (A) = three inches water gauge; and (B) = two inches water gauge. The ending suit pressure (C) shall be no less than 80 percent of the test pressure (B); i.e., the pressure drop shall not exceed 20 percent of the test pressure (B).

6.1.5 Inflate the suit until the pressure inside is equal to pressure (A), the pre-test expansion suit pressure. Allow at least one minute to fill out the wrinkles in the suit. Release sufficient air to reduce the suit pressure to pressure (B), the suit test pressure. Begin timing. At the end of three minutes, record the suit pressure as pressure (C), the ending suit pressure. The difference between the suit test pressure and the ending suit test pressure (B-C) shall be defined as the suit pressure drop.

6.1.6 If the suit pressure drop is more than 20 percent of the suit test pressure (B) during the three-minute test period, the suit fails the test and shall be removed from service.

7.0 – Retest Procedure

7.1 If the suit fails the test, check for leaks by inflating the suit to pressure (A) and brushing or wiping the entire suit (including seams, closures, lens gaskets, glove-to-sleeve joints, etc.) with a mild soap and water solution. Observe the suit for the formation of soap bubbles, which is an indication of a leak. Repair all identified leaks.

7.2 Retest the TECP suit as outlined in Test Procedures 6.0.

8.0 – Report

8.1 Each TECP suit tested by this practice shall have the following information recorded:

8.1.1 Unique identification number, identifying brand name, date of purchase, material of construction, and unique fit features, e.g., special breathing apparatus.

8.1.2 The actual values for test pressures (A), (B), and (C) shall be recorded along with the specific observation times. If the ending pressure (C) is less than 80 percent of the test pressure (B), the suit shall be identified as failing the test. When possible, the specific leak location shall be identified in the test records. Retest pressure data shall be recorded as an additional test.

8.1.3 The source of the test apparatus used shall be identified and the sensitivity of the pressure gauge shall be recorded.

8.1.4 Records shall be kept for each pressure test even if repairs are being made at the test location.

Caution

Visually inspect all parts of the suit to be sure they are positioned correctly and secured tightly before putting the suit back into service. Special care should be taken to examine each exhaust valve to make sure it is not blocked.

Care should also be exercised to assure that the inside and outside of the suit is completely dry before it is put into storage.

B. Totally-encapsulating chemical protective suit qualitative leak test.

1.0 – Scope

1.1 This practice semi-qualitatively tests gas-tight totally–encapsulating chemical protective suit integrity by detecting inward leakage of ammonia vapor. Since no modifications are made to the suit to carry out this test, the results from this practice provide a realistic test for the integrity of the entire suit.

1.2 Resistance of the suit materials to permeation, penetration, and degradation is not determined by this test method. ASTM test methods are available to test suit materials for these characteristics and the tests are usually conducted by the manufacturers of the suits.

2.0 – Definition of terms

2.1 “Totally-encapsulated” chemical protective suit (TECP suit) means a full body garment which is constructed of protective clothing materials; covers the wearer’s torso, head, arms, legs and respirator, may cover the wearer’s hands and feet with tightly attached gloves and boots; completely encloses the wearer and respirator by itself or in combination with the wearer’s gloves and boots.

2.2 "Protective clothing material" means any material or combination of materials used in an item of clothing for the purpose of isolating parts of the body from direct contact with a potentially hazardous liquid or gaseous chemicals.

2.3 "Gas tight" means, for the purpose of this test method, the limited flow of a gas under pressure from the inside of the TECP suit to atmosphere at a prescribed pressure and time interval.

2.4 "Intrusion Coefficient" means a number expressing the level of protection provided by a gas-tight totally-encapsulating chemical protective suit. The intrusion coefficient is calculated by dividing the test room challenge agent concentration by the concentration of challenge agent found inside the suit. The accuracy of the intrusion coefficient is dependent on the challenge agent monitoring methods. The larger the intrusion coefficient, the greater the protection provided by the TECP suit.

3.0 – Summary of recommended practice

3.1 The volume of concentrated aqueous ammonia solution (ammonia hydroxide NH_4OH) required to generate the test atmosphere is determined using the directions outlined in 6.1. The suit is donned by a person wearing the appropriate respiratory equipment (either a positive pressure self-contained breathing apparatus or a positive pressure supplied air respirator) and worn inside the enclosed test room. The concentrated aqueous ammonia solution is taken by the suited individual into the test room and poured into an open plastic pan. A two-minute evaporation period is observed before the test room concentration is measured, using a high range ammonia length of stain detector tube. When the ammonia vapor reaches a concentration of between 1000 and 1200 ppm, the suited individual starts a standardized exercise protocol to stress and flex the suit. After this protocol is completed, the test room concentration is measured again. The suited individual exits the test room and his stand-by person measures the ammonia concentration inside the suit using a low range ammonia length of stain detector tube or other more sensitive ammonia detector. A stand-by person is required to observe the test individual during the test procedure; aid the person in donning and doffing the TECP suit; and monitor the suit interior. The intrusion coefficient of the suit can be calculated by dividing the average test area concentration by the interior suit concentration. A colorimetric ammonia indicator strip of bromophenol blue or equivalent is placed on the inside of the suit face piece lens so that the suited individual is able to detect a color change and determine if it has a significant leak. If a color change is observed, the individual shall leave the test room immediately.

4.0 – Required supplies

4.1 A supply of concentrated aqueous (58 percent ammonium hydroxide by weight).

4.2 A supply of bromophenol/blue indicating paper or equivalent, sensitive to 5-10 ppm ammonia or greater over a two-minute period of exposure. [pH 3.0 (yellow) to pH 4.6 (blue)]

4.3 A supply of high range (0.5-10 volume percent) and low range (5-700 ppm) detector tubes for ammonia and the corresponding sampling pump. More sensitive ammonia detectors can be substituted for the low range detector tubes to improve the sensitivity of this practice.

4.4 A shallow plastic pan (PVC) at least 12":14":1" and a half pint plastic container (PVC) with tightly closing lid.

4.5 A graduated cylinder or other volumetric measuring device of at least 50 milliliters in volume with an accuracy of at least ±1 milliliters.

5.0 – Safety precautions

5.1 Concentrated aqueous ammonium hydroxide, NH_4OH' is a corrosive volatile liquid requiring eye, skin, and respiratory protection. The person conducting the test shall review the MSDS for aqueous ammonia.

5.2 Since the established permissible exposure limit for ammonia is 50 ppm, only persons wearing a positive pressure self-contained breathing apparatus or a positive pressure supplied air respirator shall be in the chamber. Normally only the person wearing the totally-encapsulating suit will be inside the chamber. A stand-by person shall have a positive pressure self-contained breathing apparatus, or a positive pressure supplied air respirator available to enter the test area should the suited individual need assistance.

5.3 A method to monitor the suited individual must be used during this test. Visual contact is the simplest' but other methods using communication devices are acceptable.

5.4 The test room shall be large enough to allow the exercise protocol to be carried out and then to be ventilated to allow for easy exhaust of the ammonia test atmosphere after the test(s) are completed.

5.5 Individuals shall be medically screened for the use of respiratory protection and checked for

allergies to ammonia before participating in this test procedure.

6.0 – Test procedure

6.1.1 Measure the test area to the nearest foot and calculate its volume in cubic feet. Multiply the test area volume by 0.2 milliliters of concentrated aqueous ammonia solution per cubic foot of test area volume to determine the approximate volume of concentrated aqueous ammonia required to generate 1000 ppm in the test area.

6.1.2 Measure this volume from the supply of concentrated aqueous ammonia and place it into a closed plastic container.

6.1.3 Place the container, several high range ammonia detector tubes, and the pump in the clean test pan and locate it near the test area entry door so that the suited individual has easy access to these supplies.

6.2.1 In a non-contaminated atmosphere, open a pre-sealed ammonia indicator strip and fasten one end of the strip to the inside of the suit face shield lens where it can be seen by the wearer. Moisten the indicator strip with distilled water. Care shall be taken not to contaminate the detector part of the indicator paper by touching it. A small piece of masking tape or equivalent should be used to attach the indicator strip to the interior of the suit face shield.

6.2.2 If problems are encountered with this method of attachment, the indicator strip can be attached to the outside of the respirator face piece lens being used during the test.

6.3 Don the respiratory protective device normally used with the suit, and then don the TECP suit to be tested. Check to be sure all openings that are intended to be sealed (zippers, gloves, etc.) are completely sealed. DO NOT, however, plug off any venting valves.

6.4 Step into the enclosed test room such as a closet, bathroom, or test booth, equipped with an exhaust fan. No air should be exhausted from the chamber during the test because this will dilute the ammonia challenge concentrations.

6.5 Open the container with the premeasured volume of concentrated aqueous ammonia within the enclosed test room, and pour the liquid into the empty plastic test pan. Wait two minutes to allow for adequate volatilization of the concentrated aqueous ammonia. A small mixing fan can be used near the evaporation pan to increase the evaporation rate of the ammonia solution.

6.6 After two minutes a determination of ammonia concentration within the chamber should be made using the high range colorimetric detector tube. A concentration of 1000 ppm ammonia or greater shall be generated before the exercises are started.

6.7 To test the integrity of the suit, the following four minute exercise protocol should be followed:

6.7.1 Raising the arms above the head with at least 15 raising motions completed in one minute.

6.7.2 Walking in place for one minute with at least 15 raising motions of each leg in a one-minute period.

6.7.3 Touching the toes with at least 10 complete motions of the arms from above the head to touching of the toes in a one-minute period.

6.7.4 Knee bends with at least 10 complete standing and squatting motions in a one-minute period.

6.8 If at any time during the test the colorimetric indicating paper should change colors, the test should be stopped and section 6.10 and 6.12 initiated (See §4.2).

6.9 After completion of the test exercise, the test area concentration should be measured again using the high range colorimetric detector tube.

6.10 Exit the test area.

6.11 The opening created by the suit zipper or other appropriate suit penetration should be used to determine the ammonia concentration in the suit with the low range length of stain detector tube or other ammonia monitor. The internal TECP suit air should be sampled far enough from the enclosed test area to prevent a false ammonia reading.

6.12 After the completion of the measurement of the suit interior ammonia concentration the test is concluded and the suit is doffed and the respirator removed.

6.13 The ventilating fan for the test room should be turned on and allowed to run for enough time to remove the ammonia gas. The fan shall be vented to the outside of the building.

6.14 Any detectable ammonia in the suit interior (five ppm ammonia [NH_3] or more for the length of stain detector tube) indicates that the suit has failed the test. When other ammonia detectors are used, a lower level of detection is possible, and it should be specified as the pass/fail criteria.

6.15 By following this test method, an intrusion coefficient of approximately 200 or more can be measured with the suit in a completely operational condition. If the intrusion coefficient is 200 or more,

then the suit is suitable for emergency response and field use.

7.0 – Retest procedures

7.1 If the suit fails this test, check for leaks by following the pressure test in test A above.

7.2 Retest the TECP suit as outlined in the test procedures 6.0.

8.0 – Report

8.1 Each gas-tight totally-encapsulating chemical protective suit tested by this practice shall have the following information recorded:

8.1.1 Unique identification number, identifying brand name, date of purchase, material of construction, and unique suit features; e.g., special breathing apparatus.

8.1.2 General description of test room used for test.

8.1.3 Brand name and purchase data of ammonia detector strips and color change data.

8.1.4 Brand name, sampling range, and expiration date of the length of stain ammonia detector tubes. The brand name and model of the sampling pump should also be recorded. If another type of ammonia detector is used, it should be identified along with its minimum detection limit for ammonia.

8.1.5 Actual test results shall list the two area concentrations, their average, the interior suit concentration, and the calculated intrusion coefficient. Retest data shall be recorded as an additional test.

8.2 The evaluation of the data shall be specified as "suit passed" or "suit failed," and the date of the test. Any detectable ammonia (five ppm or greater for the length of stain detector tube) in the suit interior indicates the suit has failed this test. When other ammonia detectors are used, a lower level of detection is possible and it should be specified as the pass/fail criteria.

Caution

Visually inspect all parts of the suit to be sure they are positioned correctly and secured tightly before putting the suit back into service. Special care should be taken to examine each exhaust valve to make sure it is not blocked.

Care should also be exercised to assure that the inside and outside of the suit is completely dry before it is put into storage.

Appendix B – General Description and Discussion of the Levels of Protection and Protective Gear

This appendix sets forth information about personal protective equipment (PPE) protection levels that may be used to assist employers in complying with the PPE requirements of this section.

As required by the standard, PPE must be selected which will protect employees from the specific hazards which they are likely to encounter during their work on-site.

Selection of the appropriate PPE is a complex process which should take into consideration a variety of factors. Key factors involved in this process are identification of the hazards, or suspected hazards; their routes of potential hazard to employees (inhalation, skin absorption, ingestion, and eye or skin contact); and the performance of the PPE materials (and seams) in providing a barrier to these hazards. The amount of protection provided by PPE is material-hazard specific. That is, protective equipment materials will protect well against some hazardous substances and poorly, or not at all, against others. In many instances, protective equipment materials cannot be found which will provide continuous protection from the particular hazardous substance. In these cases, the breakthrough time of the protective material should exceed the work durations.

Other factors in this selection process to be considered are matching the PPE to the employee's work requirements and task-specific conditions. The durability of PPE materials, such as tear strength and seam strength, should be considered in relation to the employee's tasks. The effects of PPE in relation to heat stress and task duration are a factor in selecting and using PPE. In some cases, layers of PPE may be necessary to provide sufficient protection, or to protect expensive PPE inner garments, suits, or equipment.

The more that is known about the hazards at the site, the easier the job of PPE selection becomes. As more information about the hazards and conditions at the site becomes available, the site supervisor must make decisions to up-grade or down-grade the level of protection to match the tasks at hand.

The following are guidelines which an employer can use to begin the selection of the appropriate PPE. As noted above, the site information may suggest the

use of combinations of PPE selected from the different protection levels (i.e., A, B, C, or D) as being more suitable to the hazards of the work. It should be cautioned that the listing below does not fully address the performance of the specific PPE material in relation to the specific hazards at the job site, and that PPE selection, evaluation and re-selection is an ongoing process until sufficient information about the hazards and PPE performance is obtained.

Part A. Personal protective equipment is divided into four categories based on the degree of protection afforded. (See Part B of this appendix for further explanation of Levels A, B, C, and D hazards.)

I. Level A – To be selected when the greatest level of skin, respiratory, and eye protection is required.

The following constitute Level A equipment; it may be used as appropriate:

1. Positive pressure, full face-piece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA, approved by the National Institute for Occupational Safety and Health (NIOSH).
2. Totally-encapsulating chemical-protective suit.
3. Coveralls.[1]
4. Long underwear.[1]
5. Gloves, outer, chemical-resistant.
6. Gloves, inner, chemical-resistant.
7. Boots, chemical-resistant, steel toe and shank.
8. Hard hat (under suit)[1].
9. Disposable protective suit, gloves and boots (depending on suit construction, may be worn over totally-encapsulating suit).

Note: [1]Optional, as applicable.

II. Level B – The highest level of respiratory protection is necessary but a lesser level of skin protection is needed.

The following constitute Level B equipment; it may be used as appropriate:

1. Positive pressure, fullface-piece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA (NIOSHA approved).
2. Hooded chemical-resistance clothing (overalls and long-sleeved jacket; coveralls; one or two-piece chemical-splash suit; disposable chemical-resistant overalls).
3. Coveralls.[1]
4. Gloves, outer, chemical-resistant.
5. Gloves, inner, chemical-resistant.
6. Boots, outer, chemical-resistant steel toe and shank.
7. Boot-covers, outer, chemical-resistant (disposable).[1]
8. Hard hat.[1]
9. [Reserved]
10. Face shield.[1]

III. Level C – The concentration(s) and type(s) of airborne substance(s) is known and the criteria for using air purifying respirators are met.

The following constitute Level C equipment; it may be used as appropriate:

1. Full-face or half-mask, air purifying respirators (NIOSH approved).
2. Hooded chemical-resistant clothing (overalls; two-piece chemical-splash suit; disposable chemical-resistant overalls).
3. Coveralls.
4. Gloves, outer, chemical-resistant.
5. Gloves, inner, chemical-resistant.
6. Boots (outer), chemical-resistant steel toe and shank.[1]
7. Boot-covers, outer, chemical-resistant (disposable).[1]
8. Hard hat.[1]
9. Escape mask.[1]
10. Face shield.[1]

IV. Level D – A work uniform affording minimal protection used for nuisance contamination only.

The following constitute Level D equipment; it may be used as appropriate:

1. Coveralls.
2. Gloves.[1]
3. Boots/shoes, chemical-resistant steel toe and shank.
4. Boot-covers, outer, chemical-resistant (disposable).[1]
5. Safety glasses or chemical splash goggles*.
6. Hard hat.[1]
7. Escape mask.[1]
8. Face shield.[1]

Part B. The types of hazards for which levels A, B, C, and D protection are appropriate are described below:

I. Level A – Level A protection should be used when:

1. The hazardous substance has been identified and requires the highest level of protection for skin, eyes, and the respiratory system based on either the measured (or potential for) high concentration of atmospheric vapors, gases, or particulates; or the site operations and work functions involve a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates or materials that are harmful to skin or capable of being absorbed through the skin;

2. Substances with a high degree of hazard to the skin are known or suspected to be present, and skin contact is possible; or

3. Operations are being conducted in confined, poorly ventilated areas, and the absence of conditions requiring Level A have not yet been determined.

II. Level B – Level B protection should be used when:

1. The type and atmospheric concentrations of substances have been identified and require a high level of respiratory protection, but less skin protection;

2. The atmosphere contains less than 19.5 percent oxygen; or

3. The presence of incompletely identified vapors or gases is indicated by a direct-reading organic vapor detection instrument, but vapors and gases are not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through the skin.

Note: This involves atmospheres with IDLH concentrations of specific substances that present severe inhalation hazards and that do not represent a severe skin hazard; or that do not meet the criteria for use of air-purifying respirators.

III. Level C – Level C protection should be used when:

1. The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect or be absorbed through any exposed skin:

2. The types of air contaminants have been identified, concentrations measured, and an air-purifying respirator is available that can remove the contaminants; and

3. All criteria for the use of air-purifying respirators are met.

IV. Level D – Level D protection should be used when:

1. The atmosphere contains no known hazard; and
2. Work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals.

Note: As stated before, combinations of personal protective equipment other than those described for Levels A, B, C, and D protection may be more appropriate and may be used to provide the proper level of protection.

As an aid in selecting suitable chemical protective clothing, it should be noted that the National Fire Protection Association is developing standards on chemical protective clothing. These standards are currently undergoing public review prior to adoption, including:

NFPA 1991 – Standard on Vapor-Protective Suits for Hazardous Chemical Emergencies (EPA Level A Protective Clothing)

NFPA 1991 – Standard on Liquid Splash-Protective Suits for Hazardous Chemical Emergencies (EPA Level B Protective Clothing)

NFPA 1993 – Standard on Liquid Splash-Protective Suits for Non-emergency, Non-flammable Hazardous Chemical Situations (EPA Level B Protective Clothing)

These standards would apply documentation and performance requirements to the manufacture of chemical protective suits. Chemical protective suits meeting these requirements would be labeled as compliant with the appropriate standard. When these standards are adopted by the National Fire Protection Association, it is recommended that chemical protective suits which meet these standards be used.

Appendix C – Compliance Guidelines

1. Occupational Safety and Health Program. Each hazardous waste site clean-up effort will require an occupational safety and health program headed by the site coordinator or the employer's representative. The purpose of the program will be the protection of employees at the site and will be an extension of the employer's overall safety and health program. The program will need to be developed before work begins on the site and implemented as work proceeds as stated in paragraph (b). The program is to facilitate coordination and communication of safety

and health issues among personnel responsible for the various activities which will take place at the site. It will provide the overall means for planning and implementing the needed safety and health training and job orientation of employees who will be working at the site. The program will provide the means for identifying and controlling worksite hazards and the means for monitoring program effectiveness. The program will need to cover the responsibilities and authority of the site coordinator or the employer's manager on the site for the safety and health of employees at the site, and the relationships with contractors or support services as to what each employer's safety and health responsibilities are for their employees on the site. Each contractor on the site needs to have his or her own safety and health program so structured that it will smoothly interface with the program of the site coordinator or principal contractor.

Also those employers involved with treating, storing, or disposal of hazardous waste as covered in Rule 29 must have implemented a safety and health program for their employees. This program is to include the hazard communication program required in Rule 29(3) and the training required in Rule 29(8) and (9) as parts of the employer's comprehensive overall safety and health program. This program is to be in writing.

Each site or workplace safety and health program will need to include the following: (1) Policy statements of the line of authority and accountability for implementing the program, the objectives of the program and the role of the site safety and health supervisor or manager and staff; (2) means or methods for the development of procedures for identifying and controlling workplace hazards at the site; (3) means or methods for the development and communication to employees of the various plans, work rules, standard operating procedures and practices that pertain to individual employees and supervisors; (4) means for the training of supervisors and employees to develop the needed skills and knowledge to perform their work in a safe and healthful manner; (5) means to anticipate and prepare for emergency situations; and (6) means for obtaining information feedback to aid in evaluating the program and for improving the effectiveness of the program. The management and employees should be trying continually to improve the effectiveness of the program thereby enhancing the protection being afforded those working on the site.

Accidents on the site or workplace should be investigated to provide information on how such occurrences can be avoided in the future. When injuries or illnesses occur on the site or workplace, they will need to be investigated to determine what needs to be done to prevent this incident from occurring again. Such information will need to be used as feedback on the effectiveness of the program and the information turned into positive steps to prevent any reoccurrence. Receipt of employee suggestions or complaints relating to safety and health issues involved with site or workplace activities is also a feedback mechanism that can be used effectively to improve the program and may serve in part as an evaluative tool(s).

For the development and implementation of the program to be the most effective, professional safety and health personnel should be used. Certified Safety Professionals, Board Certified Industrial Hygienists or Registered Professional Safety Engineers are good examples of professional stature for safety and health managers who will administer the employer's program.

2. Training. The training programs for employees subject to the requirements of paragraph (e) of this standard should address: the safety and health hazards employees should expect to find on hazardous waste clean-up sites: what monitoring procedures are effective in characterizing exposure levels; what makes an effective employer's safety and health program; what a site safety and health plan should include; hands-on training with personal protective equipment and clothing they may be expected to use; the contents of the OSHA standard relevant to the employee's duties and function; and, employee's responsibilities under OSHA and other regulations. Supervisors will need training in their responsibilities under the safety and health program and its subject areas such as the spill containment program, the personal protective equipment program, the medical surveillance program, the emergency response plan and other areas.

The training programs for employees subject to the requirements of Rule 29 of this standard should address: the employers safety and health program elements impacting employees; the hazard communication program; the medical surveillance program; the hazards and the controls for such hazards that employees need to know for their job duties and functions. All require annual refresher training.

The training programs for employees covered by the requirements of Rules 30-35 of this standard should address those competencies required for the various levels of response such as the hazards associated with hazardous substances; hazard identification and awareness; notification of appropriate persons; the need for and use of personal protective equipment including the emergency response plan; company standard operating procedures for hazardous substance emergency responses; the use of the incident command system and other subjects. Hands-on training should be stressed whenever possible. Critiques done after an incident which include an evaluation of what worked and what did not and how could the incident be better handled the next time may be counted as training time.

For hazardous materials specialists (usually members of hazardous materials teams), the training should address the care, use and/or testing of chemical protective clothing including totally encapsulating suits, the medical surveillance program, the standard operating procedures for the hazardous materials team including the use of plugging and patching equipment and other subject areas.

Officers and leaders who may be expected to be in charge at an incident should be fully knowledgeable of their company's incident command system. They should know where and how to obtain additional assistance and be familiar with local district's emergency response plan and the state emergency response plan.

Specialist employees such as technical experts, medical experts or environmental experts that work with hazardous materials in their regular jobs, who may be sent to the incident scene by the shipper, manufacturer or governmental agency to advise and assist the person in charge of the incident should have training on an annual basis. Their training should include the care and use of personal protective equipment including respirators: knowledge of the incident command system and how they are to relate to it; and those areas needed to keep them current in their respective field as it relates to safety and health involving specific hazardous substances.

Those skilled support personnel, such as employees who work for public departments or equipment operators who operate bulldozers, sand trucks, backhoes, etc., who may be called to the incident scene to provide emergency support assistance, should have at least a safety and health briefing before entering the area of potential or actual exposure. These skilled support personnel, who have not been a part of the emergency response plan and do not meet the training requirements, should be made aware of the hazards they face and should be provided all necessary protective clothing and equipment required for their tasks.

There are two National Fire Protection Association standards, NFPA 472 - "Standard for Professional Competence of Responders to Hazardous Material Incident" and NFPA 471 – "Recommended Practice for Responding to Hazardous Material Incidents," which are excellent resource documents to aid fire departments and other emergency response organizations in developing their training program materials. NFPA 472 provides guidance on the skills and knowledge needed for first responder awareness level, first responder operations level, hazmat technicians, and hazmat specialists. It also offers guidance for the officer corp who will be in charge of hazardous substance incidents.

3. Decontamination. Decontamination procedures should be tailored to the specific hazards of the site, and may vary in complexity and number of steps, depending on the level of hazard and the employee's exposure to the hazard. Decontamination procedures and PPE decontamination methods will vary depending upon the specific substance, since one procedure or method may not work for all substances. Evaluation of decontamination methods and procedures should be performed, as necessary, to assure that employees are not exposed to hazards by re-using PPE. References in Appendix D may be used for guidance in establishing an effective decontamination program. In addition, the U.S. Coast Guard's Manual, "Policy Guidance for Response to Hazardous Chemical Releases" U.S. Department of Transportation, Washington, D.C. (COMDTINST M16465.30) is a good reference for establishing an effective decontamination program.

4. Emergency response plans. States, along with designated districts within the states, will be developing or having developed local emergency response plans. These state and district plans should be utilized in the emergency response plans called for in the standard. Each employer should assure that its emergency response plan is compatible with the local plan. The major reference being used to aid in developing the state and local district plans is the

Hazardous Materials Emergency Planning Guide, NFT – 1. The current Emergency Response Guidebook from the U.S. Department of Transportation, CMA's CHEMTREC and the Fire Service Emergency Management Handbook may also be used as resources.

Employers involved with treatment, storage, and disposal facilities for hazardous waste, which have the required contingency plan called for by their permit, would not need to duplicate the same planning elements. Those items of the emergency response plan that are properly addressed in the contingency plan may be substituted into the emergency response plan required in 1910.120 or otherwise kept together for employer and employee use.

5. Personal protective equipment programs. The purpose of personal protective clothing and equipment (PPE) is to shield or isolate individuals from the chemical, physical, and biologic hazards that may be encountered at a hazardous substance site.

As discussed in Appendix B, no single combination of protective equipment and clothing is capable of protecting against all hazards. This PPE should be used in conjunction with other protective methods and its effectiveness evaluated periodically.

The use of PPE can itself create significant worker hazards such as heat stress, physical and psychological stress, and impaired vision, mobility, and communication. For any given situation, equipment and clothing should be selected that provide an adequate level of protection. However, overprotection, as well as under-protection, can be hazardous and should be avoided where possible.

Two basic objectives of any PPE program should be to protect the wearer from safety and health hazards, and to prevent injury to the wearer from incorrect use and/or malfunction of the PPE. To accomplish these goals, a comprehensive PPE program should include hazard identification, medical monitoring, environmental surveillance, election, use, maintenance, and decontamination of PPE and its associated training.

The written PPE program should include policy statements, procedures, and guidelines. Copies should be made available to all employees, and a reference copy should be made available at the worksite. Technical data on equipment, maintenance manuals, relevant regulations, and other essential information should also be collected and maintained.

6. Incident command system (ICS). Rule 31(1) requires the implementation of an ICS. The ICS is an organized approach to effectively control and manage operations at an emergency incident. The individual in charge of the ICS is the senior official responding to the incident. The ICS is not much different than the "command post" approach used for many years by the fire service. During large complex fires involving several companies and many pieces of apparatus, a command post would be established. This enables one individual to be in charge of managing the incident, rather than having several officers from different companies making separate, and sometimes conflicting, decisions. The individual in charge of the command post would delegate responsibility for performing various tasks to subordinate officers. Additionally, all communications were routed through the command post to reduce the number of radio transmissions and eliminate confusion. However, strategy, tactics, and all decisions were made by one individual.

The ICS is a very similar system, except it is implemented for emergency response to all incidents, both large and small, that involve hazardous substances.

For a small incident, the individual in charge of the ICS may perform many tasks of the ICS. There may not be any, or little, delegation of tasks to subordinate. For example, in response to a small incident, the individual in charge of the ICS, in addition to normal command activities, may become the safety officer and may designate only one employee (with proper equipment) as a backup to provide assistance if needed. OSHA does recommend, however, that at least two employees be designated as backup personnel since the assistance needed may include rescue.

To illustrate the operation of the ICS, the following scenario might develop during a small incident, such as an overturned tank truck with a small leak of flammable liquid.

The first responding senior officer would implement and take command of the ICS. That person would size-up the incident and determine if additional personnel and apparatus were necessary; would determine what actions to take to control the leak; and, determine the proper level of personal protective equipment. If additional assistance is not needed, the individual in charge of the ICS would implement actions to stop and control the leak using the fewest number of personnel that can effectively

accomplish the tasks. The individual in charge of the ICS then would designate himself as the safety officer and two other employees as a back-up in case rescue may become necessary. In this scenario, decontamination procedures would not be necessary.

A large complex incident may require many employees and difficult, time-consuming efforts to control. In these situations, the individual in charge of the ICS will want to delegate different tasks to subordinates in order to maintain a space of control that will keep the number of subordinates, that are reporting, to a manageable level.

Delegation of tasks can also be by function. Some of the functions that the individual in charge of the ICS may want to delegate at a large incident are: medical services; evaluation; water supply; resources (equipment, apparatus); media relations; safety; and, site control (integrate activities with police for crowd and traffic control). Also for a large incident, the individual in charge of the ICS will designate several employees as back-up personnel; and a number of safety officers to monitor conditions and recommend safety precautions.

Therefore, no matter what size or complexity an incident may be, by implementing an ICS there will be *one individual in charge* who makes the decisions and gives directions; and, all actions and communications are coordinated through one central point of command. Such a system should reduce confusion, improve safety, organize and coordinate actions, and should facilitate effective management of the incident.

7. Site Safety and Control Plans. The safety and security of response personnel and others in the area of an emergency response incident site should be a primary concern to the incident commander. The use of a site safety and control plan could greatly assist those in charge of assuring the safety and health of employees on the site.

A comprehensive site safety and control plan should include the following: summary analysis of hazards on the site and a risk analysis of those hazards; site map or sketch; site work zones (clean zone, transition or decontamination zone, work or hot zone); use of the buddy system; site communications, command post or command center; standard operating procedures and safe work practices; medical assistance and triage area; hazard monitoring plan (air contaminate monitoring, etc.); decontamination procedures and area; and other relevant areas. This plan should be a part of the employer's emergency response plan or an extension of it to the specific site.

8. Medical surveillance programs. Workers handling hazardous substances may be exposed to toxic chemicals, safety hazards, biologic hazards, and radiation. Therefore, a medical surveillance program is essential to assess and monitor worker's health and fitness for employment in hazardous waste operations and during the course of work; to provide emergency and other treatment as needed; and to keep accurate records for future reference.

9. New Technology and Spill Containment Programs. Where hazardous substances may be released by spilling from a container that will expose employees to the hazards of the materials, the employer will need to implement a program to contain and control the spilled material. Diking and ditching, as well as use of absorbents like diatomaceous earth, are traditional techniques which has proven to be effective over the years. However, in recent years new products have come into the marketplace, the use of which complement and increase the effectiveness of these traditional methods. These new products also provide emergency responders and others with additional tools or agents to use to reduce the hazards of spilled materials.

These agents can be rapidly applied over a large area and can be uniformly applied or otherwise can be used to build a small dam; thus improving the workers' ability to control spilled material. These application techniques enhance the intimate contact between the agent and the spilled material allowing for the quickest effect by the agent or quickest control of the spilled materials, and to do both. Some special agents, which when applied as recommended by the manufacturer, will react in a controlled manner with the spilled material to neutralize acids or caustics, or greatly reduce the level of hazard of the spilled material.

There are several modern methods and devices for use by emergency response personnel or others involved with spill control efforts to safely apply spill control agents to control spilled material hazards. These include portable pressurized applicators similar to hand-held portable fire extinguishing devices, and nozzle and hose systems similar to portable firefighting foam systems which allow the operator to apply the agent without having to come into contact with the spilled material. The operator is able to apply the agent to the spilled material from a remote position.

The solidification of liquids provides for rapid containment and isolation of hazardous substance spills. By directing the agent at run-off points or at the edges of the spill, the reactant solid will automatically create a barrier to slow or stop the spread of the material. Clean-up of hazardous substances is greatly improved when solidifying agents, acid or caustic neutralizers, or activated carbon absorbents are used. Properly applied, these agents can totally solidify liquid hazardous substances or neutralize or absorb them which then are less hazardous and easier to handle, transport, and dispose of. The concept of spill treatment, to create less hazardous substances, will improve the safety and level of protection of employees working at spill clean-up operations or emergency response operations to spills of hazardous substances.

The use of vapor suppression agents for volatile hazardous substances, such as flammable liquids and those substances that present an inhalation hazard, is important for protecting workers. The rapid and uniform distribution of the agent over the surface of the spilled material can provide quick vapor knockdown. There are temporary and long-term foam-type agents which are effective on vapors and dusts, and activated carbon absorption agents which are effective for vapor control and soaking-up the liquid. The proper use of hose lines of hand-held portable pressurized applicators provides good mobility and permits the worker to deliver the agent from a safe distance without having to step into the untreated spilled material. Some of these systems can be recharged in the field to provide coverage of larger spill areas than the design limits of a single charged applicator unit. Some of the more effective agents can solidify the liquid flammable hazardous substances and at the same time elevate that flashpoint above 140ºF so the resulting substance may be handled as a nonhazardous waste material if it meets the U.S. Environmental Protection Agency's 40 CFR part 261 requirements (See particularly §261.21).

All workers performing hazardous substance spill control work are expected to wear the proper protective clothing and equipment for the material present and to follow the employer's established standard operating procedures for spill control. All involved workers need to be trained in the established operating procedures; in the use and care of spill control equipment; and in the associated hazards and control of such hazards of spill containment work.

These new tools and agents are the things that employers will want to evaluate as part of their new technology program. The treatments of spills of hazardous substances or wastes at an emergency incident as part of the immediate spill containment and control efforts is sometimes acceptable to EPA and a permit exception is described in 40 CFR 264.1(g)(8) and 265.1(c)(11).

The Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities developed by the National Institute for Occupational Safety and Health (NIOSH), the Occupational Safety and Health Administration (OSHA), the U.S. Coast Guard (USCG), and the Environmental Protection Agency (EPA) October 1985, provides an excellent example of the types of medical testing that should be done as part of a medical surveillance program.

Appendix D – References

The following references may be consulted for further information on the subject of this standard:

1. OSHA Instruction DFO CPL 2.70 – January 29, 1986, *Special Emphasis Program: Hazardous Waste Sites.*
2. OSHA Instruction DFO CPL 2-2.37A – January 29, 1986, *Technical Assistance and Guidelines for Superfund and Other Hazardous Waste Site Activities.*
3. OSHA Instruction DFO CPL 2.74 – January 29, 1986, *Hazardous Waste Activity Form, OSHA 175.*
4. Hazardous Waste Inspections Reference Manual, U.S. Department of Labor, Occupational Safety and Health Administration, 1986.
5. Memorandum of Understanding Among the National Institute for Occupational Safety and Health, the Occupational Safety and Health Administration, the United States Coast Guard, and the United States Environmental Protection Agency, *Guidance for Worker Protection During Hazardous Waste Site Investigations and Clean-up and Hazardous Substance Emergencies.* December 18, 1980.
6. National Priorities List, 1st Edition, October 1984; U.S. Environmental Protection Agency, Revised periodically.
7. The Decontamination of Response Personnel, Field Standard Operating Procedures (F.S.O.P.) 7; U.S. Environmental Protection Agency, Office of

Emergency and Remedial Response, Hazardous Response Support Division, December 1984.

8. Preparation of a Site Safety Plan, Field Standard Operating Procedures (F.S.O.P.) 9; U.S. Environmental Protection Agency, Office of Equipment and Remedial Response, Hazardous Response, 1985.

9. Standard Operating Safety Guidelines; U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Hazardous Response Support Division, Environmental Response Team; November 1984.

10. Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Coast Guard (USCG), and Environmental Protection Agency (EPA); October 1985.

11. Protecting Health and Safety at Hazardous Waste Site; An Overview, U.S. Environmental Protection Agency, EPA/625/9 – 85/005; September 1985.

12. Hazardous Waste Sites and Hazardous Substance Emergencies, NIOSH Worker Bulletin, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health; December 1982.

13. Personal Protective Equipment for Hazardous Materials Incidents: A Selection Guide; U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health; October 1984.

14. Fire Service Emergency Management Handbook, International Association of Fire Chief's Foundation, 101 East Holly Avenue, Unit 10B, Sterling, VA 22170, January 1985.

15. Emergency Response Guidebook, U.S. Department of Transportation, Washington, DC, 1987.

16. Report to the Congress on Hazardous Materials Training, Planning and Preparedness, Federal Emergency Management Agency, Washington, DC, July 1986.

17. Workbook for Fire Command, Alan V. Brunacini and J. David Beageron, National Fire Protection Association, Batterymarch Park, Quincy MA 02269, 1985.

18. Fire Command, Alan V. Brunacini, National Fire Protection, Batterymarch Park, Quincy MA 02269, 1985.

[55 F.R. 14074, April 13, 1990]

19. Incident Command System, Fire Protection Publications, Oklahoma State University, Stillwater, OK 74078, 1983.

20. Site Emergency Response Planning, Chemical Manufacturers Association, Washington, DC 20037, 1986.

21. Hazardous Materials Emergency Planning Guide, NRT-1, Environmental Protection Agency, Washington, DC, March 1987.

22. Community Teamwork: Working Together to Promote Hazardous Materials Transportation Safety, U.S. Department of Transportation, Washington, DC, May 1983.

23. Disaster Planning Guide for Business and Industry, Federal Emergency Management Agency, Publication No. FEMA 141, August 1987.

(The Officer of Management and Budget has approved the information collection requirements in this section under control number 1218-0129).

Appendix E – Training Curriculum Guidelines

The following non-mandatory general criteria may be used for assistance in developing site-specific training curriculum used to meet the training requirements of 29 CFR 1910.120(e); 29 CFR 1910.120(p)(7), (p)(8)(iii); and 29 CFR 1910.120(q)(6), (q)(7), and (q)(8). These are generic guidelines and they are not presented as a complete training curriculum for any specific employer. Site-specific training programs must be developed on the basis of a needs assessment of the hazardous waste site, RCRA/TSDF, or emergency response operations in accordance with 29 CFR 1910.120.

It is noted that legal requirements are set forth in the regulatory text of Sec. 1910.120. The guidance set forth here presents a highly effective program that in the areas covered would meet or exceed the regulatory requirement. In addition, other approaches could meet the regulatory requirements.

Suggested General Criteria

Definitions:

"Competent" means possessing the skills, knowledge, experience, and judgement to perform assigned tasks or activities satisfactorily as determined by the employer.

"Demonstration" means the showing by actual use of equipment or procedures.

"Hands-on training" means training in a simulated work environment that permits each student to have experience performing tasks, making decisions, or using equipment appropriate to the job assignment for which the training is being conducted.

"Initial training" means training required prior to beginning work.

"Lecture" means an interactive discourse with a class lead by an instructor.

"Proficient" means meeting a stated level of achievement.

"Site-specific" means individual training directed to the operations of a specific job site.

"Training hours" means the number of hours devoted to lecture, learning activities, small group work sessions, demonstration, evaluations, or hands-on experience.

Suggested core criteria:

1. Training facility. The training facility should have sufficient resources, equipment, and site locations to perform didactic and hands-on training when appropriate. Training facilities should have sufficient organization, support staff, and services to conduct training in each of the courses offered.

2. Training Director. Each training program should be under the direction of a training director who is responsible for the program. The Training Director should have a minimum of two years of employee education experience.

3. Instructor. Instructors should be deemed competent on the basis of previous documented experience in their area of instruction, successful completion of a "train-the-trainer" program specific to the topics they will teach, and an evaluation of instructional competence by the Training Director.

Instructors should be required to maintain professional competency by participating in continuing education or professional development programs or by completing successfully an annual refresher course and having an annual review by the Training Director.

The annual review by the Training Director should include observations of an instructor's delivery, a review of those observations with the trainers, and an analysis of any instructor or class evaluations completed by the students during the previous year.

4. Course materials. The Training Director should approve all course materials to be used by the training provider. Course materials should be reviewed and updated at least annually. Materials and equipment should be in good working order and maintained properly.

All written and audio-visual materials in training curricula should be peer reviewed by technically competent outside reviewers or by a standing advisory committee.

Reviewers should possess expertise in the following disciplines where applicable: occupational health, industrial hygiene and safety; chemical/environmental engineering; employee education; or emergency response. One or more of the peer reviewers should be a employee experienced in the work activities to which the training is directed.

5. Students. The program for accepting students should include:

a. Assurance that the student is or will be involved in work where chemical exposures are likely and that the student possesses the skills necessary to perform the work.

b. A policy on the necessary medical clearance.

6. Ratios. Student-instructor ratios should not exceed 30 students per instructor. Hands-on activity requiring the use of personal protective equipment should have the following student-instructor ratios: for Level C or Level D personal protective equipment the ratio should be 10 students per instructor; for Level A or Level B personal protective equipment the ratio should be 5 students per instructor.

7. Proficiency assessment. Proficiency should be evaluated and documented by the use of a written assessment and a skill demonstration selected and developed by the Training Director and training staff. The assessment and demonstration should evaluate the knowledge and individual skills developed in the course of training. The level of minimum achievement necessary for proficiency shall be specified in writing by the Training Director.

If a written test is used, there should be a minimum of 50 questions. If a written test is used in combination with a skills demonstration, a minimum of 25 questions should be used. If a skills demonstration is used, the tasks chosen and the

means to rate successful completion should be fully documented by the Training Director.

The content of the written test or of the skill demonstration shall be relevant to the objectives of the course. The written test and skill demonstration should be updated as necessary to reflect changes in the curriculum and any update should be approved by the Training Director.

The proficiency assessment methods, regardless of the approach or combination of approaches used, should be justified, documented and approved by the Training Director.

The proficiency of those taking the additional courses for supervisors should be evaluated and documented by using proficiency assessment methods acceptable to the Training Director. These proficiency assessment methods must reflect the additional responsibilities borne by the supervisory personnel in hazardous waste operations or emergency response.

8. Course certificate. Written documentation should be provided to each student who satisfactorily completes the training course. The documentation should include:

a. Student's name.

b. Course title.

c. Course date.

d. Statement that the student has successfully completed the course.

e. Name and address of the training provider.

f. An individual identification number for the certificate.

g. List of the levels of personal protective equipment used by the student to complete the course.

The documentation may include a certificate and an appropriate wallet-sized laminated card with a photograph of the student and the above information. When such course certificate cards are used, the individual identification number for the training certificate should be shown on the card.

9. Record keeping. Training providers should maintain records listing the dates courses were presented, the name of the individual course attendees, the names of those students successfully completing each course, and the number of training certificates issued to each successful student. These records should be maintained for a minimum of five years after the date an individual participated in a training program offered by the training provider. These records should be available and provided upon the student's request or as mandated by law.

10. Program quality control. The Training Director should conduct or direct an annual written audit for the training program. Program modifications to address deficiencies, if any, should be documented, approved, and implemented by the training provider. The audit and the program modification documents should be maintained at the training facility.

Suggested Program Quality Control Criteria.

Factors listed here are suggested criteria for determining the quality and appropriateness of employee health and safety training for hazardous waste operations and emergency response.

A. Training Plan.

Adequacy and appropriateness of the training program's curriculum development, instructor training, distribution of course materials, and director student training should be considered, including:

1. The duration of training, course content, and course schedules/agendas.

2. The different training requirements of the various target populations, as specified in the appropriate generic training curriculum.

3. The process for the development of curriculum which includes appropriate technical input, outside review, evaluation, program pre-testing.

4. The adequate and appropriate inclusion of hands-on, demonstration, and instruction methods;

5. Adequate monitoring of student safety, progress and performance during the training.

B. Program management, Training Director, staff and consultants.

Adequacy and appropriateness of staff performance and delivering an effective training program should be considered, including:

1. Demonstration of the training director's leadership in assuring quality of health and safety training.

2. Demonstration of the competency of the staff to meet the demands of delivering high quality hazardous waste employee health and safety training.

3. Organization charts establishing clear lines of authority.

4. Clearly defined staff duties including the relationship of the training staff to the overall program.

5. Evidence that the training organizational structure suits the needs of the training program.

6. Appropriateness and adequacy of the training methods used by the instructors.

7. Sufficiency of the time committed by the training director and staff to the training program.

8. Adequacy of the ratio of training staff to students.

9. Availability and commitment of the training program of adequate human and equipment resources in the areas of:

a. Health effects,

b. Safety,

c. Personal protective equipment (PPE),

d. Operational procedures,

e. Employee protection practices / procedures.

10. Appropriateness of management controls.

11. Adequacy of the organization and appropriate resources assigned to assure appropriate training.

11. In the case of multiple-site training programs, adequacy of satellite centers management.

C. Training facilities and resources.

Adequacy and appropriateness of the facilities and resources for supporting the training program should be considered, including:

1. Space and equipment to conduct the training.

2. Facilities for representative hands-on training.

3. In the case of multiple-site programs, equipment and facilities at the satellite centers.

4. Adequacy and appropriateness of the quality control and evaluations program to account for instructor performance.

5. Adequacy and appropriateness of the quality control and evaluation program to ensure appropriate course evaluations, feedback, updating, and corrective action.

6. Adequacy and appropriateness of disciplines and expertise being used within the quality control and evaluation program.

7. Adequacy and appropriateness of the role of student evaluations to provide feedback for training program improvement.

D. Quality control and evaluation.

Adequacy and appropriateness of quality control and evaluation plans for training programs should be considered, including:

1. A balanced advisory committee and/or competent outside reviewers to give overall policy guidance.

2. Clear and adequate definition of the composition and active programmatic role of the advisory committee or outside reviewers.

3. Adequacy of the minutes of reports of the advisory committee or outside reviewers' meeting or written communication.

4. Adequacy and appropriateness of the quality control and evaluation program to account for instructor performance.

5. Adequacy and appropriateness of the quality control and evaluation program to ensure appropriate course evaluation, feedback, updating, and corrective action.

6. Adequacy and appropriateness of disciplines and expertise being used within the quality control and evaluation program.

7. Adequacy and appropriateness of the role of student evaluations to provide feedback for training program improvement.

E. Students

Adequacy and appropriateness of the program for accepting students should be considered, including:

1. Assurance that the student already possess the necessary skills for their job, including necessary documentation.

2. Appropriateness of methods the program uses to ensure that recruits are capable of satisfactorily completing training.

3. Review and compliance with any medical clearance policy.

F. Institutional Environment and Administrative Support.

The adequacy and appropriateness of the institutional environmental and administrative support system for the training program should be considered, including:

1. Adequacy of the institutional commitment to the employee training program.

2. Adequacy and appropriateness of the administrative structure and administrative support.

G. Summary of Evaluation Questions.

Key questions for evaluating the quality and appropriateness of an overall training program should include the following:

1. Are the program objectives clearly stated?

2. Is the program accomplishing its objectives?

3. Are appropriate facilities and staff available?

4. Is there an appropriate mix of classroom, demonstration, and hands-on training?

5. Is the program providing quality employee health and safety training that fully meets the intent of regulatory requirements?

6. What are the program's main strengths?

7. What are the program's main weaknesses?

8. What is recommended to improve the program?

9. Are instructors instructing according to their training outlines?

10. Is the evaluation tool current and appropriate for the program content?

11. Is the course material current and relevant to the target group?

Suggested Training Curriculum Guidelines

The following training curriculum guidelines are for those operating specifically identified in 29 CFR 1910.120 as requiring training. Issues such as qualifications of instructors, training, certification, and similar criteria appropriate to all categories of operations addressed in 1910.120 have been covered in the preceding section and are not re-addressed in each of the generic guidelines. Basic core requirements for training programs that are addressed include:

1. General Hazardous Waste Operations.

2. RCRA operations – treatments, storage, and disposal facilities.

3. Emergency Response.

A. General Hazardous Waste Operations and Site-specific Training.

1. Off-site training. Training course content for hazardous waste operations, required by 29 CFR 1910.120(e), should include the following topics or procedures:

a. Regulatory knowledge.

(1) A review of 29 CFR 1910.120 and the core elements of an occupational safety and health program.

(2) The content of a medical surveillance program as outlined in 29 CFR 1910.120(f).

(3) The content of an effective site safety and health plan consistent with the requirements of 29 CFR 1910.120(b)(4)(ii).

(4) Emergency response plan and procedures as outlined in 29 CFR 1910.38 and 29 CFR 1910.120(l).

(5) Adequate illumination.

(6) Sanitation recommendation and equipment.

(7) Review and explanation of OSHA's hazard-communication standard (29CFR 1910.1200) and lock-out-tag-out standard (29CFR 1910.147).

(8) Review of other applicable standards including but not limited to those in the construction standards (29 CFR Part 1926).

(9) Rights and responsibilities of employers and employees under applicable OSHA and EPA laws.

b. Technical knowledge.

(1) Type of potential exposures to chemical, biological, and radiological hazards; types of human responses to these hazards and recognition of those responses; principles of toxicology and information about acute and chronic hazards; health and safety considerations of new technology.

(2) Fundamentals of chemical hazards including but not limited to vapor pressure, boiling points, flash points, pH, other physical and chemical properties.

(3) Fire and explosion hazards of chemicals.

(4) General safety hazards such as but not limited to electric hazards, walking-working surface hazards, excavation hazards, and hazards associated with working in hot and cold temperature extremes.

(5) Review and knowledge of confined space entry procedures in 29 CFR 1910.146.

(6) Work practices to minimize employee risk from site hazards.

(7) Safe use of engineering controls, equipment, and any new relevant safety technology or safety procedures.

(8) Review and demonstration of competency with air sampling and monitoring equipment that may be used in a site monitoring program.

(9) Container sampling procedures and safeguarding; general drum and container handling procedures including special requirements for laboratory waste packs, shock-sensitive wastes, and radioactive wastes.

(10)The elements of a spill control program.

(11)Proper use and limitations of material handling equipment.

(12)Procedures for safe and healthful preparation of containers for shipping and transport.

(13)Methods of communication including those used while wearing respiratory protection.

c. Technical skills.

(1) Selection, use, maintenance, and limitation of personal protective equipment including the components and procedures for carrying out a respiratory program to comply with 29 CFR 1910.134.

(2) Instruction in decontamination programs including personnel, equipment, and hardware; hands-on training including Level A, B, and C

ensembles and appropriate decontamination lines; field activities including the donning and doffing of protective equipment to a level commensurate with the employee's anticipated job function and responsibility and to the degree required by potential hazards.

(3) Sources for additional hazard information; exercises using relevant manuals and hazard coding systems.

d. Additional suggested items.

(1) A laminated, dated card or certificate with photo, denoting limitations and level of protection for which the employee is trained should be issued to those students successfully completing a course.

(2) Attendance should be required at all training modules, with successful completion of exercises and a final written or oral examination with at least 50 questions.

(3) A minimum of one-third of the program should be devoted to hands-on exercises.

(4) A curriculum should be established for the 8-hour refresher training required by 29 CFR 1910.120(e)(8), with delivery of such courses directed toward those areas of previous training that need improvement or re-emphasis.

(5) A curriculum should be established for the required 8-hour training for supervisors. Demonstrated competency in the skills and knowledge provided in a 40-hour course should be a prerequisite for supervisor training.

2. Refresher training.

The 8-hour annual training required in 29 CFR 1910.120(e)(8) should be conducted by qualified training providers. Refresher training should include at a minimum the following topics and procedures:

(a) Review of and retraining on relevant topics covered in the 40-hour program, as appropriate, using reports by the students on their work experiences.

(b) Update on developments with respect to material covered in the 40-hour course.

(c) Review of changes to pertinent provisions of EPA or PSHA standards or laws.

(d) Introduction of additional subject areas as appropriate.

(e) Hands-on review of new or altered PPE or decontamination equipment or procedures. Review of new developments in personal protective equipment.

(f) Review of newly developed air and contaminant monitoring equipment.

3. On-site training.

a. The employer should provide employees engaged in hazardous waste site activities with information and training prior to initial assignment into their work area, as follows:

(1) The requirements of the hazard communication program including the location and availability of the written program, required lists of hazardous chemicals, and material safety data sheets.

(2) Activities and locations in their work area where hazardous substances may be present.

(3) Methods and observations that may be used to detect the presence or release of a hazardous chemical in the work area, such as monitoring conducted by the employer, continuous monitoring conducted by the employer, continuous monitoring devices, visual appearance, or other evidence (sight, sound or smell) of hazardous chemicals being released, and applicable alarms from monitoring devices that record chemical releases.

(4) The physical and health hazards of substances known or potentially present in the work area.

(5) The measures employees can take to help protect themselves from work-site hazards, including specific procedures the employer has implemented.

(6) An explanation of the labeling system and material safety data sheets and how employees can obtain and use appropriate hazard information.

(7) The elements of the confined space program including special PPE, permits, monitoring requirements, communication procedures, emergency response, and applicable lock-out procedures.

b. The employer should provide hazardous waste employees information and training and should provide a review and access to the site safety and plan as follows:

(1) Names of personnel and alternates responsible for site safety and health.

(2) Safety and health hazards present on the site.

(3) Selection, use, maintenance, and limitations of personal protective equipment specific to the site.

(4) Work practices by which the employee can minimize risks from hazards.

(5) Safe use of engineering controls and equipment available on site.

(6) Safe decontamination procedures established to minimize employee contact with hazardous substances, including:

(A) Employee decontamination,

(B) Clothing decontamination, and

(C) Equipment decontamination.

(7) Elements of the site emergency response plan, including:

(A) Pre-emergency planning.

(B) Personnel roles and lines of authority and communication.

(C) Emergency recognition and prevention.

(D) Safe distances and places of refuge.

(E) Site security and control.

(F) Evacuation routes and procedures.

(G) Decontamination procedures not covered by the site safety and health plan.

(H) Emergency medical treatment and first aid.

(I) Emergency equipment and procedures for handling emergency incidents.

c. The employer should provide hazardous waste employees information and training on personal protective equipment used at the site, such as the following:

(1) PPE to be used based upon known or anticipated site hazards.

(2) PPE limitation of materials and construction; limitations during temperature extremes, heat stress, and other appropriate medical considerations; use and limitations of respirator equipment as well as documentation procedures as outlined in 29 CFR 1910.134.

(3) PPE inspection procedures prior to, during, and after use.

(4) PPE donning and doffing procedures.

(5) PPE decontamination and disposal procedures.

(6) PPE maintenance and storage.

(7) Task duration as related to PPE limitations.

d. The employer should instruct the employee about the site medical surveillance program relative to the particular site, including:

(1) Specific medical surveillance programs that have been adapted for the site.

(2) Specific signs and symptoms related to exposure to hazardous materials on the site.

(3) The frequency and extent of periodic medical examinations that will be used on the site.

(4) Maintenance and availability of records.

(5) Personnel to be contacted and procedures to be followed when signs and symptoms of exposures are recognized.

e. The employees will review and discuss the site safety plans as part of the training program. The location of the site safety plan and all written programs should be discussed with employees including a discussion of the mechanisms for access, review, and references described.

B. RCRA Operations Training for Treatments, Storage and Disposal Facilities.

1. As a minimum, the training course required in 29 CFR 1910.120(p) should include the following topics:

(a) Review of the applicable paragraphs of 29 CFR 1910.120 and the elements of the employer's occupational safety and health plan.

(b) Review of relevant hazards such as, but not limited to, chemical, biological, and radiological exposures; fire and explosion hazards; thermal extremes; and physical hazards.

(c) General safety hazards including those associated with electrical hazards, powered equipment hazards, lock-out-tag-out procedures, motor vehicle hazards and walking-working surface hazards.

(d) Confined-space hazards and procedures.

(e) Work practices to minimize employee risk from workplace hazards.

(f) Emergency response plan and procedures, including first aid, meeting the requirements to paragraph (p)(8).

(g) A review of procedures to minimize exposure to hazardous waste and various type of waste streams, including the materials handling program and spill containment program.

(h) A review of hazard communication programs meeting the requirements of 29 CFR 1910.1200.

(i) A review of medical surveillance programs meeting the requirements of 29 CFR 1910.120(p)(3) including the recognition of signs and symptoms of overexposure to hazardous substances including known synergistic interactions.

(j) A review of decontamination programs and procedures meeting the requirements of 29 CFR 1910.120(p)(4).

(k) A review of an employer's requirements to implement a training program and its elements.

(l) A review of the criteria and programs for proper selection and use of personal protective equipment, including respirators.

(m) A review of the applicable appendices to 29 CFR 1910.120.

(n) Principles of toxicology and biological monitoring as they pertain to occupational health.

(o) Rights and responsibilities of employees and employers under applicable OSHA and EPA laws.

(p) Hands-on exercises and demonstration of competency with equipment to illustrate the basic equipment principles that may be used during the

performance of work duties, including the donning and doffing of PPE.

(q) Sources of reference, efficient use of relevant manuals, and knowledge of hazard coding systems to include information contained in hazardous waste manifests.

(r) At least 8 hours of hands-on training.

(s) Training in the job skills required for an employee's job function and responsibility before they are permitted to participate in or supervise field activities.

2. The individual employer should provide hazardous waste employees with information and training prior to an employee's initial assignment into a work area. The training and information should cover the following topics:

(a) The emergency response plan and procedures including first aid.

(b) A review of the employer's hazardous waste handling procedures including the materials handling programs and elements of the spill containment program, location of spill response kits or equipment, and the names of those trained to respond to releases.

(c) The hazardous communication program meeting the requirements of 29 CFR 1910.1200.

(d) A review of the employer's medical surveillance program including the recognition of signs and symptoms of exposure to relevant hazardous substances including known synergistic interaction.

(e) A review of the employer's decontamination program and procedures.

(f) A review of the employer's training program and the parties responsible for that program.

(g) A review of the employer's personal protective equipment program including the proper selection and use of PPE based upon specific site hazards.

(h) All relevant site-specific procedures addressing potential safety and health hazards. This may include, as appropriate, biological and radiological exposures, fire and explosion hazards, thermal hazards, and physical hazards such as electrical hazards, powered equipment hazards, lock-out-tag-out hazard, motor vehicle hazards, and walking-working surface hazards.

(i) Safe use of engineering controls and equipment on site.

(j) Names of personnel and alternates responsible for safety and health.

C. Emergency response training.

Federal OSHA standards in 29 CFR 1910.120(q) are directed toward private sector emergency responders. Therefore, the guidelines provided in this portion of the appendix are directed toward that employee population. However, they also impact, indirectly through State OSHA or USEPA regulations, some public sector emergency responders. Therefore, the guidelines provided in this portion of the appendix may be applied to both employee populations.

States with OSHA state plans must cover their employees with regulations at least as effective as the Federal OSHA standards. Public employees in states without approved state OSHA programs covering hazardous waste operations and emergency response are covered by the U.S. EPA under 40 CFR 311, a regulation virtually identical to Sec. 1910.120.

Since this is a non-mandatory appendix and therefore not an enforceable standard, OSHA recommends that those employers, employees or volunteers in public sector emergency response organizations outside Federal OSHA jurisdiction consider the following criteria in developing their own training programs. A unified approach to training at the community level between emergency response organizations covered by Federal OSHA and those not covered directly by Federal OSHA can help ensure an effective community response to the release or potential release of hazardous substances in the community.

a. General considerations.

Emergency response organizations are required to consider the topics listed in Sec. 1910.120(q)(6). Emergency response organizations may use some or all of the following topics to supplement those mandatory topics when developing their response training programs. Many of the topics would require an interaction between the response provider and the individuals responsible for the site where the response would be expected.

(1) Hazard recognition, including:

(A) Nature of hazardous substances present.

(B) Practical applications of hazard recognition, including presentations on biology, chemistry, and physics.

(2) Principles of toxicology, biological monitoring, and risk assessment.

(3) Safe work practices and general site safety.

(4) Engineering controls and hazardous waste operations.

(5) Site safety plans and standard operating procedures.

(6) Decontamination procedures and practices.

(7) Emergency procedures, first aid, and self-rescue.

(8) Safe use of field equipment.

(9) Storage, handling, use and transportation of hazardous substances.

(10) Use, care, and limitations of personal protective equipment.

(11) Safe sampling techniques.

(12) Rights and responsibilities of employees under OSHA and other related laws concerning right-to-know, safety and health, compensations and liability.

(13) Medical monitoring requirements.

(14) Community relations.

b. Suggested criteria for specific courses.

(1) First responder awareness level.

(A) Review of and demonstration of competency in performing the applicable skills of 29 CFR 1910.120(q).

(B) Hands-on experience with the U.S. Department of Transportation's Emergency Response Guidebook (ERG) and familiarization with OSHA standard 20 CFR 1910.1201.

(C) Review of the principles and practices for analyzing an incident to determine both the hazardous substances present and the basic hazard and responses information for each hazardous substance present.

(D) Review of procedures for implementing actions consistent with the local emergency response plan, the organization's standard operating procedures, and the current edition of DOT's ERG including emergency notification procedures and follow-up emergency.

(E) Review of the expected hazards including fire and explosion hazards, confined spaces hazards, electrical hazards, powered equipment hazards, motor vehicle hazards, and walking-working surface hazards.

(F) Awareness and knowledge of the competencies for the "First Responder at the Awareness Level" covered in the National Fire Protection Association's Standard No. 472, "Professional Competence of Responders to Hazardous Materials Incidents."

(2) First responder operations level.

(A) Review of and demonstration of competency in performing the applicable skills of 29 CFR 1910.120(q).

(B) Hands-on experience with the U.S. Department of Transportation's Emergency Response Guidebook (ERG), manufacturer material safety data sheets, CHEMTREC/CANUTEC, shipper or manufacturer contacts, and other relevant sources of information addressing hazardous substance releases. Familiarization with OSHA standard 29 CFR 1910.1201.

(C) Review of the principles and practices for analyzing an incident to determine the hazardous substances present, the likely behavior of the hazardous substance and its container, the types of hazardous substance transportation containers and vehicles, the types and selection of the appropriate defensive strategy for containing the release.

(D) Review of procedures for implementing actions consistent with the local emergency response plan, the organization's standard operating procedures, and the current edition of DOT's ERG including extended emergency notification procedures and follow-up communications.

(E) Review of the principles and practices for proper selection and use of personal protective equipment.

(F) Review of the principles and practices of personnel and equipment decontamination.

(G) Review of the expected hazards including fire and explosion hazards, confined spaces hazards, electrical hazards, powered equipment hazards, motor vehicle hazards, and walking-working surface hazards.

(H) Awareness and knowledge of the competencies for the "First Responder at the Operations Level" conveyed in the National Fire Protection Association's Standard No. 472, "Professional Competence of Responders to Hazardous Materials Incidents."

(3) Hazardous material technician.

(A) Review of and demonstration of competency in performing the applicable skills of 29 CFR 1910.120(q).

(B) Hands-on experience with written and electronic information relative to response decision-making including, but not limited to the U.S. Department of Transportation's Emergency Response Guidebook (ERG), manufacturer material safety data sheets, CHEMTREC/CANUTEC, shipper or manufacturer contacts, computer data bases and response models, and other relevant sources of information addressing hazardous substance releases. Familiarization with OSHA standard 29 1910.1201.

(C) Review of the principles and practices for analyzing an incident to determine the hazardous substances present, their physical and chemical

properties, the likely behavior of the hazardous substance and its container, the types of hazardous substance transportation containers and vehicles involved in the release, the appropriate strategy for approaching release sites and containing the release.

(D) Review of procedures for implementing continuing response actions consistent with the local emergency response plan, the organization's standard operating procedures, and the current edition of DOT's ERG including extended emergency notification procedures and follow-up communications.

(E) Review of the principles and practices for proper selection and use of personal protective equipment.

(F) Review of the principles and practices of establishing exposure zones, proper decontamination and medical surveillance stations and procedures.

(G) Review of the expected hazards including fire and explosion hazards, confined spaces hazards, electrical hazards, powered equipment hazards, motor vehicle hazards, and walking-working surface hazards.

(H) Awareness and knowledge of the competencies for the "Hazardous Materials Technician" covered in the National Fire Protection Association's Standard No. 472, "Professional Competence of Responders to Hazardous Materials Incidents."

(4) Hazardous materials specialist.

(A) Review of and demonstration of competency in performing the applicable skills of 29 CFR 1910.120(q).

(B) Hands-on experience with retrieval and use of written and electronic information relative to response decision-making including but not limited to the U.S. Department of Transportation's Emergency Response Guidebook (ERG), manufacturer material safety data sheets, CHEMTREC/CANUTEC, shipper or manufacturer contacts, computer databases and response models, and other relevant sources of information addressing hazardous substance releases. Familiarization with OSHA standard 29 CFR 1910.1201.

(C) Review of the principles and practices of analyzing an incident to determine the hazardous substances present, their physical and chemical properties, and the likely behavior of the hazardous substance and its container, vessel, or vehicle.

(D) Review of the principles and practices for identification of the types of hazardous substance transportation containers, vessels and vehicles involved in the release; selecting and using the various types of equipment available for plugging or patching transportation containers, vessels or vehicles; organizing and directing the use of multiple teams of hazardous material technicians and selecting the appropriate strategy for approaching release sites and containing or stopping the release.

(E) Review of procedures for implementing continuing response actions consistent with the local emergency response plan, the organization's standard operating procedures, including knowledge of the available public and private response resources, establishment of an incident command post, direction of hazardous material technician teams, and extended emergency notification procedures and follow-up communication.

(F) Review of the principles and practices for proper selection and use of personal protective equipment.

(G) Review of the principles and practices of establishing exposure zones and proper decontamination, monitoring and medical surveillance stations and procedures.

(H) Review of the expected hazards including fire and explosion hazards, confined spaces hazards, electrical hazards, powered equipment hazards, motor vehicle hazards, and walking-working surface hazards.

(I) Awareness and knowledge of the competencies for the "Off-site Specialists Employee" covered in the National Fire Protection Association's Standard No. 472, "Professional Competence of Responders to Hazardous Materials Incidents."

(5) Incident Commander.

The incident commander is the individual who, at any one time, is responsible for and in control of the response effort. This individual is the person responsible for the direction and coordination of the response effort. An incident commander's position should be occupied by the most senior, appropriately trained individual present at the response site. Yet, as necessary and appropriate by the level of response provided, the position may be occupied by many individuals during a particular response as the need for greater authority, responsibility, or training increases. It is possible for the first responder at the awareness level to assume the duties of incident commander until a more senior and appropriately trained individual arrives at the response site.

Therefore, any emergency responder expected to perform as an incident commander should be trained to fulfill the obligations of the position, at the level of

response they will be providing, including the following:

(A) Ability to analyze a hazardous substance incident to determine the magnitude of the response problem.

(B) Ability to plan and implement an appropriate response plan within the capabilities of available personnel and equipment.

(C) Ability to plan and implement a response to favorably change the outcome of the incident in a manner consistent with the local emergency response plan and the organization's standard operating procedures.

(D) Ability to evaluate the progress of the emergency response to ensure that the response objectives are being met safely, effectively, and efficiently.

(E) Ability to adjust the response plan to the conditions of the response and to notify higher levels of response when required by the changes to the response plan.

❑ MICHIGAN'S FIREFIGHTER AND EMPLOYEE RIGHT-TO-KNOW LAWS.

In 1986, the Michigan state legislature adopted two laws which require employers to provide hazard information to employees who may be exposed to hazardous substances. Under these laws, fire chiefs must provide information about hazardous substances used at the fire station, as well as information obtained from facilities within the community at large.

These two laws were adopted as amendments to the Michigan Occupational Safety and Health Act (MIOSHA) and to the Michigan Fire Prevention Code. Together, these two laws require fire chiefs to develop site-specific plans for facilities which use or produce hazardous substances. The laws also give the fire chief the authority to request the information which is needed to prepare these laws.

- **Employee Right-to-Know**

Under the Right-to-Know provision of MIOSHA, any employer, including a fire department, must develop and implement a written Hazard Communication Program. This program must be used to inform employees about the hazards of chemicals in the work place, as well as necessary precautions. For fire stations, this might include fuels, solvents, and other materials used in operations and maintenance.

The required components of a Right-to-Know include: (1) labeling of all containers of hazardous materials; (2) maintaining MSDS's for all hazardous substances; (3) providing training to all employees who may be exposed to such substances; and (4) posting notices to inform employees of their rights under the law.

- **Site-Specific Plans**

In addition to the provisions mentioned above, Section 14(i) of MIOSH requires that:

> "The chief of each organized fire department shall prepare and disseminate to each firefighting employee of the organized fire department a plan for executing the department's responsibilities with respect to each site within the organized fire department's jurisdiction where hazardous chemicals are used or produced."

While the law does not specifically address the quantities of chemicals that should be considered for planning, or define the criteria that should be included in such a plan, the State Fire Marshal's office of the Michigan Department of State Police has provided guidance in its Bulletin #33. The revised Local Emergency Planning Committee (LEPC) guidance is formatted to include firefighter right-to-know information. First responders are encouraged to coordinate planning with the LEPC

- **Fire Chief Requests for Information**

Under Section 5(p) of the Michigan Fire Prevention code, fire chiefs are given authority to request chemical information from any employers that are covered by Employee Right-to-Know. Upon written requests from a fire chief, an employer must provide:

1. A list of hazardous chemicals known to be present in the workplace.
2. An MSDS for any chemical identified on the list.
3. A description of the quantity and location of any hazardous chemical specified by the chief.

The information must be provided within 10 working days. The fire chief may grant an extension of 5 working days for quantity and location information.

To ensure that the chief has complete information, the employer must also provide a written update of the above information whenever there is a "significant change relating to fire hazards in the quantity, location or presence of new hazardous chemicals."

This section of the Fire Prevention Code does not require a fire chief to request information. However, if such information has been requested or is in the chief's possession, then a site-specific plan must be prepared. This would include any information submitted under SARA, Title III, as well as any information submitted voluntarily.

- **Office of Fire Safety Bulletin No. OFS-09**

Bulletin No. OFS-09 establishes guidelines for fire departments in the preparation of site-specific plans as required by Section 14(i) of MIOSHA. *(See Attachment H)* Specifically, the Bulletin provides guidance on:

1. Quantities of various categories of chemicals that should be reported by facilities on the Hazardous Chemical List.
2. Development of a Hazardous Chemical List.
3. Preparation of a site Map Form.
4. Preparation of a Chemical Action Sheet.

The Bulletin also recommends that as a minimum the site-specific plan should include:

1. An emergency call list with the names, addresses and phone numbers of knowledgeable persons at the site.
2. A map of the site indicating access routes, water supply, streams or bodies of water, sewers, location chemicals are stored, buildings on site, and important contiguous areas.
3. A listing of the type, location, and quantity of hazardous chemicals at the site, along with specific information concerning health and fire/explosion hazards, and emergency actions to be taken.

Bulletin OFS-09 recommends that such plans be developed in cooperation with the firm handling the hazardous chemicals, the affected police agencies, the emergency services coordinator, the local health official, and other local governmental agencies and private companies that may provide assistance during an emergency.

Completed plans must then be made available to all fire fighting employees, and training should be conducted regarding each site plan. If possible, training should include a tour of the site to acquaint each firefighter or command officer with the layout. Copies of the plans should also be available in the chief's car, command officer's car, or hazardous response vehicle.

- **Mutual Aid Agreements**

While the law only requires planning for each site within an organized fire department's jurisdiction, firefighters could be just as easily exposed to hazardous chemicals while responding to a mutual aid call from another jurisdiction. Fire chiefs should seek mutual aid agreements that establish a mechanism for the sharing of chemical information across borders.

Ideally, this could include exchange of site plans and perhaps even joint training efforts. At a minimum, it should include the notification of all hazardous materials sites for which planning is required. This could then be consulted in the event of a mutual aid response. The objective is having as much information about potential hazards as possible before a response to a hazardous materials emergency.

- **Enforcement of Right-to-Know in Michigan**

Firefighters and employee Right-to-Know provisions are enforced by two different state agencies – the Bureau of Safety and Regulation (Department of Labor) and the Division of Occupational Health (Department of Public Health).

Employees can file complaints with either agency and request an inspection of the workplace. If a written Hazard Communication Program has not been developed or implemented, or site-specific plans have not been prepared or disseminated, these agencies can issue citations. Fines may be assessed and fire departments can be ordered to take necessary corrective steps.

DIFFERENCES BETWEEN FIREFIGHTING RTK AND SARA, TITLE III

	Firefighter RTK	SARA, Title III
Reporting of Hazardous Chemicals	Chief's request	Automatic
Site Plans Required	Any site where hazardous substances are used or produced	Only sites where threshold planning quantities of certain substances
Reporting Quantities	Once chief requests, no minimum quantity	Above the TPQ or 10,000 pounds
Inventory Forms	Range of information, Chemical Action Sheet	Quantity, location, storage
Goals	Protect firefighters	Protect community
Enforcement	MIOSHA	EPA, fines up to $75,000/day

❑ MAIN POINTS

1. **SARA, Title I** *(Hazardous Waste Operations and Emergency Response Standard)* requires emergency response organizations to prepare for HAZMAT incidents by preparing plans, conducting training, and using the Incident Command System. These requirements are enforced by OSHA.

2. **SARA, Title III** *(Emergency Planning and Community Right-to-Know Act)* requires certain facilities to report information on hazardous substances to state, local governments, and fire departments. In Michigan, this information must be used by local governments in preparing emergency response plans. These provisions are enforced by EPA.

3. **Michigan Hazwoper** *(Hazardous Waste Operations and Emergency Response)* is virtually identical to OSHA 1910.120 in its requirements for planning, training, and emergency response.

4. **The Michigan Fire Fighter Right-to-Know law** requires fire chiefs to prepare site specific plans for facilities which have reported information on hazardous materials. Firefighters also have a right-to-know about substances that are used at the fire station. The law is enforced by MIOSHA.

❑ GOVERNMENT AGENCIES THAT ENFORCE EMERGENCY RESPONSE LEGAL REQUIREMENTS:

A. Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120)

Occupational Safety and Health Administration
Region V Office
230 S. Dearborn Street
Chicago, Illinois 60604
(312) 353-2220

B. Michigan HAZWOPER

Michigan Department of Public Health
3500 N. Logan Street
P.O. Box 30035
Lansing, Michigan 48909
(517) 335-8250

C. Emergency Planning and Community Right-to-Know

1. **U.S. Environmental Protection Agency**
   Region V
   230 S. Dearborn Street
   Chicago, Illinois 60604
   Region V Officer: (312)886-1964
   Hotline: 1-800-535-0202

2. **Michigan State Emergency Response Commission**
   c/o Department of Natural Resources
   P.O. Box 30028
   Lansing, Michigan 48909
   (517) 373-8481

D. Michigan Fire Fighter Right-to-Know

1. Michigan Department of Labor
   7150 Harris Drive
   P.O. Box 30015
   Lansing, Michigan 48909
   (517) 322-1814

2. Michigan State Police
   Fire Marshal Division
   7150 Harris Drive
   Lansing, Michigan 48909
   (517) 322-1924

OFFICE OF FIRE SAFETY

BULLETIN

FIRE DEPARTMENT HAZARDOUS MATERIAL EMERGENCY PLANNING RESPONSIBILITIES

Department of Consumer and Industry Services
Office of Fire Safety, P.O. Box 30070, Lansing, MI 48909

This document replaces, expands, and provides in one document a summary of the three requirements regarding emergency planning for a hazardous material incident. This bulletin was jointly developed by the Department of State Police, and former Departments of Labor and Public Health in 1987 and was revised in 1994 as a result of an Attorney General Opinion.

The three emergency planning requirements fire departments must meet are: 1) Firefighter Right-to-Know; 2) Hazardous Waste Operations and Emergency Response (HAZWOPER); and 3) Superfund Amendments and Reauthorization Act (SARA) Title III.

Each of these requirements is explained in detail below.

A. Firefighter Right-to-Know

Background:

Section 14i of Act 154, as amended, the Michigan Occupational Safety and Health Act (MIOSHA) requires that the chief of an organized fire department prepare and disseminate to each firefighter a plan for executing the department's responsibilities with respect to each site within their jurisdiction where hazardous chemicals are used or produced. There are no exemptions based on the quantity of chemical at the site. The purpose of this act is to ensure firefighter safety.

The administration and enforcement of this provision is under the joint jurisdiction of the Department of Consumer and Industry Services, General Industry Safety Division (517) 322-6353, and the Occupational Health Division (517) 335-8250.

Section 5p of the Michigan Fire Prevention Code (Act 207, as amended) requires that a firm handling a hazardous chemical provide the following information upon request of the fire chief:

A list of the hazardous chemical on site and a material safety data sheet (MSDS) for each chemical on the list.

A description of the quantity and location of any hazardous chemical specified by the fire chief after a review of the list.

Steps for Implementation:

1. As a first step, the fire chief surveys all sites within the fire jurisdiction that may have hazardous chemicals on site. The purpose of the survey is to gather information of the chemicals at each site and to determine whether the site uses or produces hazardous chemicals. The survey is used as a tool for gathering the information the chief is authorized to obtain under Act 207 as described above. A suggested letter, which the chief may send to each site, along with the survey form, is included as Attachment A. The survey form in included as Attachment B. Site location information, mailing addresses, etc., may be obtained from tax rolls, building inspectors, etc.

2. The survey form lists the chemical types and specifies quantities for each. Even though a plan is required at a site that uses or produces hazardous chemicals, regardless of quantity, the quantities at a site will determine if a site-specific plan must be developed or if the site can be addressed in a general plan. This is explained in further detail below.

3. The fire chief must make every effort to obtain completed surveys from each site. If a site refuses to cooperate, the chief should follow up with a second letter of request. A sample follow-up letter is included as Attachment C.

4. If the site continues to be uncooperative, the chief may refer the case to the Department of Consumer and Industry Services (CIS), MIOSHA. The referral form to be used by the fire chief is included as Attachment D. MIOSHA may cite the location for failure to be in compliance with the MIOSHA Hazardous Communications Standard.

5. The fire chief should keep a copy of each completed survey, even those returned showing that few or no hazardous chemicals are present at the site. In addition, the chief must keep a file of "no responses" and a file of the follow up correspondence written in an attempt to obtain a response.

6. The fire chief should have surveys on file that are not older than five years. Sites are requested to update their survey form as conditions change on the site. However, if no update has been submitted within the last five years, the chief must solicit an updated survey. Current information must be kept on file to fulfill the requirements of the law.

7. In addition, the fire chief must survey new or changed sites (change of ownership, expanded, conducting new business, etc.) as they occur. Information on new sites and additions to sites may be obtained with the assistance of the building inspector, zoning authority, tax rolls, etc.

8. When the surveys are returned, the fire chief must first separate those sites that <u>use</u> or produce hazardous chemicals from all others. These are the sites for which a plan (either site-specific or general) is required.

9. The chief must further separate the used and producer sites according to hazardous chemical quantity. For those sites which use or produce hazardous chemicals at or above the specified quantities, the fire chief must develop a <u>site-specific</u> plan. See #10 below. Other sites with hazardous chemicals under the specified quantities can be addressed by a <u>general</u> plan. See #11 below.

10. For those sites which use or produce hazardous chemicals <u>at or above</u> the specified quantities, the fire chief must develop a site-specific plan. This should be the chief's planning priority. To comply with the Firefighter Right-to-Know requirements:

a. Develop a site-specific plan for each site. See Attachment E for the list of planning elements which should be included in this plan.

b. Obtain more detailed information about each site as necessary to address the elements in Attachment E. (The survey form is used to determine the sites for which site-specific plans are necessary. Now additional information needs to be obtained for planning purposes.) The chief may request additional information under the authority of Act 207 as described above in the introduction. The chief may also use the information which is provided through the Superfund Amendments and Reauthorization Act (SARA) Title III reporting requirements. (See Section C below, starting on page 5.)

c. The Haz/Mat Response Planning Workbook (Department of State Police, Emergency Management Division publication 301), dated 1991 or later, contains worksheets and samples which may be used in developing site-specific plans. Refer to Attachment F for a matrix of planning elements cross-referenced to pages in the workbook. Copies of this workbook are available through Local Emergency Planning Committees (LEPCs). (See Section C starting on page 5.)

d. The fire chief should work with the Local Emergency Planning Committees (LEPCs) which exist within each county and in many larger municipalities. The LEPC must develop hazardous material emergency response plans for certain sites. The fire chief and the LEPC should cooperate in the development of these plans. Appropriate portions of these plans as listed in Attachment F will satisfy the Firefighter Right-to-Know requirements. (See Section C starting on page 5 for more information of LEPC requirements.)

e. Inform all firefighters of the existence of the Firefighter's Right-to-Know plans and their location. Make them available upon request.

f. Train all potentially affected firefighters in the procedures developed for responding to the specific site. These procedures should have been developed in conjunction with the site personnel and commensurate with the level of training accomplished by firefighters. (See page 26 in EMD PUB 301). In addition, the fire chief should be aware that there are other firefighter training requirements in the MIOSHA Safety Standard Part 74 (Firefighting) and MIOSHA Hazardous Waste Operations and Emergency Response Standard (HAZWOPER).

11. The fire chief can incorporate those sites which use or produce hazardous chemicals <u>below</u> the <u>specified quantities</u> into a general plan. To comply with the Firefighter Right-to-Know requirements:

    a. Maintain a current copy of all survey forms in a systematic manner.

    b. Inform firefighters of the existence of these forms and their location. Make them available upon request.

    c. Train firefighters for initial operational response, informing them of procedures found in the DOT Emergency Response Guidebook or other response plans the community has developed. In addition, the fire chief should be aware that there are other firefighter training requirements in the MIOSHA Safety Standard Part 74 (Firefighting) and MIOSHA Hazardous Waste Operations and Emergency Response Standard (HAZWOPER).

12. If a hazardous material response team is called in through a mutual aid agreement, the host fire district is obligated to provide site information to the team when en route or upon arrival at the scene. Plans do not need to be distributed to mutual aid agencies prior to responses.

13. Through these steps the fire chief has developed a plan (either general or site-specific) for those sites which use or produce hazardous chemicals as required by law. The other survey forms which show that the site is neither a user nor a producer must be retained as evidence of response. They may also be used for other local planning needs as the chief sees fit.

14. The preceding steps show how to comply with the Michigan Firefighter Right-to-Know law. (See Attachment G for a flow chart of this process.) It is not mandatory that these stops be followed. The fire chief may choose another method to comply. However, all of the elements discussed above must be included in Firefighter Right-to-Know plans.

B. Michigan Occupational Safety and Health Administration (MIOSHA) Hazardous Waste Operations And Emergency Response (HAZWOPER)

Background:

Since the enactment for the Firefighter's Right-to-Know legislation which was described above, the state and federal government have also promulgated rules to ensure firefighter and other emergency responder safety. The Superfund Amendments and Reauthorization Act (SARA) Title I requires the Occupational Safety and Health Administration (OSHA) to promulgate rules governing employer emergency planning and training for hazardous material responders. Federal OSHA final rule 29 CFR 1910.120 was promulgated in March 1990. Since Michigan is a state plan state, Michigan MIOSHA must also promulgate rules which are at least as strict as the federal rule. These Michigan regulations became effective October 31, 1991. They mirror the federal rule. The enforcement of this requirement is handled by CIS, Bureau of Safety and Regulations, Division of Occupational Health (517-335-8250).

Part of this rule requires employers to train all employees who may encounter or respond to a hazardous material incident. Certain levels of training are required depending upon the anticipated level of involvement. A uniform training curriculum has been developed and is being offered statewide. Information of these training requirements is not within the scope of this Bulletin. Contact the Department of CIS, Division of Occupational Health for more information on this topic.

Following is a summary of the planning requirements.

Steps for Implementation:

1. The rules state that any employer who may involve its personnel in a hazardous material incident must develop an emergency response plan.

2. See Attachment E for the list of planning elements which must be included in the MIOSHA plan.

3. The plan required under the MIOSHA rules and the plan required under Firefighter Right-to-Know requirements described above in Section A are both to ensure emergency responder safety. Therefore, one plan for each site can be developed to satisfy both requirements, assuming the required planning elements are included.

4. Some elements that are required in MIOSHA plans are generic and do not need to be included in site-specific plans. These general planning elements should be included in the department's internal standard operating procedures. Internal procedures should include detailed incident command system information, information on decontamination, use of personal protective gear, etc.

5. Site-specific plans and procedures must be available to firefighters through CAMEO or some other computer or microfiche system or they must be available in a hard copy file at the workstation.

6. The HazMat Response Planning Workbook described above in Section A may be used in developing site-specific plans. Refer to Attachment F for a matrix of the planning items cross referenced to pages in the workbook.

C. Superfund Amendments and Reauthorization Act (SARA) Title III.

Background:

SARA Title III federal legislation mandates that Local Emergency Planning Committees (LEPCs) be established by a state commission. The LEPC must be made up of a number of community organizations, including the fire service. These LEPCs are required to develop site-specific emergency response plans for those sites within their jurisdiction which have one or more "extremely hazardous substance" above a given threshold quantity. These plans are population protection oriented. The law states that the site owner must cooperate in the development of the plans by appointing a facility emergency coordinator and providing any information the LEPC deems is necessary in order to fulfill its planning responsibilities. Another part of the law requires the reporting of chemical inventories and the submission of MSDSs to fire departments and LEPCs. Emergency release notification requirements are also part of the law as well as community right-to-know provisions.

In Michigan, the Department of Natural Resources manages the reporting requirements and the appointment of LEPC members. The Department of State Police, Emergency Management Division, manages the planning elements of the law. For more information on SARA Title III contact either the Department of Natural Resources, Environmental Response Division at (517) 373-8481 or the Department of State Police, Emergency Management Division at (517) 334-5107.

Steps for Implementation:

1. The fire chief of the department which has jurisdiction over the site should participate within the LEPC in the development of these site-specific standard operating procedures.

2. See Attachment E for the list of planning elements which must be included in the LEPC plan.

3. By completing these procedures and distributing appropriate portions to firefighters the chief's firefighter safety requirements as described under Sections A and B above are partially satisfied. (Internal procedures and training must still be completed to fully satisfy firefighter safety requirements.)

4. The Hazardous Material Response Planning Workbook described above was developed to assist LEPCs in developing these site-specific plans. These workbooks have been distributed to LEPCs. See Attachment F for a matrix of planning items cross referenced to pages in the workbook.

5. The site-specific plans should be considered part of the all-hazard Emergency Operations Plan developed for each jurisdiction. The Emergency Operations Plan should reflect the overall policy the jurisdiction will follow when responding to an incident. All other plans and procedures would be consistent with the Emergency Operations Plan. The Emergency Management Coordinator for each jurisdiction maintains this plan.

6. The Emergency Management Coordinator appointed for each jurisdiction is also part of the LEPC and is responsible for assisting in the development of the site-specific plans.

Conclusion:

There are three emergency planning requirements: Firefighter Right-to-Know, MIOSHA rules, and SARA Title III. Each of these has been explained in the sections above. Each requires that specific items be included in plans. However, many of the required planning elements are similar or duplicated. Attachment E provides a specific listing of planning elements required under each law for informational purposes. Attachment F is a summary of the required items cross referenced to a page in the workbook on how to satisfy that item.

The fire chief can meet these requirements by developing the following documents and ensuring the required planning elements are incorporated:

1. Site-specific firefighter safety plans for all sites within the fire district which use or produce hazardous chemicals at or above the quantity specified on the survey form.

2. Good internal standard operating procedures for the department.

3. Participate with the Local Emergency Planning Committee (LEPC) in the development and completion of site-specific procedures for Title III sites.

4. Ensure that all plans are consistent with the overall policy for responding to a hazardous material incident as described in the jurisdictions' Emergency Operations plan.

5. Retain on file a copy of the survey form for all other sites.

Questions regarding this bulletin may be directed to the Office of Fire Safety (OFS) (517) 322-1123.

Please be advised that as a recipient of the OFS Bulletins you are free to treat the contents as a news release in your name to the local news media or any other means of circulation.

Attachment A

Date_____

Firm Name _____

Address _____

_____

Dear Facility Owner/Operator:

Section 14i of the Michigan Occupational Safety and Health Act (MISOHA), Act No. 154, P.A. of 1974, as amended, requires that each fire chief prepare and disseminate to each firefighter information on facilities within their jurisdiction that use or produce hazardous chemicals.

The Michigan Fire Prevention Code, Act No. 207, P.A. of 1941, as amended, requires that any firm handling hazardous chemicals provide information to the fire chief upon request. This allows the fire department to gather information on each chemical so that the requirements of MIOSHA can be met.

To assist our department in fulfilling its responsibilities under MIOSHA, we are requesting that you complete the enclosed survey. If your firm does not use or produce any hazardous chemical (see attachment definitions), you will need to complete the form. This information can be beneficial to you and your firefighting personnel when responding to a fire or other emergency at your facility.

If the information you provide indicates that your firm is a user or producer of hazardous chemicals and the chemicals on site meet or exceed the specific quantities, we will be contacting you for further information. This may include material safety data sheets (MSDS); a listing of the hazardous chemical by name, along with the greatest amount that may be located on site at one time; and the actual locations of the chemicals at your facility.

Please complete the survey and forward to (*insert your department's address)* within ten days. All surveys, including negative responses, will be kept on file for future use and to satisfy MIOSHA requirements. If there is a change concerning the use, production or quantity of hazardous chemicals at your firm in the future, please contact this department so that we may update our files.

If you have any questions, please contact (*insert name of department's contact)* at (*insert department's phone number*). Thank you for your cooperation.

_____
Fire Chief

_____
Fire Department

Attachment B – page 1

Chemical Survey

Information: This survey is requested to determine the quantity of specific chemical groups used, produced or stored in your facility. Fire Chiefs are required to collect chemical data under the Michigan Occupational Safety and Health Act (MIOSHA), P.A. 154 of 1974, as amended, and the Fire Prevention Code, PA 207 of 1941, as amended.

Instructions: Indicate below whether your site uses or produces any of the chemical types listed. Check all the categories that apply when a chemical has more than one characteristic (example: both a Class 3 flammable and Class 6 poison); see definitions. Each chemical group listed in this survey includes a specified quantity. Indicate the quantity category for each chemical group on your site. To complete this survey, you may need to reference material Safety Data Sheets, SARA Title III reporting forms, along with the attached definitions.

(Note: You must complete each line. Do not leave blanks. If you do not use a chemical group listed, mark "DO NOT HAVE" box.)

When substantial changes occur in the quantity or type of chemical use, manufacture or related storage, a revised survey must be submitted to the Fire Chief. In addition, a revised survey will be requested periodically as the Fire Chief determines necessary, but at least once every five years.

This survey may be followed up with a request for more detailed information. This may include a request for Material Safety Data Sheets, chemical lists maintained under the Employee Right-to-Know provisions of MIOSHA and other information.

Please return this questionnaire as indicated in the attached cover letter.

This site is:

- ❑ Chemical User – (Chemical used in activities on site)
- ❑ Chemical Producer – (Chemical manufactured at this site, includes packaging)
- ❑ Other – Mark this box if chemicals are stored on site, but not used or produced. Please specify (Examples: service station, retail store, storage facility).

_____

Date Completed: _____

Site Address: _____

Name of Premises: _____

Site Telephone: _____

Emergency Contacts: (Include Private Alarm/Security Companies)

Name/Title	**Business Telephone**	**Home Number**

Attachment B – page 2

Respond based on the maximum quantity you would have on-site, including storage, at any one time during the year.

Check 1 Box for Each Category				
Chemical type	**Specified quantity**	**Have at or Above Specified Quantity**	**Have but Below Specified Quantity**	**Do Not Have**
Class 1				
Explosives & Blasting Agents (Not including Class C Explosives)	Any Quantity			
Class 2				
Poison Gas	Any Quantity			
Flammable Gas	100 gal. water capacity			
Non-Flammable Gas	100 gal. water capacity			
Class 3				
Flammable Liquid	1,000 gallons			
Combustible Liquid	10,000 gallons			
Class 4				
Flammable Solid (Dangerous when wet)	100 lbs.			
Flammable Solid	500 lbs.			
Spontaneously Combustible Material	100 lbs.			
Class 5				
Oxidizer	500 lbs.			
Organic Peroxide	250 lbs.			
Class 6				
Poison	500 lbs.			
Irritating Material: Liquid	1,000 gal.			
Irritating Material: Solid	500 lbs.			
Class 7				
Radioactive Material (Yellow III Label)	Any Quantity			
Class 8				
Corrosives: Liquid	1,000 gal.			
Corrosives: Solid	500 lbs.			
No DOT Category				
Known Human Carcinogen	Any Category			

Please return within ten days to the official indicated in the cover letter attached to this survey.

Hazardous Chemical Definitions

Carcinogen – A chemical is considered to be a carcinogen if: 1) it has been evaluated by the International Agency for Research on Cancer (IARC) and found to be a carcinogen or potential carcinogen; or 2) 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 3) it is regulated by OSHA as a carcinogen.

Combustible liquid - Any liquid having a flashpoint at or above 100 degrees F (37.8 degrees C), but below 300 degrees F (93.3 degrees C), except any mixture having components with flashpoints of 200 degrees F (93.3 degrees C), or higher, the total volume of which make up 99 percent or more of the volume of the mixture.

Corrosive – liquid and solid – Any liquid that causes visible destruction or irreversible damage to human skin tissue. Also it may be a liquid that has a severe corrosion rate on steel.

Explosives and blasting agent – (not including Class C explosives) – "Explosive" means a chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature. "Blasting Agent" means a material designed for blasting. It must be so insensitive that there's very little probability of: 1) accidental explosion, or 2) going from burning to detonation.

Flammable liquid – Any liquid having a flashpoint below 100 degrees F (37.8 degrees C), except any mixture having components with flashpoints of 100 degrees F (37.8 degrees C) or higher, the total of which makes up 99 percent or more of the total volume of the mixture.

Flammable gas – A gas that can burn with the evolution of heat and a flame. Flammable compressed gas is any compressed gas of which: 1) a mixture of 13 percent or less (by volume) with air is flammable, or 2) the flammable range with air is under 12 percent.

Flammable solid – A solid, other than a blasting agent, or explosive, that is liable to cause fire through friction, absorption or moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard.

Flammable solid (dangerous when wet) – Water Reactive Material (Solid) – Any solid substance (including sludges and pastes) which react with water by igniting or firing off dangerous quantities of flammable or toxic gases. (Sec. 171.8)

Irritating material – liquid and solid – A liquid or solid substance which, upon contact with fire or air, gives off dangerous or intensely irritating fumes.

Non-flammable gas – Any compressed gas other than a flammable compressed gas.

Organic peroxide – An organic compound that contains the bivalent-0-0 structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.

Oxidizer – A chemical that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases. Example being: chlorate, permanganate, inorganic peroxide, or a nitrate that yields oxygen readily.

Poison – Less dangerous poisons, toxic – substances, liquid or solids (including pastes and semi-solids) so toxic to man that they are a hazard to health during transportation.

Poison gas – Extremely dangerous poisons, highly toxic poisonous gases or liquids – a very small amount of the gas, or vapor of the liquid, mixed with air is dangerous to life.

Radioactive material (yellow 111 label) – Any material, or combination of materials, that spontaneously gives off ionizing radiation.

Spontaneously combustible material – (Solid) – a solid substance (including sludges and pastes) which may undergo spontaneous heating or self-burning under normal transportation conditions. These materials may increase in temperature and ignite when exposed to air.

Attachment C

Date _____

Firm Name _____

Address _____

_____

Second Request

Dear Facility Owner/Operator:

The attached survey has been previously sent to your firm. To date we have not received a completed form. Please complete the survey as accurately as possible and return it to my office within ten days. Note that you must complete and return the survey even if you respond "do not have" to all categories.

Fire Chiefs are required to collect chemical data under the Michigan Occupational Safety and Health Act (MIOSHA), P.A. 154 of 1974, as amended, and the Fire Prevention Code, P.A. 207 of 1941, as amended. The information to complete this form should be readily available from your firm's records and materials you maintain for your Employee Right-to-Know Program as required by MIOSHA.

The requested information will be used to assure our firefighters are prepared for any chemical hazards they may encounter if called to your facility. It will result in increased safety for our firefighters and better fire protection for your firm.

Failure to respond to this survey may result in a referral to MIOSHA for follow-up action. A comprehensive hazard communication program is required by MIOSHA. If you have been unable to obtain Material Safety Data Sheets for chemicals used at your facility, you may contact MIOSHA for assistance.

Thank you.

Sincerely,

_____
Fire Chief

_____
Fire Department

Attachment D

Hazardous Chemical Referral
to
General Industry Safety Division
Michigan Department of Consumer and Industry Services
Bureau of Safety and Regulation
7150 Harris Drive
P. O. Box 30643
Lansing, Michigan 48909-8143

Referral From (Fire Department Name)		
Street Address, City, Zip Code		
PLEASE COMPLETE AS MUCH INFORMATION AS POSSIBLE		
Name of Employer Firm		Telephone No.
Job Site Street Address, City, Zip		
Nature of Business	SIC #	No. Of Employees
Location of Hazard If Known (Building, Floor, Dept. No., Section)		
Contact Person		Title
Exposure In Question (describe contaminant or hazards suspected)		
Remarks		
Has the firm been informed that this referral is being made?	☐ Yes	☐ No
Investigation Results and Action Taken (to be used by MIOSHA to respond to your referral)		

Signature

REQUIRED PLANNING ELEMENTS

Firefighter Right-to-Know

Each site-specific plan should include the following:

1. An emergency call list.
2. A site map. (For large sites it may be necessary to have a map for particular sections, in addition to a general map.)
3. A list of chemicals on site and their quantities.
4. A response data information sheet listing specific information about each chemical.
5. Specific response procedures for the site.
6. A description of the training necessary for responding to an incident at the site.

MIOSHA HAZWOPER

This plan must include the following:

1. Planning and coordination with outside parties.
2. Personnel roles, lines of authority, and communication.
3. Emergency recognition and prevention.
4. Safe distances and places of refuge.
5. Site security and control.
6. Evacuation routes and procedures.
7. Decontamination procedures.
8. Emergency medical treatment and first aid.
9. Emergency alerting and response procedures.
10. Critique of response and follow-up.
11. Personal protection equipment and emergency equipment.

SARA Title III

The LEPC plan must include the following (as summarized):

1. Identification of facilities subject to the emergency planning requirements and identification of transportation routes likely to be used in transporting hazardous substances.

2. Methods and procedures to be followed by facility owners and local responders.

3. Designation of a facility emergency coordinator and a community emergency coordinator.

4. Procedures for providing notification by the facility and the community emergency coordinator to emergency personnel and the public.

5. Methods for determining the occurrence of a release and the area likely to be affected.

6. A description of emergency equipment and facilities in the community and at the facility.

7. Evacuation plans.

8. Training programs.

9. Methods and schedules for exercising the plan.

Attachment F

Required Planning Elements Cross Referenced To The Haz/Mat Response Planning Workbook

Although the workbook was developed to meet SARA Title III requirements, it may be used as an example in developing other haz/mat planning documents. The agency is responsible for ensuring all necessary information pertaining to the requirement is met.

Planning Element	Firefighter RTK	OSHA	SARA Title III
Site Map	pg. 8		pg. 8
Chemical List	pg. 7		
Chemical Response Info.	pg. 9	pg. 9	
Facility Coordinator			pg. 1
Transportation Routes			pg. 3
Notification by Site			pg. 4
Facility Procedures			pg. 26
Facility Resources			pg. 20-22
Release Recognition and Prevention		pg. 10 + internal procedures	pg. 10
Emergency Call List	pg. 1, 5	pg. 1, 5	pg. 5
Personnel Roles		pg. 27 + internal procedures	
Incident Command		pg. 26-27 + internal procedures = BP51, A25*	
Personal Prot. Equip.		internal procedures	
Safe Distances		internal procedures	
Site Security		pg. 17-18	
Decontamination		internal procedures	
Medical Treatment		internal procedures + pg. 26	
Community Coordinator			pg. BP 52 *
Community Resources		pg. 23-25	pg. 23-25
Response Procedures	pg. 26	pg. 26-27	pg. 26-27
Public Warning			pg. 16
Risk Area Determination			pg. 11-12
Evacuation Plan		pg. 14-19	pg. 14-19
Critique of Response		internal procedures	
Training Programs	pg. 28-30		pg. 28-30
Exercise Schedule			pg. 31

* Located in the Local Emergency Planning Workbook (EMD PUB 201) dated Oct. 1991. (The local emergency management coordinator has this document as guidance for developing the emergency operations plan.)

Attachment G

Firefighter Right-to-Know – Steps for Implementation

Identify Commercial Establishments

Send Cover Letter (Attachment A), Survey and Definitions (Attachment B) to sites identified.

Resurvey all sites at least every five years

Sort to separate commercial sites that have marked the "other" box. Maintain file of "other" responses.

After 10 days, send second request letter (Attachment C) and duplicate survey to sites that have not responded.

Sort Remaining Responses into Three Categories:
1. Sites with Hazardous Chemicals at or above Bulletin 33 Levels
2. Sites with Hazardous Chemicals in quantities less than specified in Bulletin 33
3. Sites reporting no Hazardous Chemicals

Refer site to MIOSHA (Attachment D) if site refuses to cooperate.

Site with Hazardous Chemicals at or Above Bulletin 33:

1. Develop site-specific plan for each site (See Attachment E for list of planning elements).
2. Inform firefighters of the existence of the site-specific plans and their locations.
3. Make plans available upon request
4. Train affected firefighters in the procedures developed for responding to the specific site.

Sites with Hazardous Chemicals in Quantities Less Than Specified in Bulletin 33
Develop General Plan:
1. Completed survey.
2. Inform Firefighters of completed survey forms.
3. Make completed survey forms available to firefighters upon request.
4. Insure firefighters have appropriate training for initial operational response.
5. Maintain completed survey forms in systematic order.

Site Reporting No Hazardous Chemicals Used or Produced on Site

1. File responses as documentation that site was surveyed.

UNIT ONE: RECOGNITION

HAZARDOUS MATERIALS
OPERATIONS-LEVEL TRAINING
FOR THE FIRST RESPONDER

RECOGNIZING TERRORIST INCIDENTS

Upon completion of this unit, students will:

1. KNOW WHAT TERRORISM IS.
2. KNOW WHO MAY COMMIT ACTS OF TERRORISM.
3. RECOGNIZE SIGNS OF AN INTENTIONAL RELEASE OF HAZARDOUS MATERIALS.
4. KNOW WHAT DOT HAZARD CLASS VARIOUS AGENTS ARE IN.

❑ What is terrorism?

The Federal Bureau of Investigation has identified terrorism as:

> *The unlawful use of force or violence against persons or property to intimidate or coerce government, the civilian population, or any segment thereof in furtherance of political or social objectives.*

There is no federal statute which identifies terrorism as a crime, however individuals are usually convicted of associated acts. The FBI also seeks a conspiratorial dimension when evaluating potential terrorist events. Many hate crimes as well as attacks on abortion clinics and laboratories conducting animal experimentation are not classified as terrorist incidents.

- **Federal laws pertaining to weapons of mass destruction and terrorism include:**
  - Title 18, USC, Section 175 – 178 Biological Weapons Anti-Terrorism Act (BWAT)
  - Title 18, USC, Section 2332a Weapons of Mass Destruction

❑ Presidential Directive 39

Terrorism is more specifically defined as either domestic or international terrorism. Domestic terrorism is considered to involve groups or individuals whose terrorist activities are directed at elements of our government or population without foreign direction. International terrorism involves groups or individuals whose terrorist activities are foreign based and/or directed by countries or groups outside the United States or whose activities transcend national boundaries. Regardless of the type of terrorism, it is ultimately a crime and should be treated as such.

❑ What type of terrorist groups exist in the United States?

There have been several types of terrorist groups identified in the United States. These groups are usually distinguished by purpose and motive. These types include:

TYPE	MOTIVE
International	Politics, religion
Right wing	Anti-government
Issue specific	Culture, politics, religion
Cults	Religion
Delinquency	Anarchy, entertainment
All	Extortion, revenge, retaliation

Some types that are currently not very active include ethnic separatists and left wing radical organizations. These groups do not present as significant a threat as those identified above.

Of those classifications listed above, the international terrorist is probably the type most readily known. The United States has identified several countries to be sponsors of international terrorism, with centers located in the Middle East and areas of the Former Soviet Union. The activities of these groups usually focus on governmental ideologies. Right wing groups include organizations such as the Aryan Nations as well as some militias and survivalist groups. Many of these groups are fearful of government structure above the local level and express distrust for government organizations. Additional focus points for many include the right to bear arms and the fear of the establishment of a one-world government. Both of these types of organizations, right wing and international, may be highly trained and well organized with access to sophisticated equipment and weapons.

Issue specific groups include anti-abortion organizations, animal rights activists, and environmental extremists. Activities of this type of group generally focus on sabotage of specific targets related to the organization's professed area of interest. Cults add moral justification to the political/social mix of other groups, many times in the name of religion. Beliefs are strong and may include a justification for suicide in pursuit of their goals. Delinquency or anarchism is a less organized form of terrorism and many times may not fit the definition of terrorism at all. The activities of this type of group are normally conducted for harassment or entertainment purposes.

❑ Is terrorism a significant problem in the United States?

From 1983 to 1991, the FBI identified 101 terrorist incidents in the United States. Although approximately 60 percent of these took place in Puerto Rico, several of the rest had a devastating impact. Some of the more recent incidents include the 1993 World Trade Center bombing, the bombing of the federal building in Oklahoma City in 1995, the derailment in 1995 of an Amtrak train near Hyder, Arizona, and an explosion outside of a U.S. Forest Service office in Espanola, New Mexico in 1996. A more comprehensive list of recent terrorist related incidents is provided in Attachment A.

- **Tylenol Tampering, 1993**

  The placement of cyanide in Tylenol capsules resulted in several deaths and numerous blackmail threats of product tampering. Although this remains an unsolved crime, authorities speculate the responsible person(s) wanted to damage the drug manufacturer through loss of sales.

- **Salad Bar Salmonella, 1984**

  In 1984, the only documented biological attack in the United States occurred in Oregon when two cult members produced and dispensed Salmonella bacteria in the salad bars of local restaurants. The release was intended to affect the outcome of a local election. Over seven hundred individuals were affected.

- **World Trade Center, 1993**

  Around noon on February 26, 1993, the World Trade Center in New York City was the target of a bomb detonated in a vehicle located inside the attached parking structure. The devastating blast resulted in six persons killed, over 1,000 injured, and more than one billion dollars in economic losses. Recent evidence indicates that in addition to the ammonium nitrate explosives, the bomb contained salts of cyanide intended to be carried by the smoke and dust into the building to increase the lethality of the incident. Due to the magnitude of the explosion, the salts were incinerated in the blast.

- **Oklahoma City Federal Building, 1995**

  Just after 9 a.m. on April 19, 1995, a blast ripped through the Alfred P. Murrah Federal Building in Oklahoma City, Oklahoma. The explosion was the result of a bomb created by mixing ammonium nitrate and fuel oil, and resulted in one hundred sixty-eight people killed and hundreds more injured.

- **Hyder, Arizona Derailment, 1995**

  On October 9, 1995, an Amtrak train derailed near Hyder, Arizona, killing one and injuring seventy-eight more. Reports indicated that as many as twenty-six spikes had been removed from the railbed and warning systems disabled. Two letters were allegedly found near the site indicating the attack was a payback for Waco and Ruby Ridge, and were signed by a group called the "Sons of the Gestapo."

- **Espanola, New Mexico Explosion 1996**
  A United States Forest Service office in Espanol, New Mexico was the target of a deliberately set blast on January 6, 1996. There were no injuries however damages were estimated at $25,000. The USFS had been involved in a lengthy dispute over logging rights between environmentalists and local families.

There are just a few incidents that have occurred recently in the United States. Many terrorist related activities go unnoticed by the general public due to failure, law enforcement prevention activities, and localized impact. Most terrorist-related incidents in the United States have been bombing attacks, involving detonated and undetonated explosive devices, tear gas, and pipe as well as fire bombs.

❑ What are common characteristics of terrorist targets?

Although the number of terrorist incidents taking place throughout the world has gone down in recent years, the lethality of the incidents has increased. Along with this trend, one of the primary considerations for target selection will include areas containing a high concentration of the target population. This will especially be true in incidents involving weapons of mass destruction (WMD). Actual numbers of victims will vary depending on the device selected and the motivation of the terrorist.

Other reasons for selecting specific targets include symbolism and disruption of infrastructure. Whether obvious or not, a target may be chosen because it has a high symbolic value to either the perpetrator or the victim population. Disruption of utilities and other infrastructure components keep the incident in public view long after the actual incident.

Attacks on government facilities represent a direct retaliatory response to perceived affronts or actions taken by the government. Incidents involving industrial facilities could be due to a perceived company wrongdoing, a chance to damage the economic foundation of the area, or the facility may simply be a storage place for hazardous materials which might be released as part of the attack.

❑ Accident or Incident?

Terrorists are one of the few types of criminals that take credit for their crimes. Warnings will many times be issued prior to the incident through the placing of telephone calls to dispatch centers, targeted businesses, or emergency services organizations. If such a call is received, care should be given to ensure the accurate documentation of all pertinent information such as time of call, line received on, caller voice characteristics, and words used.

When responding to incidents, we can detect criminal or terrorist related activities by recognizing devices and equipment used to intentionally cause harm. Gas cylinders, improperly marked aerosol canisters, altered containers, and large containers of liquids in unusual places could indicate an intentional release of hazardous materials. Explosive devices could contain a mixture of hazardous substances and shrapnel or have separate containers of chemical or biological agents attached to the explosive charge. The presence of equipment and chemicals that do not match the type of occupancy of a given location or high levels of security may indicate the location of a laboratory or “safehouse.”

Other possible indicators include unusual liquids or vapor clouds as well as persons in the area complaining of similar medical problems. An unusual disease outbreak centered in a specific location with no obvious cause should alert authorities to the possibility of criminal activity. Although many materials may have warning properties such as odor, taste, color, and tearing, military style agents usually don’t.

Additional potential hazards for the first responder to be aware of include armed resistance, booby traps, secondary devices, and multiple release events. Because the WMD incident could be part of a more elaborate scheme, armed resistance is possible. Due to inexperience with triggering devices, the object may

discharge earlier than anticipated and trap terrorists at the scene. Manufacturing laboratories and safehouses are many times booby trapped. These devices may either be conventional (explosives, firearms, impalement), non-conventional (poison gases, liquids, solids), or a combination of both (infectious material on impalement weapon). A common terrorist tactic used in international incidents as well as recent attacks in the United States is the employment of secondary devices. These devices are different from multiple release events in that they are used to harm responders thereby slowing the response. Secondary devices may be either conventional or non-conventional and may not be the same as the initial device.

❑ What are weapons of mass destruction?

Weapons of Mass Destruction (WMD) include nuclear, chemical, and biological agents. Nuclear explosions release alpha, beta, gamma, or neutron radiation while producing extreme heat and over-pressurization or radiation poisoning. Chemical agents are solids, liquids, or gases which produce lethal or damaging effects on humans, plants, animals, and other materials through the chemical properties of the agent. Biological agents include any life form (bacteria, virus, etc.) or biochemical toxin which is produced by a life form, which can cause disease in man, animals, or plants and can cause the deterioration of material. The United States includes all toxins, whether extracted from biologic organisms or synthesized, as biological agents. Other governments define toxins as chemical agents.

- **Nuclear Weapons**

  Nuclear weapons are either thermonuclear or dispersal in nature. Thermonuclear devices produce extreme heat and over-pressurization as the result of nuclear fission or fusion. Dispersal devices do not undergo either nuclear fission or fusion, and do not produce nuclear explosions. Instead, radioactive material is dispersed by some other means such as conventional explosives and poses a risk of radiological exposure or ingestion of radioactive material.

- **Chemical Weapons**

  Chemical agents are usually identified by their biological impact or the target organ they attack. These materials can be divided into lethal (nerve, vesicant, lung-damaging, cyanides) and non-lethal (riot control, incapacitating) categories. Dissemination of chemical agents can be accomplished by the use of gas cylinders, explosive devices, aerosols, or placement.

  Nerve agents inhibit nerve transmissions throughout the body and are classified either as "G" or "V" series. The G series includes Tabun, Sarin, and Soman while the V series includes VX and V-sub-x. Binary agents consist of two less lethal components which combine to form one of the G or V series agents.

  Vesicants affect the eyes, lungs, and skin by destroying cell tissue. Many vesicants are insidious in action, with symptoms being delayed for up to twelve hours. There is little or no pain at the time of exposure. Common vesicants are mustard gas, lewisite, and phosgene oxime.

  Cyanides are usually absorbed into the body through respiration, although there are some notable exceptions. These compounds affect the ability of individual cells to use oxygen carried by the blood. Examples include hydrogen cyanide, cyanogen chloride, and cyanogen. Many of these materials are used in industrial processes.

  Riot control agents cause tears and intense eye pain. In high concentrations, tear compounds are irritating to the skin and cause a temporary burning or itching sensation. In a confined space, a very high concentration of these materials can be lethal.

  Lung-damaging or choking agents are compounds that injure the respiratory tract and cause the lungs to become filled with fluid, resulting in death due to the lack of oxygen. Choking agents

include phosgene, perfluoroisobutylene, and chlorine. Many of these materials are also used in industrial processes.

Incapacitating agents produce physiological or mental effects prohibiting concerted effort. The effect may persist for hours or days after exposure. Lethal agents which are incapacitating at sub-lethal doses are not classified as incapacitating agents. Examples of these agents include BZ, PCP, and LSD.

- **Toxin Weapons**

  Toxin weapon compounds are poisonous substances made by micro-organism, vegetable, or animal. These toxins cannot reproduce nor are they communicable, however some are thousands of times more lethal than nerve agents. Neurotoxins inhibit the functioning of the nervous system but may do so in a fashion different than chemical nerve agents. Although neurotoxins are effective at significantly lower concentrations than chemical nerve agents, they may take longer to manifest symptoms. Cytotoxins function by killing individual cells in the body or by inhibiting various cellular functions.

  Generally, toxins can be disseminated in the same manner as chemical agents (i.e., gas cylinders, explosive devices, aerosols, placement) but are usually not volatile and with the exception of mycotoxins do not pose a dermal risk.

- **Pathogen Weapons**

  Classes of pathogens useful as biological weapons include bacteria, viruses, rickettsiae, and fungi. Some examples of each include the following:

  - Bacteria – anthrax, tularemia, plague
  - Viruses – ebola, smallpox, rabies
  - Rickettsiae – typhus, rocky mountain spotted fever
  - Fungi – histoplasmosis, San Joanquin fever

  There are several key differences between pathogen agents and chemical/toxin agents. These include:

  - Secondary transmission may occur
  - Latent period due to incubation
  - Vaccines and treatment effective for some
  - More difficult to detect in the environment

  Dissemination of pathogen agents can include the use of low order explosive charges, aerosols, vectors, or placement. Because pathogenic agents are living organisms, the delivery system used must be capable of spreading the agent over a large area without killing the organism.

❑ Agent Classification

Although agents are classified in accordance with the DOT hazard classification system, the extent of the hazards can be deceiving, rendering this classification system insufficient for military class agents. For example, methyl isocyanate (Bhopal) has a threshold limit value (TLV) of .02 ppm whereas sarin's (Tokyo subway) TLV is .000017 ppm. Both are considered to be in hazard class 6.1 with a Packing Group. Other agents and their hazard classes are as follows:

Agent	Hazard Class
Nerve	
Tuban (GA)	6.1
Sarin (GB)	6.1
Soman (GD)	6.1
Vagent (VX)	6.1
Vesicants	
Mustard (H)	6.1
Distilled mustard (HD)	6.1
Nitrogen mustard (NM)	6.1
Lewisite (L)	6.1
Blood Agents	
Hydrogen cyanide (HC)	6.1
Cyanogen chloride (CK)	2.3
Choking Agents	
Chlorine (CL)	2.3
Phosgene (CG)	2.3
Irritants	
CS	6.1
CR	6.1
CN	6.1
OC	2.2 (sub risk 6.1)
Biological Agents/Toxins	
Anthrax	6.2
Mycotoxin	6.1 or 6.2
Plague	6.2
Tularemia	6.2

❑ Agent Detection

Currently, no real-time biological warfare (BW) detection systems are available. During the 1991 Gulf War, the United States deployed air samplers that collected and concentrated aerosol particles into a liquid suitable for testing with a small antibody-based enzymatic test kit. This rudimentary detection system took several hours to produce a result and could only determine retrospectively if a biological attack had taken place.

The M8A1 Automatic Chemical Agent Alarm electronically monitors for hazardous levels of nerve agent vapor only. This device is generally used in stationary positions. While sensitive, this alarm is also prone to false positive responses due to high concentrations of certain organic compounds such as some pesticides and vehicle exhausts.

The most widely available tool for determining the presence of chemical agent vapors is the M256A1 Chemical Agent Detector Kit used by the military. This kit contains vials of liquid chemical reagents that are combined and exposed to the air in a specific sequence to indicate the presence of hazardous levels of chemical agent vapors. The full sequence of tests requires 20-25 minutes. This kit is more sensitive to nerve

agents than the automatic alarm, and are not sensitive to the same type of interferents that can cause false alarms. This kit will detect most nerve, vesicant, and cyanide agents.

The Chemical Agent Monitor (CAM) provides a means for determining the presence of vapors emanating from localized liquid contamination. This hand-held air sampler detects and identifies select nerve and vesicant agent vapors, and depicts the degree of contamination in a rough quantitative form displayed as a bar graph.

The most prevalent detectors are the M8 and M9 treated papers, which are sensitive to droplets of liquid chemical agents. M9 paper detects all chemical agents but does not help to identify the agent present. M9 paper also reacts to many organic solvents including such things as brake fluid and insect repellants. M8 paper provides identification of select nerve and vesicant agents.

❑ Protective Equipment

The military used protective garments designed to withstand the rigors of battlefield conditions. These multi-piece suits are divided into four Mission Orientated Protective Posture (MOPP) levels and include an air purifying respirator with a hood, an adsorbent charcoal overgarment, butyl rubber gloves, and overboots. OSHA has never approved MOPP garments or military respirators for use by civilian responders. However, the following protective garments have been tested by the military to ensure protection against military chemical agents and have been approved by OSHA for use by civilian workers.

The Responder CSM garment is a single use disposable suit available in levels C through A. The material has been tested against nerve and vesicant agents, and has been approved by the Army for emergency response use at one of their chemical agent laboratories.

Trellchem HPS (Level A) and Trellchem TS (Level B) suits are reusable. These garments are equipped with ventilation, using an airline from remote air source which maintains a positive pressure in the suit, thereby improving their protection efficiency. This ensemble has been approved by the Army for routine initial entry procedures, chemical accident response assistance, and some construction activities.

Specialty Suits

The Explosive Protection Suit is capable of protecting the bomb technician from blast effects and any agents released. The suit incorporates an air filtering system to minimize potential respiratory exposure.

The Toxic Environment Protective Outfit consists of an encapsulating suit, a microclimate cooling system, a communication system, and a four-hour breathing system which can be either self contained or a supplied air system. Pending successful completion of testing, the Army plans to adopt the ensemble and begin production in late 1997.

❑ Decontamination

Military battlefield decontamination operations will decontaminate personnel and equipment only enough to enhance mission success. Residual risk may be acceptable if it does not significantly impair operations. Civilian responders however, must constantly be concerned with off-site migration of materials which may pose a risk to themselves, other responders, or the general public. Although the military uses specific decontamination agents, civilian responders are cautioned that use of these types of materials can worsen the situation if not used properly.

Civilian decontamination generally follows one of three basic pathways:

1. Copious amounts of water
2. Water and soap
3. Chemical specific solution such as bleach to neutralize cyanides*

**This method should only be used if the full nature of all chemicals is known and only one of the first two methods is not sufficient.*

Dry decontamination procedures may also be used in selected situations. Refer to the Decontamination unit in Section III for dry decon procedures.

❑ How do I decontaminate a victim?

After skin contact with a liquid chemical agent, the time available for decontamination is severely limited! Chemicals acting directly on skin (vesicants) do not have to penetrate as far as systemically active agents (nerve agents). In very general terms, agents on the surface of the skin are accessible for up to three minutes. It is recommended that skin decontamination be completed within two minutes. Agents not removed within that time continue through the various skin layers to the circulatory system in about 30 minutes. The following procedures outline the general steps to follow when decontaminating a casualty:

Remove all potentially contaminated clothing
Remove material from skin surface as quickly as possible

Wash the entire potentially exposed area with a bleach solution, avoiding contact with sensitive areas such as eyes. Local EMS protocols may prescribe specific strengths of bleach to be used, however a concentration less than 0.5% is not recommended. Response personnel should also be familiar with local or organizational procedures used to decontaminate a large number of people exposed to agents used in connection with terrorist incidents.

❑ What should be done if a terrorist incident is suspected?

If you receive a warning, locate a device which has not activated, or if a device has obviously activated, it is imperative that you notify all responding personnel of the possible involvement of a terrorist or terrorist group. This information will impact the way in which they respond.

- **Notification**

Appropriate state and federal agencies must also be notified. State agencies to be notified include the Michigan State Police Emergency Management Division and the Michigan Department of Public Health. Local health departments should also be alerted. The Federal Bureau of Investigation (FBI) has response jurisdiction over all terrorist incidents in the United States. Responsibility for consequence management of terrorist incidents has been assigned to the Federal Emergency Management Agency (FEMA). These agencies will coordinate their response with other organizations needed to successfully deal with each incident.

- **Security**

The area around the incident must be isolated and secured for several reasons:

1. Potential for the presence of hazardous materials
2. Possibility of armed terrorist group members in the area
3. Potential for secondary devices
4. Crime scene preservation

Local agencies identified in current response plans may be utilized for scene security.

- **Secondary device search**

Because terrorists many times place secondary (and possibly tertiary) devices to disrupt evacuations and to target first responders, it is imperative that consideration be given to the possible presence of such devices. If possible, a search should be conducted to locate any devices that have not activated. If such a device is located, notify the incident commander who will seek expert assistance. DO NOT attempt to move or disarm the device.

- **Medical Assistance**

Whenever an incident is identified as terrorist in nature, medical assets should be alerted and provided all information necessary to deal with potentially contaminated patients and other casualties. In incidents involving weapons of mass destruction, medical facilities can be quickly overwhelmed.

- **Document everything**

The area impacted by an act of terrorism becomes a crime scene. The smallest pieces of evidence may provide a clue needed to identify the agent(s) released, the design of the device, the nature of the terrorist organization, or the identity of the actual perpetrator. Successful prosecution depends on evidence protection and documentation. All on-scene methods employed to identify the WMD agent(s) used, must be recorded and results documented as potential evidence. Dual samples should be taken and one retained for evidence. All samples must follow strict chain-of-custody protocol to ensure validity of laboratory results.

- **Safety Considerations**

A site safety plan must be developed to cover all known or potential risks as a result of a terrorist act. Pertinent information contained in the plan needs to be communicated to all responders in a safety briefing. The safety plan must deal with citizen volunteers, both official and unofficial, as well as the risk of additional attacks. Safety zones as identified in the plan should be established after giving consideration to the possibility of additional devices and unexpected migration of hazardous materials.

- **Who can I tell?**

There are several operational resources available to the first responder during a response to an incident involving terrorist related activities. Once a state of emergency is declared, the Michigan State Police Emergency Management Division can coordinate state resources such as special response equipment, National Guard, and additional police and fire personnel.

Wayne County has formed a Technical Support Team capable of assisting local responders by providing specialized information on chemical and biological agents. Although the team may not be available to physically respond to all incidents, team members will provide as much technical assistance to the incident commander as possible.

Metropolitan Medical Strike Teams are being formed by the federal government over the next five years in 127 key cities. Michigan cities slated to host teams include Detroit and Grand Rapids. These teams are to provide a rapid response to deal with medical aspects of an event involving weapons of mass destruction. Detroit's team is expected to be active by the end of 1997 with Grand Rapids to follow within the next five years.

The Army Chemical and Biological Defense Command (CBDCOM) can provide access to Army medical, scientific, and response experts who can assist the incident commander in dealing with the release of a military type of chemical or biological agent.

Army Technical Escort units are stationed in Maryland, Arkansas, and Utah. These units are responsible for ensuring safe transport of military chemical, biological, and nuclear materials, and dealing with transportation incidents involving these agents.

The Centers for Disease Control Emergency Response group can provide technical assistance, including epidemiological, and can be on scene within 8 hours.

❑ Contact Numbers

- FBI (Detroit) 313-965-2323
- MSP Special Ops 517-336-6604
- DEQ PEAS 800-292-4706
- U.S. EPA Region V 312-353-2318
- NRC 800-424-8802
- CBDCOM 410-671-4411
- CDC 404-488-7100

CHEMICAL AND RADIATION HAZARDS, AND PESTICIDE RECOGNITION

Upon completion of this unit, students will:

1. UNDERSTAND SELECTED CHEMICAL AND PHYSICAL PROPERTIES.

2. DESCRIBE VARIOUS CHEMICAL REACTIONS.

3. DEFINE THE FOLLOWING TERMS:

A) ACID, BASE, pH
B) REACTIVITY
C) OXIDIZER
D) VOLATILITY
E) BOILING POINT
F) FLASH POINT
G) CORROSIVE
H) FLAMMABILITY
I) DENSITY
J) SPECIFIC GRAVITY
K) VAPOR DENSITY
L) VISCOSITY
M) MISCIBILITY
N) ALPHA, BETA, & GAMMA RADIATION

4. DESCRIBE THE PROPER PROTECTIVE ACTIONS FOR RADIATION INCIDENTS.

5. GIVEN A PESTICIDE, LABEL, IDENTIFY AND EXPLAIN THE SIGNIFICANCE OF THE FOLLOWING:

   A) Name of Pesticide
   B) Signal Word
   C) EPA Registration Number
   D) Precautionary Statement
   E) Hazard Statement
   F) Active Ingredient

❑ Review of the Basic Principles of Chemistry

First Responders Operations must be familiar with some of the fundamental principles of chemistry as an aid in understanding and predicting chemical reactions in a HazMat incident. The information in this unit is very general. Remember, the greater the knowledge of the specific characteristics of a particular chemical, the less likely First Responders Operations personnel will be to take inappropriate actions that may endanger health and safety. A number of general chemistry concepts will play an important role in the evolution of a HazMat incident.

❑ GENERAL PRINCIPLES

❑ STATES OF MATTER

All elements exist in nature in one of three states of matter: solid, liquid, or gas. Almost all substances change from one state to another when the temperature or pressure applied to that substance is altered. The change in temperature and/or pressure either compresses the substance's molecules or allows them to expand. As a substance changes from solid to the liquid state and then to the gaseous state, the molecules move more rapidly and further apart.

- **Solids**

A solid is a substance that retains a definite size and shape under normal conditions. When most solids melt, they change to liquid. The temperature at which this occurs is called the melting point (m.p.). When solids change directly to gas, the process is called sublimation.

- **Liquids**

A liquid is a substance that flows easily and has a specific volume but no specific shape. When liquids freeze, they become solids. The temperature at which liquid freezes is called the freezing point (f.p.). When liquids change to gas, they "vaporize". The temperature at which this change occurs is called the boiling point (b.p.).

- **Gases**

A gas is a substance that expands or is compressed readily and has no independent shape or volume. Gases may condense to form liquids; this change occurs when a gas is cooled to its b.p. (Substances that occur naturally as gases have lower boiling points when compared to those that occur naturally as solids and liquids.).

- **Specific Gravity**

Specific gravity is a concept used to measure the weight of solids and liquids in comparison to water. Water has a specific gravity of one; therefore, solids and liquids that are heavier than water have specific gravities greater than one. Similarly, solids and liquids that are lighter than water have specific gravities less than one.

Specific gravity has no unit of measure. It is only a relative value (relative to water). Knowing the specific gravity of a substance will indicate whether a substance will sink or float in water.

- **Vapor Density**

Vapor density is a similar concept used to measure the weight of gases in comparison to air. Air has a vapor density of one (1). Therefore, vapors with a density less than one are lighter than air and will rise. Those with vapor density greater than one will sink and gather in low-lying areas or close to the ground. This principle has major implications for sampling the air, determining safest areas during an emergency and predicting how the gas will spread.

EXAMPLE:
Lancaster, Pennsylvania, 1981
An eight-year-old boy climbed into an abandoned septic tank in his yard to retrieve a lawnmower grasscatcher. Grass clippings have been dumped into the septic tank for years. The boy is overcome by gas produced by decomposition of the clippings. Two EMT's and one Firefighter are overcome by the gas and die attempting a rescue. The boy is eventually pulled to safety.

❑ TEMPERATURE

Temperature plays a very important role in both firefighting and response to Hazmat incidents because it can affect the nature of a chemical reaction. Three different scales are used to measure temperature: Centigrade, Fahrenheit, and Kelvin. The first two scales are used in everyday life and appear in reference textbooks and chemical databases. The Kelvin scale is used primarily in technical and scientific settings.

Centigrade (C) (sometimes called Celsius) is the scale on which water boils at 100º and freezes at 0º. To convert ºF to ºC, use this formula ºF = 9/5ºC+32.

Fahrenheit (F) is a scale used to measure temperature. On this scale, water boils at 212º and freezes at 32º. To convert ºF to ºC, subtract 32 and multiply by 5/9. (For example: 212ºF-32=180, 180x5/9=100ºC.)

Kelvin (K) is also referred to as the absolute temperature scale. Zero degrees (0º) on this scale is the point at which all molecular movement stops and there is an absence of any heat. On the Kelvin scale, water freezes at +273º and boils at +373º.

- **Comparison of thermometric scales:** Because three scales exist, it is extremely important to know which scale was used to measure a temperature.

❑ CHEMICAL REACTIONS

Chemical reactions occur when two or more substances come in contact with one another and energy is either absorbed or released. Polymerization, condensation, combustion, and ionization are examples of chemical reactions. The rate at which chemical reactions occur depends on a number of factors, including:

- Physical and chemical characteristics
- Temperature
- Concentration
- Pressure
- Catalysts present
- Amount of product involved

The physical characteristics that influence the rate of reaction include surface area (the greater the area of contact, the faster the reaction).

Increasing temperature and concentration usually increase the rate of the reaction. Pressure is not as predictable. The greatest influence of pressure is on gases and vapors. As pressure increases, the volume of a gas is decreased, thereby increasing the content per volume and increasing the rate of reaction. This is similar to increasing the concentration of a substance.

A catalyst is a substance that increases the rate of a chemical reaction, but is not changed by the reaction. (It is consumed in one part of the reaction and reproduced in its original form in another.) A substance that interferes with the action of a catalyst is called an inhibitor. An example is tetra-ethyl lead, added to gasoline to ensure that the air-gas mixture does not ignite before it should.

- **What is a chemical reaction**

When molecules of two compounds meet each other, they sometimes rearrange their patterns of connected atoms to form new compounds, frequently with the release of heat. This is happening in a flame of burning hydrogen. Air is a mixture of about 21% oxygen and 79% nitrogen. Atoms of hydrogen are combining violently in the flame with atoms of oxygen to produce molecules of water. If we hold a cold mirror above the flame, we can see the steam condensing. Such arrangements are called chemical reactions. Burning is a chemical reaction involving oxygen with release of much heat.

- **Why are chemical reactions important to the first responder?**

Some reactions can be dangerous when the chemicals involved are said to be incompatible. For example, mixing hydrochloric acid and lye (sodium hydroxide) will produce a violent reaction, which can generate enough heat to spatter these dangerous materials.

- **What is happening when something explodes?**

Some chemical reactions produce gas from solid or liquid materials. We are all familiar with the bubbling from a tablet of Alka Seltzer dropped into a glass of water. There are two chemicals mixed together in a tablet that react when wetted to produce carbon dioxide gas (CO_2). When the reaction between the ingredients of blasting powder is started with a spark or shock, a violent generation of heat and gas can shatter rocks or a bomb or shell casing. In this mixture, one compound that can burn reacts with another called an oxidizer, which takes the place of the oxygen in air. Nitrates, perchlorates, and peroxides are oxidizers. All the necessary ingredients are in some single compounds such as TNT, in which the atoms can rearrange to produce gas very suddenly in an explosion. Fuels such as gasoline are mixtures of compounds of hydrogen and carbon. When their vapors are mixed with air in the right proportions they can react similarly with oxygen to produce steam and carbon dioxide in a violent explosion. Combustible dusts such as grain dust in a grain elevator also can explode. An explosion is simply a very rapid chemical reaction producing much gas and heat.

SAMPLE CHEMICAL CHARACTERISTICS

Name	Flammable Range	Flash Point	Boiling Point	Auto Ign. Temperature
Acetylene	2.5% 100%	Gas	-119º	581º
Acetone	2.6% 12.8%	0º	133º	869º
Isopropyl Alcohol	2.3% 12.7%	53º	180.1º	750º
Gasoline	4% 12%	-40º		
Methyl Ethyl Ketone	1.8% 11.5%	20º	175.3º	961º
Propane	2.1% 9.5%	-156º	-43.8º	842º
Kerosene	.7% 5%	100º	392º 500º	444º
Toluene	1.27% 7%	40º	231º	997º
Xylene	1% 1.1%	81º 90º	281º	---------

- **Two deadly gases generated from incompatible chemicals**

There are other incompatible chemicals that generate poisonous gases when mixed. Hydrogen cyanide (HCN) is a deadly gas with an almond smell. It is used in gas chambers to execute criminals, or to fumigate buildings. It is produced when sodium cyanide (NaCN) (a solid) reacts with sulfuric (or any other) acid.

$$H_2SO + 2\ NaCN \rightarrow 2\ HCN\uparrow + Na_2SO$$

In this reaction, the upward arrow after the HCN indicates that this product may escape from the mixture as a gas. In the reaction, the hydrogen and sodium trade places. Sodium cyanide is also a very poisonous chemical and is dissolved in water with other ingredients in many metal plating baths. Another deadly gas is hydrogen sulfide (H_2S), which smells like rotten eggs, and can be produced by a similar reaction:

$$H_2SO + Na_2S \rightarrow 2\ HCN + Na_2SO$$

Sodium sulfide, itself, also is poisonous.

- **What can happen when water reactive chemicals are wetted?**

There is a group of chemicals that react violently with water. Adding water to concentrated sulfuric acid (or oleum) can generate so much heat that the mixture boils and splatters. Another example of violent mixing is adding water to solid hydroxide (or to a concentrated solution). In these cases, there is simple mixing but not a chemical reaction producing new compounds. An example of the latter if the fire or explosion produced when sodium metal meets water:

$$2\ H_2O + 2\ Na \rightarrow H_2 + 2\ NaOH$$

In this reaction, more active sodium replaces one hydrogen in the water molecule. The hydrogen is a flammable gas, which may catch fire or explode from the heat of the reaction.

❑ Boiling Liquid Expanding Vapor Explosion (BLEVE)

A Boiling Liquid Expanding Vapor Explosion is commonly defined as a container rupture caused by heat. When a container is heated below the level of the liquid, that heat is absorbed into the liquid, causing the liquid to boil. If the container, such as a tank car, is equipped with a safety valve system, the building up of pressure will result in product vapor being released through the valve.

As vapors are released, the contents of the tank are cooled and the wetted surface of the tank is reduced. If the source of heat continues to impinge on the container, it will eventually begin heating the metal surface that is not in contact with the liquid. The vapor behind the metal surface cannot remove the heat as fast as the liquid, and the tank shell heats up, losing it's strength. When the strength of the metal is reduced enough, the tank shell will tear open. The tank will break up more or less violently depending on how much product is left.

A BLEVE may also result from impact of containers, especially those containing liquefied gases. For example, the volume of propane as a gas is 270 times greater than the volume as a liquid. If a propane tank is ruptured, rapid vaporization of the liquid would take place because the temperature outside the tank would be greater than the boiling point. This could result in an explosion that fragments the container violently.

A BLEVE can be prevented in a number of different ways. First and most importantly, the source of ignition should be removed to prevent the heating of the tank or container. Second, water can be applied at 500 gallons per minute with an unmanned nozzle to keep the container cooled. In situations where massive amounts of water cannot be applied, such as in incidents on isolated transportation routes, the area may have

to be evacuated as the container is allowed to burn. Although property may be destroyed, lives may be saved.

❑ What effects do surface area, boiling point, and flash point have on burning rate?

- **Surface Area**

  In a flame, a chemical reaction is taking place between the burning material and the oxygen part of the air. The more surface that is exposed to air, the faster the reaction can proceed. In a lump of burning coal, only the surface is combining with oxygen and generating heat. If we powder the coal fine enough and dust it into the air the reaction can speed up to the point of explosion. Similarly cold gasoline liquid can burn quietly. But if it heats up and generates vapor the reaction can increase to explosive speed. Kerosene and heavier oils are less volatile, and thus safer. Volatility refers to how readily a material will vaporize or evaporate hence increasing surface area.

- **Boiling Point**

  The boiling point is the temperature at which a liquid changes into vapor, and thus is a measure of the volatility of the fuel. The spark that starts the flame or explosion simply heats up a tiny portion until the reaction starts. This generates enough additional heat (the flame) to spread the reaction.

- **Flash Point**

  The minimum temperature at which a liquid gives off enough vapors that will ignite and flash-over but will not continue to burn without the addition of more heat.

❑ **What is the meaning of acid, base, pH, and neutralization?** *(Condensed Chemical Dictionary)*

Acid						Neutral				Alkali/Base/Caustic			
1	2	3	4	5	6	7	8	9	10	11	12	13	14

- **Acid**

  One of a large class of chemical substances whose water solutions have one or more of the following properties: sour taste, ability to make litmus dye turn red and to cause other indicator dyes to change to characteristic colors, ability to react with and dissolve certain metals to form salts, and ability to react with bases or alkalies to form salts. All acids contain hydrogen. In water, ionization or splitting of the molecule occurs so that some or most of this hydrogen forms H_3O^+ ions (hydronium ions), usually written more simply as H^+ (hydrogen ion).

  Acids are referred to as strong or weak according to the concentration of H^+ ions that results from ionization. Hydrochloric, nitric, and sulfuric are strong or highly ionized acids; acetic acid (CH_3COOH) and carbonic acid (H_2CO_3) are weak acids. Tenth normal hydrochloric acid is 100 times as acid (pH=1) as tenth normal acetic acid (pH=3). The pH range of acids is from 6.9 to 1.

- **Neutral**

  A chemical reaction in which water is formed by mutual interaction of the ions that characterize acids and bases when both are present in an aqueous solution, i.e., $H^+ + OH^- \rightarrow H_2O$, the remaining product being a salt. R.T. Sanderson states: " An aqueous solution containing an excess of hydronium ions is called acidic. It readily releases protons to electron-donating substances. An aqueous solution containing an excess of hydroxyl ions is called basic. It readily accepts protons from substances that can release them and is in general an excellent donor. No aqueous solution can contain an excess of both hydronium and hydroxyl ions, because when these ions collide, a proton is immediately transferred from the hydronium to the hydroxyl ion, and both become water molecules."

  Neutralization occurs with both (1) inorganic and (2) organic compounds: (1) $Ca(OH)_2 + H_2SO_4 \rightarrow CASO_4 + 2H_2O$; (2) $HCOOH + NaHCO_3 \rightarrow HCOONa + CO_2 + H_2O$. It should be noted that neutralization can occur without formation of water, as in the reaction $CaO + CO_2 \rightarrow CaCO_3$. Neutralization does not mean that attaining of pH 7.0; rather it means the equivalence point for an acid-base reaction. When a strong acid reacts with a weak base, the pH will be less than 7.0, and when a strong base reacts with a weak acid, the pH will be greater than 7.0.

- **Alkali/Base/Caustic**

  Any of a large class of compounds with one or more of the following properties: bitter taste, slippery feeling in solution, ability to turn litmus blue and to cause other indicators to take on characteristic colors, ability to react with (neutralize) acids to form salts. Included are both hydroxides and oxides of metals.

  Water-soluble hydroxides such as sodium, potassium, and ammonium hydroxide undergo ionization to produce hydroxyl ion (OH^-) in considerable concentration, and it is this ion that causes the previously mentioned properties common to bases. Such a base is strong or weak according to the fraction of the molecules that breaks down (ionizes) into positive ion and hydroxyl ion in the solution. Base strength in solution is expressed by pH. Common strong bases (alkalies) are sodium and potassium hydroxides, ammonium hydroxide, etc. These are caustic and corrosive to skin, eyes, and mucous membranes. The pH range of basic solutions is from 7.1 to 14.

❑ What class of chemicals corrode metals?

Acids are capable of reacting with metal to produce pits and holes. This is called corrosion. This also may occur more slowly by reaction of the metal with oxygen, sometimes helped my moisture. Strong acids must be kept in special containers that can resist corrosion. If hydrochloric acid were kept in an ordinary steel drum, it would quickly eat a hole in the metal and leak out. The reaction is:

$$2\ HCl + Fe - H_2 + FeCl$$

The reactive hydrogens are replaced by the more reactive iron to produce FeCl (ferrous chloride). This is a soluble powder that replaces the steel and thus a hole is formed. Escape of acids or acid mists or gases can cause corrosion of cars and structures as well as injury to eyes, lungs, teeth, and damage to clothing. Chemicals that destroy the skin, such as concentrated sulfuric or nitric acid and lye (which is a strong base) also are called corrosives.

❑ What are some physical properties of chemicals and why are they important to understand?

There are a number of important physical properties that we should understand to assist us in assessing hazards and determining risks.

Autoignition point is the minimum temperature required to cause self-sustained combustion in any substance in the absence of a spark or flame.

Flammable or Explosive Limit refers to the range of vapor concentrations that will burn or explode if a source of ignition is present. LEL stands for lower explosive limit and UEL for upper explosive limit. Air concentrations that fall between the LEL and UEL can lead to fires and explosions.

Solubility is the ability or tendency of one substance to blend uniformly with another, for example solids in liquids, liquids in liquids, gases in liquids, or gases in gases. Liquids and gases are often said to be miscible in other liquids and gases, rather than soluble.

Vapor pressure tells how readily something evaporates, making it airborne and available to be inhaled. Liquid materials that evaporate easily are considered volatile liquids. This means that air concentrations can build up quickly even though the substance is in a liquid form. Liquids with high vapor pressures may be especially hazardous in enclosed or confined spaces.

Viscosity is how thick or runny a liquid is. Tar and molasses have high viscosities. Water and alcohol have low viscosities.

❑ RADIATION PRINCIPLES

- **Definitions**

Atoms are building blocks of matter. The atomic structure has a dense center nucleus surrounded by electron cloud.

Nuclear radiation occurs when the forces of the dense center are unbalanced. The unstable center breaks apart, emitting energy and particles.

Gamma defined means most of the energy released in radioactive decay is in wave form.

Beta defined means very small particles are emitted in radioactive decay.

Alpha defined means larger particles are emitted in radioactive decay.

- **The Nature of Radiation**

Radiation interacts with other atoms in the environment. The radiation affects the electron cloud of other atoms causing a chemical change. This interaction:

1. Destroys living tissue
2. Affects electronic equipment
3. Does not affect inert materials (i.e., earth, wood, concrete, food)
4. Does not make other material radioactive

- **Characteristics of Radiation**

A. Alpha

1. Travels a few inches in air.
2. Is stopped (shielded) by a piece of paper.
3. Does not penetrate the skin or clothing.
4. Does not penetrate shipping containers.
5. Is dangerous only if source material is consumed or inhaled.

B. Beta

1. Travels a few feet in air.
2. Is stopped (shielded) by a book or by heavy clothing.
3. Will cause skin burns.
4. Does not cause damage to internal tissue unless source material is consumed or inhaled.
5. Very small percentage (if any) will penetrate shipping containers.

C. Gamma

1. Travels up to a mile in air.
2. Can be shielded by heavy material (i.e., several inches of lead, a few feet of concrete or earth).
3. Penetrates the whole body; large dose can cause death. Low dose levels over a prolonged period (years) can cause cancer.
4. Shipping containers will be massive and of rugged construction.

- **Measurement of Radiation**

The unit of measure for radiation is the Roentgen. The total amount received, or total dose is measured by a dosimeter. Range of the dosimeter depends on intended use; low is for training and peacetime response; high is for nuclear war.

The rate of exposure or intensity of radiation is measured by a rate meter or survey meter. Range depends on intended use.

- **Detection Capability of survey meters and dosimeters**

1. Radiation must be able to penetrate the instrument to be measured.

2. Civil defense instruments detect and measure gamma radiation.

3. Civil defense has one type of survey meter that will detect beta radiation.

4. Civil defense instruments do not detect alpha radiation.

- **Uses of Radiological Materials**

Radioactive materials will be encountered wherever they are manufactured, where they are used, or enroute. First responders are most likely to encounter materials while the materials are enroute.

1. There are no radiological isotope production facilities in Michigan.

2. Industry use or produce relatively large amounts of material (i.e., radiography cameras, used at construction sites to detect flaws in pipes, detection devices used to measure flow or thickness of materials, density gauges used to determine density of soils for road construction and waste disposal sites, and oil drilling equipment) which emit radioactive matter.

3. Medical facilities (i.e., hospitals; doctor's offices and clinics) are producers of small amounts of beta emitter.

4. There are four (4) power plants in Michigan were large amounts of radioactive material are present. These plants maintain their own emergency response staff.

5. Consumer products source are present in very small amounts and are not hazard to the first responder. Examples are false teeth, tinted eye glasses, lantern mantels, antique dishes.

6. Transportation of all radioactive materials is subject to regulation.

   A. Package material is regulated by the Nuclear Regulatory Commission. Quantities that could present a hazard if released are transported in containers that meet rigid specs.

   B. Labeling and placarding are regulated by the Federal Department of Transportation. There are three classes of labels:

      a. Class I exposure < 0.5 mrem/hr at surface of package
      b. Class II exposure < 50 mrem/hr at surface of package
      c. Class III exposure < 200 mrem/hr at surface of package

The higher level represents more of a hazard, but all are low enough to present no danger to package handlers. Placard on the vehicle is required only if a package with a Class III label or fissile materials is on board.

- **Protective Action**

  Time – Limit the amount of time near the material.
  Distance – The amount of radiation decreases as distance is increased. Stay as far away as practical.
  Shielding – Heavy material will absorb radiation.

- **Radiological Monitor Training**

  HS-3 (home study) available through FEMA brochure.
  FCRM (12 hours) available through local emergency management office.
  FCCRT (40 hours) available through Michigan State Police/Emergency Management Division.

❑ PESTICIDE RECOGNITION AND IDENTIFICATION

Pesticides can be a real challenge to the emergency responder. A pesticide is generally defined as any chemical or mixture of chemicals used to control or destroy any living organism that is considered to be a pest, such as some insects. Pesticides may be found in containers ranging from paperboard boxes to rail shipments. The Environmental Protection Agency is the Federal Agency charged with regulating the pesticide industry.

A part of the regulatory practice is to require a label on all packaging of pesticides. The label must include the following:

- Name of Pesticide
- Signal Word
- EPA Registration Number
- Precautionary Statement
- Hazard Statement
- Active Ingredient

On the following pages are explanations for these requirements.

Label Example

ACME ANT ROACH KILLER

exterminatrolatum

ACTIVE INGREDIENTS

2-(1-Methylethoxy)Pheny; Methocarbamate	*6.30%*
2,2-Diclorovinyl Dimethyl Phosphate	*5.25%*
Related Compounds	*5.91%*
Petroleum Distillates	*72.24%*
Inert Ingredients	*10.30%*

KEEP OUT OF REACH OF CHILDREN

CAUTION
CAUTION
CAUTION

See back panel for further precautionary statements

EPA Reg. No. 11715-109-675
EPA Est. No. 1171-TN-1

❑ Name of Pesticide

This is the name given by the manufacturer. It is the trade name not the actual chemical name. It should not be confused with the list of active ingredients.

The name will be different from manufacturer to manufacturer. When reporting this information to CHEMTREC, remember to include the manufacturer's name.

ACME ANT ROACH KILLER

exterminatrolatum

ACTIVE INGREDIENTS

2-(1-Methylethoxy)Pheny; Methocarbamate	*6.30%*
2,2-Diclorovinyl Dimethyl Phosphate	*5.25%*
Related Compounds	*5.91%*
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KEEP OUT OF REACH OF CHILDREN

CAUTION
CAUTION
CAUTION

See back panel for further precautionary statements

EPA Reg. No. 11715-109-675
EPA Est. No. 1171-TN-1

❑ Signal Word

The signal word will tell you the severity of the pesticide. There are three signal words that can be used. DANGER is used for the most toxic chemicals, WARNING is less toxic, and CAUTION indicates a relatively minor degree of toxicity. The signal word will be highlighted in some manner on the label. It may be in bold print, outlined or a differentiated color.

ACME ANT ROACH KILLER

exterminatrolatum

ACTIVE INGREDIENTS

2-(1-Methylethoxy)Pheny; Methocarbamate	*6.30%*
2,2-Diclorovinyl Dimethyl Phosphate	*5.25%*
Related Compounds	*5.91%*
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KEEP OUT OF REACH OF CHILDREN

CAUTION
CAUTION
CAUTION

See back panel for further precautionary statements

EPA Reg. No. 11715-109-675
EPA Est. No. 1171-TN-1

- **EPA Registration Number**

The Environmental Protection Agency is the federal agency charged with the regulation of pesticides. Each pesticide is given a number to be used for identification. The manufacturer is also assigned to a number to identify the product. When contacting CHEMTREC, report both the product number and the manufacturer number whenever possible.

ACME ANT ROACH KILLER

exterminatrolatum

ACTIVE INGREDIENTS

2-(1-Methylethoxy)Pheny; Methocarbamate	*6.30%*
2,2-Diclorovinyl Dimethyl Phosphate	*5.25%*
Related Compounds	*5.91%*
Petroleum Distillates	*72.24%*
Inert Ingredients	*10.30%*

KEEP OUT OF REACH OF CHILDREN

CAUTION
CAUTION
CAUTION

See back panel for further precautionary statements

EPA Reg. No. 11715-109-675
EPA Est. No. 1171-TN-1

- **Precautionary Statement**

There will be a caution statement indicating the care that must be taken when handling the product. These statements may include the following: "Keep out of reach of Children," "Restricted use Pesticide," or "Hazard to Humans and Domestic Animals."

These statements should be taken as advisory to your possible entry to the scene.

Back Panel

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
Caution: *Harmful if absorbed through the skin. Keep out of reach of children. Avoid contact with skin, eyes and clothing. Do not remain in enclosed areas after use.*

ACME ANT ROACH KILLER

exterminatrolatum

ACTIVE INGREDIENTS

2-(1-Methylethoxy)Pheny; Methocarbamate	*6.30%*
2,2-Diclorovinyl Dimethyl Phosphate	*5.25%*
Related Compounds	*5.91%*
Petroleum Distillates	*72.24%*
Inert Ingredients	*10.30%*

KEEP OUT OF REACH OF CHILDREN

CAUTION
CAUTION
CAUTION

See back panel for further precautionary statements
EPA Reg. No. 11715-109-675
EPA Est. No. 1171-TN-1

❑ Hazard Statement

The typical wording might indicate an environmental hazard and would advise avoiding the contamination of water supplies. Other labels may indicate the hazard to humans and the first aid measures to be taken. Some labels may refer you to other parts of the container.

Back Panel

ENVIRONMENTAL HAZARDS: *This product is toxic to fish. Do not apply directly to water. Drift and runoff from treated sites may be hazardous to aquatic organisms in adjacent waters.*

ACME ANT ROACH KILLER

exterminatrolatum

ACTIVE INGREDIENTS

2-(1-Methylethoxy)Pheny; Methocarbamate	*6.30%*
2,2-Diclorovinyl Dimethyl Phosphate	*5.25%*
Related Compounds	*5.91%*
Petroleum Distillates	*72.24%*
Inert Ingredients	*10.30%*

KEEP OUT OF REACH OF CHILDREN

CAUTION
CAUTION
CAUTION

See back panel for further precautionary statements

EPA Reg. No. 11715-109-675
EPA Est. No. 1171-TN-1

- **Active Ingredients**

This is the section of the label that will tell you the actual chemicals involved. The percentages of the chemicals will be listed as active ingredients and identified. Inert ingredients will be listed by percentage but not otherwise identified. All percentages must equal 100%. The active ingredients are designated above.

With some applications, such as agriculture, pesticides may be mixed in a container with water or other pesticides and be labeled DILUTED. Although this mixture is not required to be otherwise labeled or placarded, the individual using it must carry product identification and rate of application, usually expressed as RATE/ACRE or RATE/SQUARE FOOT. Some pesticide users store them in groups according to the SIGNAL WORD.

SUMMARY

After discovering a pesticide is involved in a hazardous materials incident, it will be easier to identify the actual product. Remember to pass all information garnered from the label to your resource officer. When contacting CHEMTREC you must supply as much information as possible. Use what you have learned to complete the following exercise.

SPECIMEN LABEL

PRECAUTIONARY STATEMENTS
DANGER

AZARDS TO HUMANS AND DOMESTIC ANIMALS

[illegible] releases the poisonous gas hydrogen phosphide (phosphine) when moist. Do [illegible] dust or fumes. Do not open container except for immediate usage. Always open [illegible] Keep available a gas mask and canister which has been jointly approved by the [illegible] Environmental and Safety Administration and the National Institute of Occupational [illegible] and Health for phosphine protection. Personnel of unaltered [illegible] not get in eyes or on [illegible] when handling pellets. FUMITOXIN should be used only by experienced [illegible] personnel. Symptoms of overexposure: Passing headache or chest [illegible] and [illegible]

ENVIRONMENTAL HAZARDS

[illegible] phosphide decomposes in the atmosphere to form traces of phosphide. Spent FUMITOXIN is of no environmental hazard when disposal instructions are followed. Pure [illegible] phosphide is practically insoluble in water, fats, and oils, and is stable at normal [illegible] temperatures. It may corrode [illegible] such as copper, brass [illegible] and gold, and some [illegible] especially at high temperatures and humidity. Precautions should be taken to protect material made from such components including some types of [illegible] paper and underlayment.

PHYSICAL OR CHEMICAL HAZARDS

[illegible] from liquid or water at this contact immediately release of the gas. Piling of pellets [illegible] from their decomposition may cause a temperature increase and a flash could occur. Protect from moisture, open flames or heat.

DIRECTIONS FOR USE

[illegible] violation of federal law to use this product in a manner inconsistent with its labeling.

GENERAL INFORMATION

FUMITOXIN is a fumigant which when applied according to label instructions is intended [illegible] atmospheric humidity. FUMITOXIN has been found effective against the following stored product insects and their pre-adult stages: Black eyed Cowpea weevil, Lesser grain borer, Bean beetle, Bruchid, Green beetle, Ruby green beetle, Lesser grain borer, Confused flour beetle, Red flour beetle, Cadelle, Dried fruit mite, Mediterranean flour moth, Indian meal moth, Almond moth, Angoumois grain moth, European grain moth, Bean weevil, Rice weevil, Pea weevil, Granary weevil, Dried fruit beetle, Drugstore beetle, Cigarette beetle, and Tobacco beetle. Also controls stored leaf beetle (stored product form), and grader moth.

PLACARDING INSTRUCTIONS

[illegible] must be placed on all entrances with signs containing at least the signal word DANGER and the skull and crossbones, and the words: Area under fumigation do [illegible] and completely aerated. The date of fumigation, name of the fumigant used, emergency telephone number for contact, and the name and address of the fumigator. The red [illegible] warning signs and the fumigated area is completely aerated and safe for entry as [illegible] by a suitable detector. Do not move trucks, vans or trailers during fumigation. They must be completely aerated before movement is allowed.

STORAGE AND DISPOSAL

STORAGE: Store only in cool, dry, locked ventilated room.

CONTAINER DISPOSAL: Triple rinse (or equivalent) and offer for recycling or reconditioning, or dispose of in a sanitary landfill, or by other approved State and local procedures.

PESTICIDE DISPOSAL: Pesticide spray mixture or residue that cannot be used according to label instructions must be disposed of according to Federal, State or local procedures under the Resource Conservation and Recovery Act.

WARRANTY: Seller warrants that the product conforms to its chemical description and when used according to label directions under normal conditions of use, it is reasonably fit for the purposes stated on the label. Seller makes no other warranty, either express or implied, and Buyer assumes all risk should the product be used contrary to label instructions.

SPECIFIC INSTRUCTIONS

RAW AGRICULTURAL COMMODITIES AND BULK ANIMAL FEEDS: For stored seed of listed stored products, such as stored almonds, barley, broad nuts, cashews, chufas, cocoa beans, coffee beans, corn, cottonseed, dates, filberts, flaxseed, grass seed, millet, oats, peanuts, pecans, pistachio nuts, popcorn, rice, safflower seed, seed and pod vegetables, [illegible] barley, [illegible] sorghum, soybeans, sunflower seeds, [illegible] wheat, [illegible] seed or feed ingredients.

RESTRICTED USE PESTICIDE

For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicator's certification.

Fumitoxin T.M

COATED PELLETS

FOR USE AGAINST LISTED INSECTS WHICH INFEST STORED COMMODITIES, SPECIFIED PROCESSED FOODS, AND ANIMAL FEEDS.

* ACTIVE INGREDIENT:	
Aluminum Phosphide.....	55%
INERT INGREDIENTS.....	45%
	100%

Keep out of reach of children

DANGER—POISON

PRACTICAL TREATMENT

If swallowed, **call a physician or Poison Control Center. Drink 1 or 2 glasses of water and induce vomiting by touching back of throat with finger. Do not induce vomiting or give anything by mouth to an unconscious person.** ***If inhaled,*** **remove victim to open air and remove contaminated clothing. Keep victim warm. Call a physician immediately.** ***If on skin,*** **wash affected area with soap and water. If in eyes, flush thoroughly with water. See side panel for additional precautionary statements.**

Manufactured for
PESTCON SYSTEMS, INC.

Box 469, Alhambra, Ca 91802
Telephone: (213) 283-2761

Contents 1,650 pellets
Net Weight 1,000 g (2 lbs 3.28 ozs)

EPA Reg No 5857-2-ZA
EPA Est No 46060 CI 04

For the above commodities stored in bulk, FUMITOXIN pellets may be [illegible] the commodity flows into a bulk or silo in order to provide uniform spacing between pellets. For bulked commodities not stored in bulk, pellets may be placed in [illegible] moisture permeable envelopes and fumigation proceeds as for with processed foods.

Dosage for commodities other than dates, nuts and peanuts is 170-300 pellets per 1000 Bushels.

Dosage for dates, nuts and peanuts in bags or storage boxes is 100-200 pellets per 1000 cubic feet of storage space. For peanuts in bulk use tablets. Effectiveness of the fumigation is dependent on the tightness of bin or warehouse, commodity temperature, and length of exposure period.

PROCESSED FOODS AND PACKAGED ANIMAL FEEDS: See enclosed sheet for list of processed foods which may be fumigated.

These commodities may be fumigated in relatively gas tight structures, under gas proof tarpaulins, or in sealed bins or hopper cars (static or rolling). Sealed bins and hopper cars (static or rolling) must be placarded during fumigation as per EPA requirements. Pellets may be placed in moisture permeable envelopes, not more than ten pellets per envelope. Envelopes must be fastened to a substantial support. After fumigation pellet residue shall be disposed of by burying or saturating with water to which a small amount of wetting agent has been added. Do not dispose of dust or bulk.

Dosage for specified processed foods and packaged animal feeds is 100-200 pellets per 1000 cubic feet of storage space.

PROCESSED BREWER'S RICE, MALT, AND CORN GRITS: Under no condition shall any processed food come in contact with FUMITOXIN or FUMITOXIN residue except as follows. Fumitoxin may be added directly to processed brewer's rice, malt and corn grits stored by brewers for use in the manufacture of beer. The fumigant may be probed into the commodity or fed into the stream as the commodity flows into a storage area. Dosage for such treatment is 100-200 pellets per 1000 cubic feet of storage space. FUMITOXIN shall not be placed on or attached to packages intended for consumers or cartons delivered to retailers. Retail finished food two days before it is offered to consumer.

CEREAL MILLS AND FEED MILLS: Dosage for cereal mills and feed mills is 100-150 pellets per 1000 cubic feet. Fumigation of such areas must be conducted by licensed fumigators. All safety precautions such as sealing of building, posting and placarding of entrances, not flying pelts and fire alarms and posting of guards, if required, must be adhered to.

BISRED TOBACCO: Dosage for stored tobacco is 100-165 pellets per 1000 cubic feet. Aeration time for hogsheads will not be less than three days, for all other containers two days.

FOR NON FOOD PRODUCTS: Suggested dosage for control of pests in cotton (cloth and unprocessed), feathers, human hair, [illegible] and [illegible] raw wool is 165-330 pellets per 1000 cubic feet.

BISRED BEEHIVES, SUPERS, AND OTHER BEEKEEPING EQUIPMENT: Dosage for control greater wax moth in stored beehives, supers, and other beekeeping equipment is 165 pellets per 1000 cubic feet.

Exposure times required for all commodities are approximated in the following guide: Commodity at 50-59°F (10-15°C) at least four days; Commodity at 60-69°F (16-20°C) least three days; Commodity over 69°F (20°C) not less than two days; Do not fumigate when commodity temperature is below 40°F (5°C).

FUMIGATION OF UNMANNED BARGES: For bulked raw commodities and seeds to be transported in bulk, FUMITOXIN pellets may be fed into the commodity as the barge is being loaded or may be inserted below the surface of the commodity after loading is completed. For bulked commodities not transported in bulk and for bulked processed food, the FUMITOXIN pellets must be contained and fastened to a substantial support. FUMITOXIN pellets or its residual dust must not come into contact with the processed foods or its packaging. Dosage and exposure time on unmanned barges is similar to that used for the same commodities fumigated in land based structures or storage areas.

Following application of the fumigant, the barges must be sealed and warning placards posted.

Prior to unloading of unmanned barges, make appropriate tests to assure safety of work area.

FUMIGATION OF GRAIN ON SHIPS: *Bulk grain fumigation of grain on ships must be supervised by a person trained in shipboard application. Only dry bulk carriers and tankers with dry cargo quarters above the cargo holds may be fumigated. The vessel must be inspected by a qualified person to ascertain that the cargo can be fumigated without appreciable hazard to the crew. The fumigator must conduct a meeting with responsible ship's officers and cover all aspects of the work to be done and the possible dangers involved. Application of the fumigant shall not begin until the training of a holder's completed. Additional safety precautions and procedures provided in supplemental labeling entitled "Fumigation of Grain Ships" must also be followed.

*Important: Shipboard or land ship or shipbuilding fumigation is also governed by U.S. Coast Guard Regulations. Refer to and comply with these regulations prior to fumigation.

TOXICOLOGY FOR THE FIRST RESPONDER

After this section, students will:

1. UNDERSTAND THE TYPES OF HEALTH PROBLEMS THAT OCCUR IN THE FIRE SERVICE.

2. KNOW THE DIFFERENT WAYS IN WHICH HAZARDOUS MATERIALS CAN ENTER THE BODY.

3. UNDERSTAND THE DIFFERENT EFFECTS WHICH CHEMICALS MAY HAVE ONE THE BODY.

4. KNOW THE STEPS THAT CAN BE TAKEN TO LIMIT EXPOSURE TO HAZARDOUS MATERIALS.

❑ HEALTH PROBLEMS IN THE FIRE SERVICE

Firefighters are dying from responses to hazardous materials incidents. The deaths are caused by exposure to a wide range of harmful chemicals that are released when products are burned or when materials are spilled or leaked.

❑ Toxic Products of Combustion

When a fire destroys a home, factory or office, it presents an environment that is similar to what firefighters faced several hundred years ago. Heat from a fire can exceed 500 degrees F; thermal drafts can create gale force winds; buildings weakened by fire can collapse on firefighters; the lack of oxygen can suffocate.

Now fires can also create hidden dangers in the form of chemicals that are given off when products burn. Products such as furniture, pipes, wall coverings, and insulation materials contain strange sounding chemicals that can give off deadly gases and fumes when burned.

For example, polyvinyl chloride, one of the major ingredients in most plastics, decomposes in a fire to form hydrogen chloride, phosgene, and many other products, some of which are known or suspected of causing cancer.

Here are a few types of common materials and the toxic chemicals created when they are burned:

Product	Toxic Chemicals
Wool, Silk, Nylon Paper, Polyurethane	Hydrogen Cyanide
Wool, Silk, Nylon, Melamine	Ammonia
PVC, Acrylics, Retardant-treated Materials	Hydrogen Chloride
Hydrogen Fluoride, Fluorinated Resins, Sulfur Sources	Sulfur Dioxide
Hair, Wools, Meats, Hides	Hydrogen Sulfide
Plastics, Solvents	Phosgene
Fabrics, Celluloid	Nitrogen Oxides

❑ FATAL FACT

Firefighters in Washington, D.C., responded to a fire confined to an office copying machine made of teflon and other plastic parts. There was little smoke, and they put the fire out in 20 minutes. The firefighters did not wear SCBA. Twenty-four hours later one of the firefighters who responded to this incident collapsed in the station house. He had developed muscle spasms like those caused by an epileptic seizure. He recovered but died several hours later from severe hemorrhaging and fluid in this lungs.

❑ Line-of-Duty Deaths

We originally believed that most fire deaths were caused by the flames. Now experts believe that 80% of all fire deaths result from lung damage caused by toxic materials.

Along with apparatus accidents, falls, and heart attacks, inhalation of hazardous materials is the leading cause of death among firefighters, according to a study conducted by the International Association of Firefighters.

SUN-SENTINEL

FORT LAUDERDALE, FL
SUNDAY 332,630

FEB 21 1993
BURRELLE'S

Cancer forces early retirement for highly decorated firefighter

By TAO WOOLFE
Staff Writer

FORT LAUDERDALE — The firefighters who have worked with Herbie Blabon wish his retirement was just another one of his practical jokes.

They wish the cancer forcing him to retire would simply go away. But Blabon, the most decorated firefighter in the city, was prepared to walk out of the firehouse this morning at 8 a.m. after working his last 24-hour shift.

It wasn't easy.

"I'll always be a fireman," he said on Saturday night, his voice almost breaking. "I'll still get excited when I see a truck go by."

Blabon was one of 100 firefighters who fought the Jan. 13, 1969, Everglades Fertilizer Plant fire that burned for three days and spewed chemical-laced smoke that peeled the paint off trucks. The firefighters battled the blaze with no breathing masks. Blabon is the 29th of those firefighters who have been diagnosed with cancer. Nineteen have died.

Blabon, 49, who has been with the department for 27 years, said his illness, which has caused a tumor to grow on his neck, is forcing him to retire a year early. Although the cancer is in remission, he must go through chemotherapy treatments that will render him too weak to work.

"It hit everyone around here like a baseball bat. The guys said: 'How could it be him? How could he have cancer?'" Battalion Chief Stephen McInerny said. "The guys couldn't look each other in the eyes."

Blabon had always been there for everyone else. And his practical jokes were legendary.

"You could be having a bad day and reach up to get a bowl out of the cabinet and have it be half filled with water, and it would make you laugh," said firefighter Tim Habig, 33, whose bunk was next to Blabon's. "He was like my surrogate father to me. I'll miss having someone to lean on."

Staff photo/LOU TOMAN

Battalion Chief Tommy O'Day, left, says goodbye to Herbie Blabon as shifts intersect/

❑ Percentage Breakdown of Causes for Line-of-Duty Deaths

Apparatus Accidents	14.7%
Building Collapse	11.8%
Burns	11.8%
Drowning	2.9%
Electrocutions	5.9%
Falls	14.7%
Falling Tree	2.9%
Heart Attack	-14.7%
Hit by Car	5.9%
Inhalation of Hazardous Materials	14.7%

Source: Statistics as reported to the IAFF by Fire Department Administration

❑ Cancer in the Fire Service

As the use of hazardous materials has increased, so has the rate of cancer among firefighters. A number of disturbing facts suggest that cancer is becoming one of the greatest long-term killers of firefighters. *(See Attachment J)*

Fact 1: Cancer deaths for firefighters have doubled during the past 30 years.

Fact 2: Cancer deaths for firefighters have increased by almost twice the increase in cancer deaths for the general public.

Fact 3: One in three Los Angeles firefighters is expected to develop cancer by the age of sixty, compared with one in five people in general.

Fact 4: In studies conducted by the Institute of Cancer and Blood Research, firefighters suffered up to three times of normal rate for cancer of the mouth and throat and more than twice the normal rate for cancers of the brain, lung, rectum, and pancreas.

Firefighters' health is definitely threatened by exposures to hazardous materials. By understanding how chemicals affect the body and the methods available to reduce exposure, firefighters can take positive steps to protect their health.

❑ HOW DO TOXIC SUBSTANCES ENTER THE BODY?

Some chemicals cause harm to your body at the point of contact. The corrosive that splashes on you from a tanker spill will burn your skin or eyes. The solvent that you use to wash your hands may cause a skin reaction called dermatitis.

Certain chemicals will also penetrate beyond the point of contact. For example, some solvents will be absorbed through your skin without causing any burning or irritation. The solvent is then carried to other parts of the body where damage may occur.

There are four ways in which substances can enter your body:

❑ Breathing

The most common and rapid route of chemical exposure for firefighters is through breathing or inhalation. Some chemicals, such as corrosives, may burn or scar the air passages and lungs. Fibers, such as asbestos or fiberglass, become lodged in the walls of the lungs where they cause scarring. Still other substances pass immediately through the lungs into the blood and are carried to other parts of the body. In some cases, they may build up in specific organs, such as the liver or kidneys.

The rate at which chemicals are absorbed into the lungs will be affected by the rate of respiration. Firefighters who are breathing deeper because of the demanding work required at a hazardous materials incident will absorb greater amounts of contaminants that are present.

Unlike the skin, which can resist certain materials, the lungs do not have any defense mechanisms. More importantly, the lungs have a surface area that is 40 times greater than the outside of the body.

To protect yourself, wear positive-pressure SCBA!

❑ Eye/Skin Contact

The skin usually acts as a protective barrier for the body. But some chemicals, such as solvents containing benzene, toluene, and trichloroethylene, can pass through the skin and spread to other parts of the body. These solvents also break down the skin's natural barrier and allow materials to penetrate that could not do so normally. Some parts of the body are more susceptible to absorption than others. See the chart below.

❑ Absorption of Chemicals into the Skin

Body Area	Absorption
Scrotum	Absorbs 300 times more than foot
Forehead/Scalp	34 times more
Back/Forearm	10 times more
Palm/Ankle	5 times more

Even though the skin provides some protection from chemical exposures, the protective barrier may break down if the skin is damaged. Factors such as heat, cold, humidity, or trauma can lead to greater absorption of harmful chemicals through the skin.

Turn-out gear does not protect you from chemicals that can be absorbed through the skin. Your SCBA facepiece does protect your eyes. Wear it until you know you are in a clean area.

❑ Injection

Hazardous materials may also enter the body by injection, as in an accidental needle stick, or by exploding fragments of glass or metal.

Use extra care when working around sharp objects that may be contaminated. Needles, broken glass, and nails can all break the skin and may be contaminated with hazardous chemicals, bacteria, viruses or other dangerous materials. Wear thick gloves and boots with steel toes and shanks.

❑ Swallowing

Do you smoke or eat when you are on break at a hazardous materials incident? If you do, you may be exposed to dusts, fumes or vapors through hand-to-mouth contact and through coughing, when inhaled particles are removed from the lungs to the throat and are then swallowed.

Once a hazardous material enters the digestive system, it may be made more or less toxic by the substances that work to digest your food. Once in the digestive system, the hazardous materials may pass through your system or may be absorbed into your bloodstream and carried to other parts of the body.

If you must eat or smoke at an incident, decontaminate yourself first by washing thoroughly.

❑ HOW DO CHEMICALS AFFECT THE BODY

Harmful effects from chemicals arise only if chemicals are in the body in large enough amounts and for long enough periods of time. The amount of time it will take to cause a harmful effect will depend on the type of chemical and your body's individual response to that chemical.

If a large amount of a compound enters your body at one time, your body will have a hard time breaking it down and getting rid of it. The chemical will have more time to have a toxic effect or to interact with chemicals that you are exposed to later.

Even small amounts of some chemicals, such as those that may cause cancer, can cause harmful effects. Chemicals that are stored in the body, such as PCB's, are more likely to cause health problems years after the exposure occurs.

Exposure to a hazardous material is considered to be the process by which people, animals, the environment, and equipment are subjected to or come in contact with that material. Contamination however, is the process of transferring a hazardous material from its source to people, animals, the environment, or equipment. The contaminated individual or item may then act as a carrier of the hazardous material. Therefore, an individual can be exposed without becoming contaminated. If a contaminated individual or object is not successfully decontaminated, the contaminant can be carried to the warm or cold zones. This process is called Secondary Contamination.

❑ Acute Effects

Some chemicals cause health effects that occur in a few seconds, minutes, or days after exposure. For example, chlorine gas can cause immediate burning of the air passages and the lungs. These short-term or acute health effects generally go away after a short time. However, some short-term effects may cause permanent damage, such as skin burns from an acid spill.

❑ Chronic Effects

Chronic or long-term health effects are usually caused by exposure to small amounts of hazardous substances over a long period of time.

Most firefighters are aware of the dangers of carbon monoxide exposure. Breathing high levels of carbon monoxide can cause headaches, dizziness, and even death in the short-term.

However, we are just now learning that breathing small amounts of carbon monoxide over a long period of time can result in long-term damage to the heart muscle. Heart attacks or other forms of heart disease might not appear until much later in life. Although not as obvious, the long-term effects of exposure to carbon monoxide are just as serious.

❑ Sensitization

When you become sensitized or allergic to a chemical, your body overreacts in trying to defend itself against the chemical. This overreaction may cause further health problems.

Sensitization or allergic reactions usually involve either the skin or the respiratory system. The symptoms of allergic skin reactions are similar to other skin irritations: usually a red, itchy rash with blistering or cracking. Epoxy resins and nickel are two substances which commonly cause allergic skin reactions.

Asthma is an allergic reaction of the respiratory system. Symptoms include wheezing, chest tightness, shortness of breath, and coughing. These reactions can be severe or even life threatening. Toluene diisocyanate (TDI) and epoxy resin powders are two materials that often cause respiratory sensitization.

Important Points About Sensitization

1. You may not have a reaction to a chemical the first time you are exposed to it. You must be exposed to the chemical more than once for a true allergic reaction to develop.

2. Only some people exposed to a chemical will ever become sensitized. This is different than an irritant reaction, which could happen to anyone who is exposed to enough of the material.

3. Once you have become sensitized, very low exposures may cause you to have a severe reaction. You may be unable to work in the area where the chemical is being used.

❑ WHAT PROTECTIVE MEASURES CAN RESPONDERS IMPLEMENT?

First responders can take a number of steps that will provide protection from hazardous materials. Protective measures can be taken before an incident occurs, during an incident, and after an incident has been completed.

Read through the following scenario about a hazardous materials incident that occurred in Florida in 1983. After the scenario, decide what steps could have been taken before, during, and after the incident to protect the health of the firefighters involved. Be prepared to report back to the group.

Fire Department Responds to Nursery Warehouse Fire

At approximately 10:15 p.m., a two-person engine unit responded to a reported structure fire at a nursery warehouse. There was no pre-fire plan for the nursery, and the firefighters were not aware of the building's type or contents. Upon arrival, the firefighters saw a 20 by 30 foot wood frame warehouse totally engulfed in flame. Three civilians were in the process of fighting the fire with garden hoses.

The initial engine unit waged an outside attack on the fire. About 30 minutes later, a second engine and a tanker arrived with two firefighters, along with a two-person rescue unit. Soon after the arrival of these additional firefighters, the crew was informed that several chemicals were contained in the building. At that point, firefighters were instructed to use SCBA.

The Chief, who was in route to the fire, was notified by radio of the chemical hazard. Upon his arrival on the scene, he ordered the crew to remove the roof and asked the nursery owner to compile a list of chemicals in the warehouse.

The firefighters who were first on the scene and a civilian began experiencing chest tightness, shortness of breath, abdominal cramps, nausea, and burning eyes, nose and throat. A short time later,

the rescue unit transported four firefighters and two civilians to a local hospital emergency room. About two hours later, the remaining crew members went to the same emergency room.

Three days after the fire, three firefighters were sent to an industrial clinic and returned later in the day with a recommendation from the nurse that they return to work. These three, along with three other firefighters, were sent back to the clinic later in the afternoon to see a physician.

The physician performed a brief physical exam and recommended that they return to work. Three firefighters thought they were still sick and sought an outside medical opinion. The outside physician recommended that firefighters exposed to burning pesticides should undergo pulmonary function tests, blood tests, and a second blood gas analysis before returning to duty. Subsequently, all firefighters exposed at the fire were given blood tests, including serum cholinesterase.

Based on the information provided, answer the following questions:

1. What steps should have been taken before the incident and how could these actions have helped to protect the firefighters?

2. What resources were available to the fire department regarding the dangers of the chemicals involved in this incident? What additional ones should have been used?

3. What steps should have been taken during the incident to protect the firefighters as well as the environment?

4. What steps should have been taken after the incident in addition to those that were followed?

❑ Protective Measures in General

Time, distance, use of protective equipment, and the amount and concentration of a toxic substance determine the exposure that you receive at a hazardous materials incident. Since the identity or concentration of a chemical may not be immediately known, responders must limit their exposure by taking the following actions:

- Limit the amount of time you are exposed by performing only essential tasks, such as rescue, in the contaminated area.

- Maintain as much distance from the hazard as is practical. If possible, stay upwind, uphill and upstream.

- Wear positive-pressure SCBA and appropriate protective clothing and equipment.

- Decontaminate yourself, your equipment, and your clothing to prevent carrying contaminated material away from the incident.

- After the incident, prepare a log that includes the date, time and type of incident, as well as information on the chemicals involved.

- If you need medical advice, look for health care providers who are trained in occupational medicine.

SUMMARY

1. Fires create hidden dangers in the form of chemicals that are given off when products burn. As a result, firefighters suffer from increased rates of occupational disease.

2. Chemicals enter the body in four different ways: breathing, eye/skin contact, injection, and swallowing. Breathing is the most common and rapid route of entry.

3. Short-term or acute health effects appear in a few seconds to a few days after exposure to a chemical. Acute effects may be reversible.

4. Long-term or chronic health effects may take many months to many years to develop and are usually permanent. They are usually caused by exposure to small amounts of a chemical over a long period of time.

5. You can limit your exposure to hazardous materials by:

   - Conducting prefire planning.
   - Limiting the time you spend in the contaminated area.
   - Maintaining your distance from the hazard.
   - Wearing SCBA and proper protective clothing and equipment.
   - Decontaminating personnel and equipment after an incident.

❑ ANALYSIS OF THE NURSERY WAREHOUSE INCIDENT

In 1984 the National Institute for Occupational Safety and Health (NIOSH) at the request of the International Association of Fire Fighters conducted a health hazard evaluation at the fire department involved in the nursery warehouse fire.

As a result of its investigation, NIOSH provided the following recommendations:

1. Firefighters should not enter burning structures unless properly protected with approved positive- pressure SCBA's and with other appropriate protective equipment.

2. Prefire planning should be done to provide firefighters with information necessary to protect their health and the environment during a chemical or pesticide fire. Prefire planning includes compiling a list of flammable and toxic substances used and stored at all businesses serviced by the fire department.

3. Toxicity information on pesticides can be obtained from the Environmental Protection Agency's "Pesticide Clearinghouse." Their toll-free number is 800-399-5352. They can provide assistance on fire control, protective measures, and decontamination procedures.

4. Conventional turnout gear may not provide adequate protection from pesticide-contaminated smoke, mist, and run-off water. The hazards of exposure from a pesticide fire may be sufficient to justify minimizing firefighters' exposure.

5. Local environmental protection agencies should be notified immediately of the possibility of contamination of ground water or surface water. All run-off water should be contained with an earth dike and later removed in accordance with EPA regulations.

6. All contaminated equipment should be properly cleaned or disposed of in a timely manner to prevent unnecessary exposure.

7. A medical surveillance program should be implemented for all firefighters. The program should include preplacement exams, periodic exams, and special exams after a fire that involves known or suspected exposures to toxic substances.

REFERENCES

❑ HUMAN RESOURCES:

CHEMTREC: (800) 424-9300. 24 hour assistance available for information in dealing with hazardous chemical exposures. This number is for emergency use only.

REAC/TC (Radiation Emergency Assistance Center/Training Site): (615) 482-2441. 24 hour assistance for radiation emergencies. Treatment and consultation are available as well.

National Pesticide Network: (800) 858-7378. 24 hour assistance for incidents involving pesticides and agrichemicals.

❑ PUBLISHED RESOURCES:

"North American Emergency Response Guidebook." Department of Transportation. Absolute must for every hazardous materials team.

US Dept. of Health and Human Services, NIOSH: "Pocket Guide to Chemical Hazards," 1987. DHHS (NIOSH) Publication #85-144. Lists hazardous chemicals with their common names, recommendations for levels of protection, IDLH levels, routes of exposure, target organs and other useful information. **INDISPENSABLE** reference.

Stutz DR, Ricks RC and Olsen MF, "Hazardous Materials Injuries." Organized much like the DOT Guidebook. Good general text, although some of the medical treatment recommendations are dated.

NFPA #49: "Hazardous Chemicals Data' 1975." Chemicals listed alphabetically with descriptions, for explosion hazards, life hazards, firefighting and storage recommendations. Limited list of chemicals, but what is there is useful.

Gosselin RE, Smith RP and Hodge HC. "Clinical Toxicology of Commercial Products" 5th Edition, 1984, Baltimore, Williams and Wilkins. An encyclopedic textbook of commercial chemical hazards. Excellent desk reference.

TABLE 1
OCCUPATIONAL DISEASE DEATHS PER 100,000 FIREFIGHTERS
1986

Cancer	36
Heart Disease	65
Lung Disease	9
Other	6
TOTAL	116

TABLE 2
OCCUPATIONAL RETIREMENTS PER 100,000 FIREFIGHTERS
1986

On-Duty Injury	330
Occupational Illness	
- Cancer	20
- Heart Disease	182
- Lung Disease	23
- Mental Stress	25
- Hearing Loss	19
- TOTAL	295
Physical Fitness Failures	17

TABLE 3
FIREFIGHTERS FORCED TO LEAVE DEPARTMENT/RETIRE BECAUSE OF OCCUPATIONAL DISEASES
1986

As reported in a survey by the International Fire Fighters Association, 203 firefighters were forced to leave their departments or retire because of occupational diseases.

Disease	Number	Percent	Average Age
Heart Disease	135	66.5	47
Lung Disease	17	8.4	35
Cancer	14	6.9	57
Mental Stress	18	8.9	40
Hearing Loss	14	6.9	47

Toxic Products of Combustion

Norm Dinerman, M.D.

HYDROGEN CYANIDE:

Source: Wool, Silk, Polyacrylnitrile, Nylon, Polyurethane, Paper.
Type of toxicity: Systemic (Cellular Poison). This is a rapidly fatal asphyxiant that induces cellular hypoxia by formation of a stable complex with cytochrome oxidase.
Clinical Aspects: HCN may be inhaled, or absorbed through the skin. The characteristic odor of bitter almonds cannot be smelled by 30-50% of the population. Usually seen are emesis, palpitations, confusion, anxiety and vertigo. Initially B.P. may be elevated, with a slow pulse, followed by a diminution of B.P. and rise in pulse rate. Rapid respirations give way to slow and labored respiratory patterns, with coma and convulsions following. The E.K.G. may show S.T. elevation or depression. Acute pulmonary edema and lactic acidosis may be seen.
Treatment: Cyanide Antidote Kit by Lilly. Basic goal is to produce methomeoglobbin then thiocyanate. Rapid treatment, at the scene, if possible, is required for life salvage.

AMMONIA:

Source: Wool, Silk, Nylon, Melamine
Type of toxicity: Direct irritant to respiratory structures, and skin. It is capable of exerting a profoundly caustic action. Coma & convulsions are noted, as systemic aspects of toxicity.
Clinical Aspects: Readily identifiable by its pungent odor, conjunctivitis and lacrimation are noted early, producing temporary blindness. Restlessness, chest tightness, a frothy sputum and cyanosis with collapse may be noted. These appear at concentrations greater than 1000 ppm. At greater than 1500 ppm, laryngospasm and immediate death may occur. Victims usually complain of intense pain in eyes, mouth and throat, and manifest a feeling of suffocation. There may be an inability to speak secondary to laryngeal edema, with stridor noted. Ammonia increases respiratory secretions. Skin contact will produce local irritation or burns.

HYDROGEN CHLORIDE:

Source: Polyvinylchloride, chlorinated acrylics and retardant-treated materials.
Type of toxicity: Direct pulmonary irritant, and inflames conjunctiva of eyes. At conc. of 15 ppm, localized irritation of throat noted. A conc. greater than 100 ppm may result in pulmonary edema and laryngeal spasm. Mists of HC1 less harmful than anhydrous HC1, because the mist droplets have no hydrating action. The HC1 gas reacts with moisture in the lungs to produce the acid destruction manifest by violent inflammation.
Clinical Effects: May be insidious, and frequently delayed in onset, as much as one to two days, but one to six hours is usually noted. Skin irritation with frank burns may be noted. Pain, swelling of the conjunctiva may be noted, as well as corneal erosions. Pulmonary damage manifests as dyspnea, chest pain and tightness and pulmonary edema.
Treatment: Prompt evacuation of the victim, as well as irrigation (decontamination of the skin and eye, as well as administration of 100% oxygen). These patients should be observed for at least 24 hours for delayed toxicity.

HYDROGEN FLUORIDE:

Source: Fluorinated resins or films.
Toxicity: Direct irritant to mucosal surfaces, skin and the pulmonary tract. The fluoride ion is a direct cellular poison and interferes with calcium metabolism. It reacts with tissue proteins.

Clinical Effects: On the skin, it will produce irritation and deep penetrating necrotic lesions. Inhalation results in a severe pneumonitis with shortness of breath, chest tightness, coughing.
Treatment: Termination of exposure followed by decontamination with irrigation. Meticulous pulmonary care may be required for treatment of the lung damage produced.

SULFUR DIOXIDE:

Source: From all sulfur sources, this represents the common oxidation product of same.
Toxicity: Direct irritant on contact with moistened mucous membrane surfaces and the lung, by virtue of the formation of sulfurous acid.
Clinical Effects: Patients often present with dyspnea, cough, chest tightness, and chest "burning". Pulmonary edema with respiratory distress and failure are noted. Vomiting, difficulty swallowing, fever, pharyngeal and glossal erythema, headache, vertigo, agitation, memory loss, abdominal pain, diarrhea, tremor, convulsions, pneumonia and peripheral neuritis may be noted.
Treatment: Decontamination with irrigation and dilution. Meticulous pulmonary care, once again is mandatory.

ISOCYANATE: (Toluene di-isocyanate)

Source: Urethane isocyanate polymers.
Toxicity: Exerts a pharmacodynamic reaction (universally experienced) with severe irritation being noted, especially of the eyes, G.I. tract, lungs. An allergic reaction will also be noted in selected individual manifest by an acute pneumonitis with edema.
Clinical Effects: Skin - produces irritation and inflammation; Eyes - Conjunctival irritation and inflammation; G.I. - Nausea, vomiting and abdominal pain (from inhalation); Lungs - Severe coughing, burning and irritation of the upper tract with a choking sensation. There is sputum product with laryngitis, retrosternal soreness, chest pain and asthma (a chemical bronchitis with bronchospasm). Chronic bronchitis may result; Neurological - Headache, insomnia, euphoria, ataxia, anxiety neurosis, depression and paranoia.
Treatment: Irrigation and decontamination, once again, are the mainstays of early treatment. The asthmatic component may require theophylline treatment.

ACROLEIN:

Source: From polyolefins and cellulosics.
Toxicity: Direct irritant.
Clinical Effects: Causes lacrimation with intense irritation of the upper respiratory passages.
Treatment: Meticulous respiratory care. Usually minor irritation will resolve with cessation of exposure.

HYDROGEN SULFIDE:

Source: Hair, Wools, Meats and Hides, from decomposition of sulfur containing organic materials.
Toxicity: With moisture, forms a caustic, sodium sulfide, that is a direct irritant to eyes, wet skin and the respiratory passages. Rotten egg odor is unmistakable, but low conc. will fatigue the sense of smell rapidly. Capable of producing respiratory paralysis and death.
Clinical Effects: Consistent with respiratory tract irritation, manifest by cough, chest tightness and dyspnea.
Treatment: Removal from exposure and immediate flushing of eyes with water. If exposure is severe, hospitalization & observation for 72 hours for delayed onset of severe pulmonary edema is advisable.

NITROGEN OXIDES:

Source: Fabrics, Cellulose nitrate and Celluloid.
Toxicity: Converted to nitric acid with hydration. Since the oxides are poorly soluble in water, delayed effects are common, with a latent period of 5-24 hours as hydration takes place in the lungs.

Clinical Effects: In high concentration, there is immediate cough and chest pain. At low concentrations, there may be no warning, and the appearance of red-brown, orange, or copper colored gases at the fireground are indications for immediate use of the breathing apparatus. Insidious symptoms include chest tightness, dyspnea, shortness of breath, coma and death.
Treatment: Meticulous pulmonary care, in addition to decontamination and irrigation.

PHOSGENE:

Source: From decomposition of heated organic compounds with chlorine, such as when carbon tetrachloride fire extinguishers are used. Chlorinated hydrocarbons, and a number of plastics will produce same. Phosgene will decompose to HC1 and CO.
Toxicity: Poor water solubility leads to delayed appearance of clinical toxicity. Direct irritant of pulmonary tract.
Clinical Effects: Choking, cough, chest pain, hemoptysis.
Treatment: Irrigation after decontamination. Meticulous pulmonary care.

EATING SMOKE

When a fire destroys a residential home or an industrial factory, it presents a work environment that closely resembles, at first glance, what firefighters faced several hundred years ago. In many respects, fire has maintained many of its potent characteristics. Fire's heat can still exceed 500°F (260°C); thermal drafts continue to create gale-force winds; fire can still weaken parts of buildings causing them to fall-in or collapse on firefighters; and the air still lacks adequate amounts of oxygen as the products of combustion form "smoke".

Technology has created a distinct difference in the modern fire environment: polyvinylchloride, polychlorinated biphenyls, acrylic, phenol, polystyrene, and urea formaldehyde to name just a select few. What are these new strange-sounding chemicals? They are commonplace ingredients in our environment as components of household furniture, plastic pipes, buildings, wall coverings, automobiles, buses, airplanes, and coverings for electrical and other insulation materials.

The rapid proliferation of these chemicals in our society has caught the scientific community off-guard. There are simply too many new chemicals and too few funds to research all of their potential hazards. Nevertheless, we do know that the "smoke" derived from these burning chemicals contain numerous toxic compounds. From a blinding, suffocating hazard, smoke has become a toxic fume containing substances such as carbon monoxide, hydrogen chloride, hydrogen cyanide, sulfur dioxide, phosgene, and so on.

The potential of these chemical substances to cause bodily harm to the firefighter is dependent upon many factors at the fire scene: the level of concentration, respiratory rate and volume, time of exposure, clothing worn and type of respiratory equipment used. Unlike even human skin, which can resist certain materials, the lungs lack any protection to resist these toxic substances. In addition, these toxic materials can be absorbed by a surface area in the lungs that is forty (40) times greater than the body's outside surface area.

The health effects can be short-term or even initially non-existent. Such exposures can also result in long-term illnesses involving the cardiovascular system, the respiratory system, the central nervous system and other body organs.

Despite our common awareness today that it is respiratory problems that account for 80% of all fire deaths, it wasn't always our perception. In fact, we initially believed just the opposite, that is, deaths were primarily due to the fire's flames. One of the first fire incidents to alter our viewpoint occurred in 1929 at the Cleveland Clinic. This fire, which destroyed the laboratory's X-ray films caused the death of 125 persons. An analysis afterwards indicated that the presence of carbon monoxide and oxides of nitrogen were responsible for the majority of the fatalities --- not the flames of the fire.

In 1973, a Boeing 707-300 series aircraft made a safe emergency landing after discovering that a plastic waste basket near the rear lavatory was on fire. Despite the successful landing, before the fire spread to the plane's fuel supply, 124 people perished as a result of the toxic materials they had inhaled from the synthetic materials that comprised the aircraft's interior.

The 1980 fire at the MGM Grand Hotel in Las Vegas provided yet another grim reminder of the toxic effects of smoke. Most of the 84 fatalities and 679 injured during the blaze were due to the inhalation of toxic gases containing carbon monoxide and hydrogen cyanide.

Of all the chemicals that make up smoke, **carbon monoxide (CO)** has traditionally been considered the number one killer. This colorless, odorless and tasteless gas is universally found in fires since it develops as an end product of combustion. The affinity of oxygen and hemoglobin in the blood's plasma is less than 200 times the affinity between hemoglobin and carbon monoxide. As a result, hemoglobin combines with carbon monoxide to form carboxyhemoglobin instead of oxyhemoglobin. Deprived of its chemical vehicle, oxygen can no longer be transported to the tissues of the body resulting in a condition known as hypoxia. When individuals experience hypoxia, they commonly exert symptoms such as headaches, fatigue, dizziness and sleepiness. Carbon monoxide exposures without proper respiratory protection can cause permanent damage to firefighter's cardiovascular system. The long-term effects of hypoxia results in damage to the respiratory apparatus of the body's cells and leads to irreversible tissue death. Studies with animals have shown that damage to heart muscle cells can occur when the concentration of carboxyhemoglobin in the blood reaches 8-10%. Firefighters, who can reach this level within a matter of minutes combating a fire, have shown higher incidences of myocardial infarction (heart attacks) due to such myocardial damage. In many instances, a person lacking adequate oxygen supplies can behave in a totally irrational manner, yet believe that they are acting normally. Thus, people attempting to escape in a fire have been known to try to knock down a closed door instead of simply turning the doorknob. Firefighters, trapped in smoke-filled buildings with depleted air supplies on their SCBA, have been known to behave in a disoriented manner as they attempt to escape. This scenario is commonly found in firefighters' deaths caused by smoke inhalation. A well-publicized example was the death of three firefighters in a Lubbock, Texas motel fire. While a number of causal factors have been identified and examined as potentially responsible for the fatalities, there was one common element linking the three firefighters. All three men had become disoriented in a large smoke-filled dining room. Hand prints found on the walls substantiate the point that the firefighters desperately tried to escape, but could not orient themselves properly to exit the room.

However, carbon monoxide is not necessarily always the primary killer in fires. Recent evidence indicates that fires involving plastic decomposition products can cause lung and pulmonary damage due to a metabolic acidosis or body reaction that abnormally reduces the alkalinity in the blood and tissues. Studies analyzing one of the primary chemical molecule of plastics, **polyvinylchloride (PVC)**, has discovered that it decomposes in a fire to form hydrogen chloride, phosgene and a host of other products, some of which are known or suspected carcinogens. PVC is a combination of many small similar molecules in a formation known as a polymer. It is widely used as a rubber substitute, as electrical and telephone wire and cable covering. The widespread use of PVC can also be found in electrical fixtures, plastic drains, interior plumbing, upholstery, raincoats, shoe soles, shower curtains, phonograph records, office copying machines, baby pacifiers, etc.

Although the products of degenerated PVC may not be severe toxic hazards as independent agents, there is concern that its synergistic effects could be extremely potent. That is, a situation whereby the combined toxic effect of an exposure to two chemicals is much greater than the sum of the effect of each chemical alone (for example, 3 + 1 = 8).

The following is one example of the potential dangers that exist for firefighters in fires containing PVC. Firefighters in Washington, D.C., without using SCBA, had quickly extinguished a fire confined

solely to an office copying machine constructed of teflon and other plastic parts. Smoke was not excessive during the course of the fire and the firefighters' work was completed in about 20 minutes. However, after arriving back at the station house, several firefighters complained of burning sensations in their throats, headaches, dizziness and nausea. Twenty-four hours after the fire, a 33 year-old firefighter collapsed in the station house. Reports later indicated that he had developed muscle spasms similar to those found during an epileptic seizure. However, the firefighter recovered quickly, indicated that he was okay and went into the kitchen area for lunch. After the meal, the sergeant on duty began looking for the firefighter to check on his condition. He was found unconscious on the floor next to his bed. Despite resuscitation efforts, the firefighter was pronounced dead on arrival about 26 hours after he had returned from the office fire. The coroner's report showed that he was suffering from severe pulmonary hemorrhaging and edema due to chemical pneumonitis from chemical fume exposures.

Another chemical that is more dangerous when interacting with other toxic materials is **hydrogen chloride (HCl).** Exposures even to low levels of hydrogen chloride are not willingly tolerated; if escape is not possible then death can result. When hydrogen chloride combines with water, it forms the compound hydrochloric acid, which can destroy the body's mucous membranes causing individuals to lose their sense of smell (anosmia). This can be critical to survival, since an individual would usually not be aware of the sensory loss and consequently does not realize that he should escape from the area. Although high concentrations of hydrochloric acid are not common in most fires, the loss of smell can lead to death or injury by unsuspected exposures to other toxic gases present in the environment.

Phosgene (COCl2) is still another colorless gas, but with the aroma of musty hay. Its use in industry is a recent development after originally being used as a chemical warfare agent during World War I. Overexposure to phosgene can cause bronchial irritation, dizziness, headaches and weakness. Fire deaths have been attributed to phosgene, which is generated from the extinguishing agent carbon tetrachloride (CCl_4). It can also be generated at fires involving electrical wiring.

Oxides of nitrogen (NO2, NO) are yellow and brown gases that cause many of the same symptoms as phosgene. They are produced at the scene of a fire by the oxidation or fixation of nitrogenous materials in the atmosphere. For example, nitrogen dioxide is formed when materials such as ABS plastics, cotton, and various wool and polyester products are burned. While oxides of nitrogen cause throat irritation, it is usually not noticed immediately because these chemicals anesthetize the throat. However, oxides of nitrogen can also irritate the lungs and initiate the secretion of such large amounts of fluids (pulmonary edema) that it causes an individual to suffocate. As mentioned earlier, it was the primary agent responsible for the fatalities at the Cleveland Clinic fire.

Hydrogen cyanide (HCN) is present at fires involving wool, silk, and other natural products along with a variety of other nitrogen polymers, such as nitriles, polyamides, nylons, urea formaldehyde and polyurethane (used in furniture upholstery and building materials). Although it is a colorless gas, it does possess a faint odor similar to bitter almonds. Low levels of exposure can cause weakness, headaches and confusion as hydrogen cyanide deactivates the catalysts necessary for metabolic oxidation in the body. That is, it stops tissue respiration. Exposure to high levels of hydrogen cyanide, such as fire in a clothing or carpeting store, can lead to respiratory failure and death.

Another colorless gas with a highly intimidating odor is **sulfur dioxide (SO2)**. It is generated at a fire by the incomplete combustion of sulfur containing materials, such as plastics, polysulfones (a component of alkaline battery cases and electronic parts), and chlorosulfonated polyethylene (used in beds and upholstery). The overpowering odor of the compound limits its toxic effects; however, it is another chemical that in conjunction with other toxic gases can lead to serious injury or death.

Hydrogen sulfide (H2S) also gives off an immediately recognizable odor, which can be easily mistaken for rotten eggs. Low exposure levels will result in eye irritations while exposures to higher

concentrations for short durations of time (thirty minutes) can lead to death as hydrogen sulfide acts to paralyze the medulla, the respiratory center of the brain. Like hydrogen chloride, it can also cause the loss of smell. It is commonly found at fires when rubber insulation and woolen materials are present.

Acrolein (CH2=CHCHO) is another toxic compound formed at fires as a result of the combustion or pyrolysis (a chemical change brought about by heat) of cellulosic materials (wood, cotton, paper), plastic materials (styrene, polyoefins) and glycerol products (oils, fats). When acrolein is inhaled it can produce symptoms, such as nose and throat irritation, nausea, shortness of breath, lung damage, pulmonary edema, and possibly even death.

Even **carbon dioxide (CO2),** produced from the complete combustion of organic materials (chemical compounds containing carbon) at a fire, can be dangerous at extremely high levels. Although carbon dioxide is a necessary part of normal respiration, at high exposure levels, it is a prime example of a synergistic agent. That is, carbon dioxide increases the effects of other toxic compounds in the air by speeding up the rate of respiration. When the acidic-tasting carbon dioxide is present at hazardous levels (and consequently low levels of oxygen in the body), persons tend to complain of headaches, dizziness and hyperventilation.

Although there have been few studies directly linking firefighting and cancer, there does appear to be significant circumstantial evidence that when firefighters are exposed to known or suspected carcinogenic substances it can lead to cancer.

The inhalation of **benzene (C6H6)** can result in irritation of the eyes, drowsiness, nausea and headaches at low exposure levels. When inhaled at high levels, unconsciousness and death can result from respiratory paralysis. Benzene, which has been recognized for a century as a powerful bone marrow poison, has recently been identified by the National Institute for Occupational Safety and Health (NIOSH) as a human leukemogen. The degradation of PVC appears to be one of many sources of benzene in a fire environment. Other likely sources are petroleum products that act as a fuel in a fire along with the thermal degeneration of other plastic compounds, such as styrene. Benzene appears to be a prevalent component in fires when gasoline stations, auto repair shops and even homes when synthetic materials are involved.

Firefighters can be exposed to aromatic carcinogens as well, such as **MOCA (4,4-methylene bis (2-chloroaniline)), benzidine**, and **phenol.** MOCA is used in the manufacture of isocyanate resins in the plastics, aircraft and synthetic rubber industries; communication equipment; and space and missiles components. Benzidine is used in plastics, rubber and dyes. The hazards of exposure associated with phenol was seen several years ago, when a tanker in Pennsylvania carrying 11,000 tons of phenol burned for almost two days while firefighters attempted to extinguish it.

The list of potential carcinogens that firefighters are exposed to goes on and on. **Chlorinated hydrocarbons**, which are used as solvents, degreasing agents, cutting fluids and fumigants, can be found at fires involving dry cleaning establishments, especially when carbon tetrachloride was used as an extinguishing foam. PCDDs (poly-chlorinated dibenzodioxins) and PCDFs (polychlorinated dibenzodifurans) are generated by the burning of pentachloropenol, which is widely used as a termite control in residential homes. Another chlorinated hydrocarbon, TCE (1,1,2-trichloroethane) can be generated at service station and auto repair shop fires.

Another carcinogenic agent that firefighters are frequently exposed to is **asbestos**. This exposure usually occurs after the fire during overhaul when respiratory protection is frequently discarded. Asbestos can be found in many places in a building's structure. It is commonly used for thermal and acoustic insulation, acoustical tile, decorating and fire-proofing surface materials, adhesives, caulking, spackling compounds, roofing, wall boards and floor tiles. During the overhaul period as firefighters are pulling down ceilings and breaking open walls to search for fire extension, asbestos fibers may become airborne and inhaled.

Firefighters can not only be exposed to toxic and carcinogenic substances at a fire, but also when they respond to other emergencies such as transportation chemical spills. The following example, which occurred in Southern California, illustrates the hazards of such incidents. In 1973, a tanker truck containing a potentially carcinogenic **dichloropropene/dichloropropane** mixture spilled on the roadway after an accident. Nineteen firefighters were involved in the clean-up, two of whom died in 1980 from cancer of the lymph glands. Furthermore, a similar cancer increase has been experienced by residents in the surrounding community.

In emergency situations involving electrical installation, storage, or highway transportation accidents, firefighters also risk exposure to **polychlorinated biphenyls (PCB).** While utility workers involved in a PCB spill realize the highly toxic and suspected carcinogenic properties of this substance and don special, impermeable clothing, firefighters are frequently unaware of the nature of the substance they are dealing with. In fact, they could be taking contaminated equipment back to the station house and contaminated clothing back to their own homes. During the Elizabeth, New Jersey chemical dump fire, firefighters actually took contaminated hose back to the station house. They started to clean the hose, with the substances on the hose draining right by a mobile van headquarters for the U.S. Environmental Protection Agency (EPA) and the U.S. Coast Guard, until an IAFF staffer pointed out that the hose contained the same toxic chemicals as those present at the dump site.

A number of **pesticides** found at agricultural sites, grocery stores, drug stores, garden and plant shops, hardware stores and residential homes have also been found or suspected of being cancer-causing agents. The list includes chlordane, heptachlor, aldrin, dieldrin, mirex, chlordimeform and chloroform. A fire in 1974 at an agrochemical co-operative warehouse in the midwest resulted in feelings of mental distress, depression, anger, violence, suicide and memory dysfunction. Physiological symptoms included chest tightness and shortness of breath. An investigation by the National Institute for Occupational Safety and Health (NIOSH) supported the fact that these symptoms were related to the fire even though they were surfacing five years after the fire had occurred. Although the long-term effects of this pesticide fire are unknown, there is the potential that these firefighters may develop more serious diseases in the future.

While many pesticides and hydrogen cyanide have been identified as respiratory hazards when inhaled, some can also be absorbed through the skin. In this situation, the firefighter would need not only positive-pressure SCBA but also special protective clothing. This would also hold true when firefighters must respond to emergencies involving **radioactive materials**. Radioactive materials are used in X-rays, nuclear power plants, biological and chemical research, food and medical supplies sterilization, and so forth. Probably the most serious situation involving radioactive materials would occur during a transportation fire. High-level radiation sources are usually shipped in lead and steel containers. If these containers are damaged or destroyed during a transportation accident, then the combustible materials and the radioactive substances could combine creating a sustained fire as well as releasing radioactive substances into the environment.

Whether synergistic effects are present with carcinogens is unknown at this time. Firefighters, especially, those not using positive-pressure SCBA may be unsuspecting victims, whose illnesses or deaths will finally allow medical researchers to determine and understand the effects of multiple exposures to toxic or carcinogenic substances, even at low concentrations.

The above discussion only highlights some of the ingredients commonly found in the modern fire environment. It would take hundreds of pages to adequately describe all of the potential toxic substances that could be encountered by a firefighter. *Even then, firefighters would probably still be entering potential toxic atmoshperes without adequate knowledge of the environment.* The need to wear positive-pressure SCBA in any emergency environment is clearly illustrated in the following example.

This incident occurred several years ago when two firefighters died during a rescue mission. In this instance, the fire department was called after four employees had "reportedly" fallen down the stairs in the basement. The first employee had entered the basement to shut off a sump pump overflowing with sledge. The other three employees entered the basement to assist the first employee, who appeared to have slipped and fallen off the stairs. The two responding firefighters immediately collapsed and fell into the sludge. All six people died because of the toxic materials created by the sludge - **hydrogen sulfide and methane gas** (CH_4). While the back-up units entered the basement wearing "demand" SCBA, they still experienced dizziness, faintness, shortness of breath, coughing, choking, nausea, vomiting, etc.

UNIT TWO: EVALUATION

HAZARDOUS MATERIALS
OPERATIONS-LEVEL TRAINING
FOR THE FIRST RESPONDER

MEDICAL SURVEILLANCE

After this section, students will be able to:

1. DEFINE "MEDICAL SURVEILLANCE".
2. IDENTIFY ELEMENTS OF MEDICAL SURVEILLANCE.
3. EXPLAIN WHY MEDICAL SURVEILLANCE IS IMPORTANT TO FIRST RESPONDERS.
4. CITE THE OSHA STANDARD REQUIRING MEDICAL SURVEILLANCE.

❑ Introduction to Medical Surveillance

HazMat incidents often place First Responders in uncontrolled and potentially hazardous environments. Opportunity exists for exposure to a large array of chemical, biological, and physical hazards. It makes sense, therefore, to monitor the health of those responding to such incidents by performing periodic medical examinations. Such examinations are designed to detect early changes in health so that exposures can be recognized and controlled before irreversible disease processes begin. These medical examinations are usually performed within a medical surveillance program.

Medical surveillance is the collection and interpretation of data from monitoring programs and from other available sources for the purpose of detecting changes in the health status of individuals and groups.

The focus of medical surveillance is on changes that have already taken place, providing a means of early detection of potential medical problems. Ideally, surveillance should be performed on First Responders throughout their working lifetimes.

The unique and hazardous work environments of First Responders (as well as fixed site-hazardous waste workers) has prompted OSHA to establish a health protection standard for hazardous waste workers and emergency response (29 CFR 1910.120). In it, medical surveillance is a required part of the health protection program for these workers. Firefighters, therefore, have a right to medical surveillance under OSHA law. All First Responders should be familiar with what the law requires to ensure that they get their rightful protection.

EXAMPLE:
Sun Valley, California, 1985

A fire at a chemical company burns a wide variety of chemicals. Firefighters arriving on the scene note flames consuming the roof, and explosions sending showers of sparks through the air. Though the door of the facility is placarded with an NFPA placard (indicating highly hazardous, flammable, and reactive materials present), the fire department has no information about the specific chemicals involved or their amounts. A six-block area is evacuated. Though firefighters wear SCBA while on the fireground, many do not use SCBA after the fire is extinguished. Police officers also do not use any respiratory protection while directing traffic. Fifty-two firefighters and three police officers are evaluated for nausea, respiratory difficulties, and dizziness. Vital signs and breath sounds are assessed. Symptomatic treatment is given.

Evaluation of the site following the fire indicates that there are several containers labeled for hydrogen fluoride, uranium acetate (radioactive material), and asbestos present. Actual quantities of the materials cannot be documented.

Two months later, two police officers and two firefighters remain off duty with respiratory and other injuries (including congestion and nose blisters) as a result of exposure to the smoke.

❑ Elements of Medical Surveillance

The health status information required for a medical surveillance program can be gathered from several different sources. These data sources, or "elements," include:

- **QUESTIONNAIRE DATA**

  Questionnaire data should include medical, occupational, family, and other personal background. Special emphasis should be placed on any current symptoms that might be related to exposure to hazardous substances.

In addition, risk factors that may predispose an individual to an undesirable health effect should be discussed. For example, it is important to determine whether there are any cardiac or respiratory disease history or risk factors for someone who will be required to wear full respiratory protection.

A detailed occupational history should be given including current job duties, all previous job duties, and part-time work to determine if there are previous or current exposures that should be made known to medical personnel. Non-occupational activities (that is, hobbies and neighborhood environment) should also be discussed in order to reveal any potential exposure to hazards in the non-work environment.

- **PHYSICAL EXAMINATION**

A comprehensive exam of all body systems, especially vision, hearing, cardiovascular, pulmonary, and musculoskeletal systems, should be performed. Any further emphasis should be keyed to other target organs for agents of presumed exposure. Examinations that should be performed are:

1. Pre-placement exams when a First Responder is hired or changes job duties.

2. Medical testing for specific exposures depending on job assignment.

3. Periodic exams regularly scheduled at least annually to compare any medical changes with baseline data from the pre-placement exam.

4. Examination after a suspected or confirmed exposure to a hazardous material.

5. A termination or exit exam when a First Responder leaves a job or assignment.

- **DIAGNOSTIC MEDICAL TESTING**

Special medical testing such as blood tests, urinalysis, pulmonary function testing, and electrocardiograms may be performed. Certain tests, such as a complete blood count, should be conducted periodically or during a pre-placement exam in order to establish a baseline against which future exams can be measured.

EXAMPLE:

Firefighters respond to a fire at an agricultural research facility where there are burning insecticides and pesticides. In particular, the smoke carries vapors and dusts of organo-phosphate pesticides (e.g., parathion), as well as products of combustion. Though firefighters are wearing SCBA, the vapors and dusts cover them and come in contact with exposed skin, especially in the neck area and around their arms where the turnout coats overlap gloves.

Following this exposure, seven exposed firefighters report nausea and headaches. Of these, two heavily exposed firefighters also report numbness and tingling in their hands. All are evaluated at a nearby hospital, where health care personnel have been alerted to the possible exposures of the firefighters. In addition to routine blood chemistry tests (to assess liver function), serum cholinesterase levels are drawn to rule out pesticide toxicity. (Organic phosphates lower cholinesterase levels, and cholinesterase is an enzyme necessary for normal nerve function.)

The two most heavily exposed firefighters have cholinesterase levels at only 50% of their baseline levels. These two are admitted and are given intravenous medication (pralidixone and atropine) to treat the symptoms. Complete recovery is noted within 48 hours, and they are followed over the next three months with periodic blood tests.

The other firefighters are given treatment for their symptoms of headaches and nausea. Though they are not admitted, they are followed over the next few months until their cholinesterase levels return to baseline levels.

- **BIOLOGIC MONITORING**

Biologic monitoring measures the amount of an agent in an individual's body fluid. Ordinarily, biologic monitoring is not included in a general medical surveillance program because of the lack of knowledge about agents of exposure and the lack of specific tests to evaluate exposure to certain agents. However, special biologic monitoring studies may be included in a medical surveillance program when First Responders are potentially exposed to specific agents for which tests are available.

EXAMPLE:
Jersey City, New Jersey, 1982
Following a fire in several subway cars, the Port Authority of New York and New Jersey notifies the Jersey City Fire Department that the electrical components of the subway cars contain polychlorinated biphenyls (PCBs). Though none of the 45 firefighters directly involved in the fire are experiencing adverse reactions, biological monitoring is done to assess whether the exposure had increased the levels of PCBs in their bodies. Blood samples are drawn and analyzed for PCBs as well as for levels of other toxins produced when PCBs burn. Also, the site of the fire and two turnout coats are sampled for levels of these toxins. Though samples of the site and the clothing show small amounts of the toxins present, the blood levels reveal that the firefighters did not have higher levels of these toxins, when compared to levels of the general population.

- **Physicians written opinion**

The physician should already be aware of the department's policies regarding written opinion. Copies go to both the employer and the employee. The employer must be provided a copy for the employee. Medical records must be filed **SEPARATELY** from the personnel records. They are confidential.

The opinion must include:

1. Results of the medical exam and tests.

2. Physician's opinion as to whether the employee has any detected medical conditions which could increase risk of health impairment.

3. Physician's recommended limitation, if any, on the employee's assigned work.

4. A statement that the employee has been informed by the physician of the results of the medical exam and any medical conditions which require further exam or treatment.

The written opinion obtained by the employer should not reveal specific findings or diagnoses unrelated to occupational exposure.

- **Record keeping**

Maintenance and access to medical records must be performed in accordance with Occupational Safety and Health Administration regulations and maintained in accordance with NFPA 1500. OSHA regulations require the employer to assure that medical records on exposed workers be maintained for 30 years after they leave employment (29 CFR Part 1910.20). The results of medical testing and full medical records must also be available to the worker, his/her union representatives, and OSHA inspectors (29 CFR Part 1910.20).

Ideally, the medical records are maintained only by the health care personnel who provide occupational health services to the exposed employee, rather than by the employer.

- The employer must retain: the name and social security number of the employee, the physician's written opinion, any employee medical complaints related to exposure to hazardous substances, and a copy of the information provided to the examining physician by the employer.

- Record keeping and reporting of the medical surveillance program must be made. During this review, information on specific exposures, working conditions, and use of protective equipment must be incorporated into the analysis. For First Responders, this might translate to integration of medical information with a log of the alarms an individual responder has been on.

Exposure Records or incident reports completed after each alarm could be an extremely important diary of exposure opportunities, and may well be the legal proof needed in a contested worker compensation claim in the future. Such records also help health and safety representatives and medical personnel keep track of potentially exposed members who may require medical follow-up.

Summary

It is important for First Responders to monitor their health through periodic medical exams. Early detection of problems can help prevent the development of serious or chronic illness.

Firefighters have a right to medical surveillance under the law. Every First Responder should take the appropriate steps to ensure that his or her employer is taking proper steps to monitor employee health and safety as comprehensively as possible.

What information should be provided to the examining physician?

Providing materials associated with OSHA Hazardous Waste Worker Standard to physicians conducting your medical surveillance program will enhance the quality and benefit you receive. Your employer is required to provide the following:

1. A copy of OSHA Standard 29 CFR Part 1910.120, Hazardous Waste Operations and Emergency Response.
2. A description of the employee's duties as they relate to the employee's exposure.
3. The employee's previous exposure levels and anticipated exposure levels.
4. A description of any personal protective equipment used or to be used.
5. Information from the employee's previous medical exams which is not readily available to the examining physician.
6. NFPA 1001, 1500

HAZARDOUS MATERIAL EXPOSURE REPORT

THIS FORM IS TO BE COMPLETED EACH TIME THERE IS A SUSPICION THAT AN EMPLOYEE HAS BEEN EXPOSED TO A HAZARDOUS MATERIAL.

Employee Name _____ Rank_____

Station_____ Apparatus _____

Incident Number_____ Exposure Date_____

Incident Address_____

Name and Type of Occupancy_____

_____

What exposed to _____

_____

_____

How exposed_____

_____

_____

Duration of Exposure_____

SYMPTOMS:

Eyes_____ Ears Ringing_____

Cough_____ Headache_____

Dizzy_____ Skin Irritated/Rash_____

Nose/Lung Irritation_____ Unconscious_____

Nausea_____ Other_____

Cough Blood/Nose Bleed_____

EMPLOYEE SIGNATURE _____ Date_____

WITNESS_____ Date_____

HAZARDOUS INCIDENT RESPONSE TEAM
REFERENCE WORKSHEET

Chemical_____

Trade Name_____ U.N.#_____

Synonyms_____ E.P.A.#_____

Chemical Symbol_____ Nature of Associated Hazard:_____

Description

Physical State_____ Type of Containers_____

Appearance/Odor_____

Properties

Flash Point_____ Ignition Temp._____

Boiling Point_____ Flammable Limits_____

Vapor Density (Air=1)_____ Specific Gravity (H_2o=1)_____

Water Soluble? Yes____ No____ Slightly_____

Health/Safety

Life Hazard Notes_____

_____

Recommended Protective Clothing_____

Most compatible chemical suit_____

Reactivity_____

Incompatible with_____

Recommended firefighting methods/agents

Extinguishment methods_____

Neutralization methods_____

Stabilization methods_____

Evacuation Distances

Initial_____ Downwind_____ Crosswind_____

Reference Used_____ Filled out by_____

❑ EMERGENCY TREATMENT

- **FIRST AID for Exposure/Contamination**

1. Remove from contaminated area, if possible.

2. Evacuate to fresh air when a person has been overcome by fumes (vapors) or exposed to a gaseous poison. Administer O2 at 6-10L by mask.

3. Remove contaminated clothing and isolate. Ensure that rescuer is fully protected during this procedure. Wear rubber gloves.

4. Irrigate the eye with water for at least 15 minutes after eye exposure to any potentially harmful substances.

5. Decontaminate the skin if the patient has been exposed to something that will burn the skin or penetrate through it. Use large amounts of water and noncaustic soap.

6. If swallowed, administer a glass of milk or water to dilute the agent, unless the patient is comatose, convulsing, or has no gag reflex.

7. Save all vomitus and bring to the hospital should spontaneous vomiting occur.

- **THE MOST IMPORTANT PART OF THERAPY IS SUPPORT OF VITAL FUNCTIONS.**

Ensure an adequate airway. In the event of respiratory difficulties, whenever possible, arterial blood gases should be obtained to assess the adequacy of ventilation and oxygenation. Frequently this will not be possible. Depressed ventilation requires an increase in ventilation. Observe for changes in ventilation. Depressed ventilation with decreasing response will require ventilatory assistance. Be prepared to intubate before the ventilation becomes inadequate to support the patient. Hypoxia is associated with rapid respirations and shortness of breath. Administer oxygen. Both inadequate ventilation and hypoxia may be present. Intubate and administer oxygen. Support ventilation as necessary. Oxygen therapy may aggravate respiratory failure, which is seen in patients with longstanding respiratory disease. Watch for evidence of decreasing ventilation after giving oxygen or respiratory depressants such as morphine and demerol.

Determine level of consciousness. If patient is in shock, administer normal saline or Ringer's Lactate, IV, 2cc/min. Apply MAST Trousers, if necessary. Place patient in Trendelenburg position. AVOID vasopressors, if possible. If not in shock, initiate IV, D, W, KVO.

If cardiac or pulmonary problems occur, refer to the Appendix, from source listed below, for treatment.

If swallowed, initiate emesis with syrup of IPECAC except under the following conditions:

1. Ingestion of strong acids or bases;
2. Patient is unconscious, has lost gag reflex, or is seizing.

NOTE: In the past, emesis after ingestion of petroleum hydrocarbons was thought to be contraindicated. However, emesis is now encouraged by most poison centers. Activated charcoal and saline cathartic should follow gastric evacuation. They trap the poison, speed its elimination from the gastrointestinal tract, and are excreted in the stool.

- **FLUID THERAPY IS RECOMMENDED FOLLOWING THESE GUIDELINES:**

    1. If shock is present or imminent, Ringer's Lactate or saline should be administered at 2 cc/min.

    2. If shock is not present, and cardiac problems are present or anticipated, or drugs must be administered: D,W at a KVO rate is recommended.

Source: Stutz, D.R., Ricks, R.C., Olsen, M.F. Hazardous Materials Injuries A Handbook for Pre-Hospital Care, Bradford Communications Corp., Greenbelt, Maryland.

Chemical Effects on Organs & Diagnostic Tests

CHEMICAL	ORGANS AFFECTED		SPECIAL DIAGNOSTIC TESTS
Acetaldehyde	Eyes Lungs Central Nervous System (CNS) Upper Respiratory Tract* (URT)	Skin Brain	Urinalysis, Blood – Acetaldyhyde Content
Acetic	URT Teeth Lungs	Skin Eyes	Skin pH
Acetic Anhydride	URT Lungs	Skin	None
Acetonitrile	Skin Lungs Kidney Gastrointestinal (GI) Tract**	URT Liver	Urinalysis & Serum – Thiocyanate Content; Blood - Cyanide Content
Acetylene (See the following chemicals which may be present as impurities: Arsine, Hydrogen Sulfide, Phosphine, Carbon Disulfide, Carbon Monoxide)			
Acridine	Skin	Eyes	Urinalysis; Blood – Acridine Content
Acrolein	Lungs Skin	Eyes URT	None
Acrylonitrile	Eyes		Urinalysis—Thiocyanate Content; Blood – Spectrographic determination of Acrylonitrile; Exhaled Breath (G.C.***)
Allyl Alcohol	Eyes URT Skin	Lungs Liver Kidneys	None
Aluminum & Compounds	Skin	Lungs	Pulmonary Macrophage
Ammonia	Eyes Skin	URT Lungs	None

CHEMICAL	ORGANS AFFECTED		SPECIAL DIAGNOSTIC TESTS
Amyl Acetate	Eyes Lungs	Skin Nervous System	Exhaled Breath (GC)
Amyl Alcohol	Eyes Skin Nervous System	URT Liver	Blood – Amyl Alcohol Content
Aniline & Aniline Dyes (Some derivatives produce potentially malignant growths after years of exposure)	Skin Liver Urinary Tract	Heart Bladder	Blood – Methemoglogin; Erythrocytes – Heinz Bodies; Urinalysis – para-aminophenol and diazotizable metabolities determination
Antimony & Compounds	GI Tract URT Blood Heart	Skin Lungs CNS Nose	Blood & Urinalysis – Antimony Content by AA or Anodic Stripping
Arsenic CARCINOGENIC	Skin Kidney Nervous System	Lungs Liver	Urinalysis, Hair, and Nails – Arsenic Tri-oxide Content; breath may smell of garlic
Arsine	Skin Heart Liver	Blood Kidney Nervous System	Urinalysis, Blood, and Hair – Arsenic Content; breath may smell of garlic
Barium & Compounds	Skin Heart Blood	GI Tract URT Nervous System	Urinalysis – Barium Content
Benzene CARCINOGENIC	Skin Blood	URT Nervous System	Urinalysis – Phenol Content; Blood – regularly scheduled, complete blood exam essential
Benzidine & its Salts (See Aniline & Aniline Dyes)	Bladder (Cancer)		
Benzyl Chloride	Skin Lungs	URT	None
Beryllium & Compounds	Lungs Skin Eyes	Joints GI Tract Nose	Urinalysis, Blood, and Lung Biopsies – Beryllium Content

CHEMICAL	ORGANS AFFECTED		SPECIAL DIAGNOSTIC TESTS
Bismuth & Compounds	Skin	Mouth	Urinalysis & Blood – Bismuth Content
Bleaching Powder (See Chloride of Lime)			
Boron Compounds	Skin Eyes	Lungs Nervous System	Urinalysis, Blood and Body Tissue - Boron Content
Brass (See Copper & Zinc; also Lead may be present)			
Bromine & Compounds SUSPECT CARCINOGEN	Eyes URT Liver Nervous System	Skin Lungs Kidneys	Urinalysis & Blood – Bromide Content
Butadiene	Eyes URT	Skin Nervous System	None
Butanone (See Ketones)			
n-Butyl Acetate	Eyes URT	Skin	None
n-Butyl Alcohol	URT	Skin	None
n-Butylamine	URT Skin Nervous System	Lungs Eyes	None
Butyl Mercaptan (See Mercaptans)			
Cadmium SUSPECT CARCINOGEN	Skin Heart Liver Kidney Reproductive System	URT Lungs GI Tract Nervous System	Urinalysis & Blood – Cadmium Content
Calcium Cyanamide	Skin Eyes	URT Heart	Urinalysis & Blood – Cyanamide Content

CHEMICAL	ORGANS AFFECTED	SPECIAL DIAGNOSTIC TESTS
Calcium Oxide (Lime)	Skin Lungs Eyes URT	Blood & Skin pH
Carbon Dioxide	Skin Eyes URT (Asphyxiant)	Respiratory Rate
Carbon Disulfide	Eyes Skin Heart Liver Kidney GI Tract Olfactory Nervous System	Urinalysis & Blood – Carbon Disulfide
Carbon Monoxide	Total Body System (Decreases oxygen-carrying capacity of Blood)	Blood – Carboxyhemoglobin Content; Exhaled Breath – CO
Carbon Tetrachloride SUSPECT CARCINOGEN	Skin Eyes Pancreas GI Tract Liver Kidney Lungs Nervous System	Blood -- Carbon Tet Content; Exhaled Breath (G.C.)
Cellosolve (Ethylene Glycol Monoethyl Ether)	Skin Blood URT Eyes Nervous System	Exhaled Breath (G.C.)
Chloride of Lime	Skin Eyes URT Mouth Lungs	None
Chlorinated Benzenes	Skin Eyes URT	None
Chlorinated Diphenyls and Naphthalenes	Skin Liver	None
Chlorine	Skin Eyes Teeth Lungs URT	None
Chloroprene CARCINOGENIC	Skin URT Hair Lungs Liver Kidney Nervous System	None
Chromium Compounds CARCINOGENIC	Skin Eyes Lungs Nose URT	Urinalysis, Blood – Chromium Content

CHEMICAL	ORGANS AFFECTED		SPECIAL DIAGNOSTIC TESTS
Coal Tar & Fractions CARCINOGEN	Skin Lungs	Eyes	Skin--exam under Wood's light; histologic exam of skin biopsy
Cobalt and Compounds	Skin Lungs	Eyes GI Tract	None
Copper and Compounds	Skin URT	Nose Eyes	Urinalysis, Blood – Copper Content
Cresol	Skin URT Liver	Eyes Lungs Kidney	None
Cycloparaffins	Eyes	Skin	Exhaled Breath (G.C.)
Diacctone Alcohol	Eyes Blood Nervous System	URT Kidneys	None
1,2-Dichloroethylene	Skin	URT	Exhaled Breath (G.C.)
Dichloroethyl Ether	Eyes Lungs	URT	None
Dimethylformamide	Skin Eyes URT Reproductive System	Liver Kidneys GI Tract	None
Dimethylhydrazine	Skin Eyes Kidneys URT	Blood Liver GI Tract Repro System	None
Dimethyl Sulfate	Skin Lungs Kidney	Eyes Liver Nervous System	None
Dinitrobenzene	Skin	Liver	Urinalysis – Dinitrobenzene Content Blood – Methemoglobin
Dinitrophenol	Skin Kidney Nervous System	Eyes Liver	Urinalysis – Dinitrophenol and amino-nitrophenol Content

CHEMICAL	ORGANS AFFECTED		SPECIAL DIAGNOSTIC TESTS
Dioxane	Eyes URT GI Tract	Kidneys Liver	None
Diphenyls, Chlorinated (See Dimethylformamide)			
Epichlorohydrin SUSPECT CARCINOGEN	Skin URT Liver High Blood Pressure	Eyes Lungs Kidneys	None
Ethtyl Acetate	Eyes Skin Nervous System	URT Lungs	Exhaled Breath (G.C.)
Ethyl Alcohol	Eyes Liver	Skin URT	Urinalysis, Blood, and Exhaled Breath – Alcohol Content
Ethylbenzene	Skin CNS	URT Eyes	Urinalysis – Hippuric Acid Content
Ethyl Chloride SUSPECT CARCINOGEN	Skin Heart Nervous System	Eyes Kidneys	None
Ethylene Chlorohydrin	Eyes URT Liver	Blood Lungs Kidneys	Urinalysis, Blood and Exhaled Breath – Ethylene Chlorohydrin Content
Ethylenediamine	Skin Eyes Lungs	Kidneys URT	None
Ethylene Dibromide SUSPECT CARCINOGEN	Skin Eyes URT Reproductive System	Lungs Liver Heart	None
Ethylene Dichloride CARCINOGENIC	Eyes URT GI Tract	Liver Skin Nervous System	None
Ethylene Glycol	Eyes Blood	Kidneys Nervous System	None

CHEMICAL	ORGANS AFFECTED		SPECIAL DIAGNOSTIC TESTS
Ethylene Glycol Dinitrate	Skin Circulatory System	Heart	Electrocardiograms, Blood Pressure
Ethylene Oxide SUSPECT CARCINOGEN	Eyes Lungs	Skin Nervous System	None
Ethyl Ether	Skin Reproductive System	Nervous System	Blood -- Ether Content
Ethyl Silicate	Eyes URT Kidneys	Lungs Liver	None
Fluorine & Compounds	Skin URT Bones	Eyes Lungs	Urinalysis, Blood – Fluoride Content; Roentgenogram of spine
Formaldehyde	Eyes Skin	URT Repro System	None
Formic Acid	URT	Skin	None
Freon	URT Heart	Lungs Nervous System	None
Furfural	Skin URT	Eyes	None
Gasoline	Skin URT GI Tract	Eyes Lungs	None
Germanium Compounds	URT		Urinalysis, Feces – Germanium Content
Graphite (May contain Silica; See Silica)			
Hexamethylenetetramine	Skin Kidneys	GI Tract	None
Hydrazine	Skin Lungs Reproductive System	Eyes URT	Blood Plasma – Pyridyl Test for Hydrazine Assay

CHEMICAL	ORGANS AFFECTED	SPECIAL DIAGNOSTIC TESTS
Hydrogen Chloride	Eyes Skin URT Teeth Lungs (Choking sensation usually causes one to leave area before lungs are affected)	None
Hydrogen Cyanide	Total Body System	Blood Tissues – Cyanide Determination; Serum, Urinalysis – Thiocynate Content
Hydrogen Fluoride (See Fluorine & Compounds)		
Hydrogen Peroxide	Skin Eyes URT Lungs	None
Hydrogen Sulfide	Skin Eyes URT Lungs GI Tract Heart	None
Hydroquinone	Skin Eyes Blood	Urinalysis – Hydroquinone Detection
Iron Compounds	Skin URT Lungs	None
Isopropyl Acetate	Eyes URT Nervous System	None
Isopropyl Alcohol	Eyes URT	Urinalysis, Blood, and Body Tissues – Isopropyl Alcohol And Acetone Content
Kerosine	Skin Lungs Nervous System	None
Ketones	Skin URT Nervous System	Blood, Urinalysis - Acetone Content
Lead	GI Tract Blood Cardiovascular	Blood – Lead Content, Free Electrolyte Protoporphyrin; Blood Smear – Stipple Cells; Urinalysis -- Lead and Coproporphyrin

CHEMICAL	ORGANS AFFECTED		SPECIAL DIAGNOSTIC TESTS
Manganese Compounds	URT	Nervous System	Urinalysis, Blood, and Feces - Manganese Content
Mercaptans	Skin	Nervous System	None
Mercury & Compounds	Skin Kidneys Circulatory System Reproductive System	GI Tract Nervous System	Urinalysis – Mercury Content
Methyl Alcohol	Skin Kidneys URT	Eyes Liver Nervous System	Blood - Methyl Alcohol; Urinalysis – Formic Acid & Methyl Alcohol
Methyl Bromide (See Bromine & Compounds)			
Methyl Butyl Ketone (See Ketones)			
Methyl Chloride	Liver Nervous System	Kidneys	None
Methyl Chloroform	Eyes Nervous System	Skin	Blood – Infrared Analysis for 1,1,1-trichloroethane
Methylene Chloride	Eyes Lungs	URT Nervous System	None
Methyl Formate	URT Nervous System (unusual)	Skin	None
Methyl Mercaptan (See Mercaptans)			
Molybdenum & Compounds			Blood, Urinalysis – Molybdenum Content
Naptha	Skin URT	Eyes Nervous System	None
Napthalene	Skin Kidneys Liver	Eyes Bladder CNS	Urinalysis – Napthalene Content; Erythrocytes – Heinz Bodies

CHEMICAL	ORGANS AFFECTED	SPECIAL DIAGNOSTIC TESTS
Napthylamine (Beta) CARCINOGENIC	Skin Bladder Kidneys	Urinalysis -- Napthylamine Content
Nickel & Compounds CARCINOGENIC	Skin Lungs	Blood, Urinalysis – Nickel Content
Nickel Carbonyl CARCINOGENIC	Skin Lungs URT Nervous System	Blood, Urinalysis – Nickel Content
Nitric Acid	Skin URT Eyes Lungs	None
Nitrobenzene	Skin Liver Nervous System Total Body System	Blood – Methemoglobin Content; Urinalysis - Nitrophenol Content (affects oxygen-carrying ability of blood)
Nitrogen Oxides	Eyes URT Lungs	None (Nitrous Oxide a mild anesthetic)
Nitroglycerin	Heart Skin Eyes Total Body System (Toxic effects of nitroglycerin increased by alcohol consumption)	None
Nitroparaffins	Eyes URT Skin Nervous System	None
Nitrophenols (Ortho-, Meta-, and Para-)	Circulatory System	Urinalysis - Paranitrophenol Content
Osmium & Compounds	URT Eyes Lungs Skin (Osmium Salts)	None
Oxalic Acid	Heart Skin URT Kidneys Nervous System	Blood – Calcium Level
Ozone	Eyes URT Lungs Nervous System	None
Perchloroethylene	Skin Eyes Nose Nervous System	Blood – Tetrachloroethylene Content

CHEMICAL	ORGANS AFFECTED	SPECIAL DIAGNOSTIC TESTS
Phenol	Lungs Bladder Nervous System Corrosive to all Body Tissue	Urinalysis, Blood – Phenol Content
Phenylhydrazine	Skin Liver Kidneys Heart GI Tract Circ. System	None
Phosgene	Skin URT Eyes Lungs	None
Phosphine	Eyes Nose Skin Lungs Kidneys Nervous System Total Body System	None
Phosphorus & Compounds	Skin Eyes URT GI Tract Liver Kidneys Heart Lungs Gones (especially jaws)	Roentgenographic exam of lower jaw to detect necrosis of mandible
Phthalic Anhydride	Eyes Skin URT Lungs	None
Picric Acid	Skin GI Tract Nervous System	Urinalysis – Picric Acid Content
Platinum & Compounds	Skin URT	None
Propyl Acetate	Skin URT	None
Propyl Alcohol	Eyes URT Nervous System (mild depressant)	None
Propylene Dichloride	Skin URT Liver Kidneys CNS Heart	None
Pyridine	Eyes Nose Throat Skin Nervous System	None
Quinone	Skin Eyes Lungs Nervous System	Urinalysis – Hydroquinone Content

CHEMICAL	ORGANS AFFECTED	SPECIAL DIAGNOSTIC TESTS
Selenium & Compounds	Skin Eyes URT Lungs Liver GI Tract Nervous System	Urinalysis – Selenium Content
Silica Dust	Lungs	Pulmonary function tests
Silver & Compounds	Skin Eyes Lungs	Skin – Exam with Ultra violet Lamp; Cornea - Exam with Slit Lamp
Sodium & Potassium Hydroxides	Skin Eyes URT Lungs	None
Styrene SUSPECT CARCINOGEN	Eyes Nose Throat URT Nervous System	Urinary Vanillyl Mandelic Acid (VMA) Measurements
Sulfur Dioxide	Eyes URT Lungs Skin	None
Sulfuric Acid	Eyes URT Lungs	None
Sulfur Monochloride	Skin Eyes URT Lungs	None
Tellurium & Compounds	Nervous System	Urinalysis, Feces – Tellurium Content
Tetrachloroethane	Skin Liver Kidneys Heart Nervous System	None
Tetraethyl Lead (TEL)	GI Tract Blood Nervous System Reproductive System	Blood, Urinalysis – Lead Content
Tetramethyl Lead	Same as TEL but more of inhalation hazard	Blood, Urinalysis – Lead Content
Tetramethylthiuram Disulfide	Skin Lungs Liver Kidney (Intolerance to Alcohol)	None

CHEMICAL	ORGANS AFFECTED	SPECIAL DIAGNOSTIC TESTS
Tetryl	Skin Eyes Nose Liver GI Tract	Skin – Webster's Reagent (diluted solution of sodium hydroxide in ethyl alcohol) turns dark brown by tetryl on skin
Thallium & Compounds	Skin GI Tract Nervous System Circulatory System Hair falls out	Blood, Urinalysis – Thallium Content
Thorium & Compounds	Skin (Mesothorium, radium 228, produced malignant tumors in radium dial painters)	Blood, Urinalysis – Thorium Content; Breath – Thoron; Feces – Thorium X
Tin & Compounds	Skin URT Lungs (stannosis) Brain (cerebral edema)	Tissue – Tin Content
Titanium & Compounds	URT Skin Lungs (Titanium Tetrachloride)	None
Toluene (See Also Benzene; may contain benzene as an impurity)	Skin Eyes URT Liver Nervous System Circulatory System	Blood- Toluene Content; Urinalysis – Hippuric Acid
Tolylene Diiosocyanate (TDI)	Eyes Nose Throat Skin Lungs	None
Trichloroethylene CARCINOGENIC	Eyes Skin Heart Lungs Liver Nervous System (Pronounced intolerance to alcohol)	Urinalysis – Determine Metabolites (trichloroacetic acid and trichloroethanol)
Tricresyl Phosphate	Skin GI Tract Nervous System (paralysis)	Plasma – Cholinesterase Activity
Trinitrotoluene (TNT)	Skin GI Tract Liver Circ. System Blood (aplastic anemia)	Urinalysis – Qualitative & quantitative Analysis for Trini-trotoluene and its metabolites

CHEMICAL	ORGANS AFFECTED	SPECIAL DIAGNOSTIC TESTS
Turpentine	Skin Eyes Nose GI Tract Lungs Kidneys Nervous System	None
Uranium & Compounds (CARCINOGEN)	Kidneys Liver Lungs	Urinalysis – Uranium Content
Vanadium	Eyes Nose Throat URT Lungs Blood	Urinalysis – Vanadium
Vinyl Chloride CARCINOGENIC	Skin Eyes Nervous System	None (Releases Phosgene when heated to decomposition; causes Angiosarcoma, a rare liver cancer)
Xylene	Eyes Nose Throat Skin Nervous System	None
Zinc & Compounds	Skin Eyes Nose Throat Lungs URT GI Tract (Zinc refining) Nervous System (Zinc oxide fumes cause "brass founders' ague" or "brass chills", a short-lived illness)	None
Zirconium Compounds	Some anti-perspirants containing zirconium salts have produced inflammation of the armpit	None

*Upper Respiratory Tract (URT) = Nose, throat, windpipe, and bronchi.
**Gastrointestinal (GI) Tract = Stomach and intestines.
***G.C. = Gas Chromatograph, a method of analysis.

NOTE: OSHA regulations require medical examinations for the following substances:		
Asbestos	N-Nitrosodimethylamine	Beta-Propiolactone
Vinyl Chloride	Bis-Chloromethyl Ether	2-Acetylaminoflourene
4-Nitrobiphenyl	Benzidine	4-Dimethylaminoazobenzene
4,4-Methylene Bis (2-Chloroaniline)	Ethyleneimine	Cotton Dust
Alpha-Naphthylamine	Coke Oven Emmissions	Acrylonitrile
Methyl Chloromethyl Ether	Benzene (not in effect at this time; on appeal to U.S. Supreme Court)	Lead (standard on appeal)
3,3-Dichlorobenzidine (and its salts)	Beta-Naphthylamine	Dibromochloropropane
4-Aminodiphenyl	Arsenic	

PERSONAL PROTECTIVE EQUIPMENT

After this section, students will be able to:

1. UNDERSTAND THE IMPORTANCE AND PURPOSE OF PERSONAL PROTECTIVE EQUIPMENT.
2. DIFFERENTIATE BETWEEN NFPA LEVELS OF PROTECTION AND EPA LEVELS OF PROTECTION.
3. EXPLAIN EACH EPA LEVEL OF PROTECTION.
4. CITE THE CONDITIONS REQUIRING EACH LEVEL OF PROTECTION.
5. PROVIDE SEVERAL LIMITATIONS TO CHEMICAL PROTECTIVE CLOTHING.
6. EXPLAIN THE ADVANTAGES AND DISADVANTAGES OF A VARIETY OF MATERIALS USED FOR CHEMICAL PROTECTIVE CLOTHING.
7. DEFINE PERMEATION, DEGRADATION, AND PENETRATION.
8. SELECT THE PROPER PERSONAL PROTECTIVE EQUIPMENT FOR A DEFENSIVE RESPONSE TO A HAZARDOUS MATERIAL INCIDENT.

❑ Why is personal protective equipment (PPE) necessary?

Personal protective equipment (PPE) is necessary to protect the responder from the adverse health affects of working with hazardous materials. Wisely chosen PPE can provide protection against *some chemical hazards.* No PPE is sufficient for all hazards. Predominant physical, chemical or toxic properties of the material dictate the type and degree of exposure.

❑ How can PPE protect me from injuries?

Many accidents involving hazardous materials can be prevented by the wearing of proper PPE. Every precaution should be taken against hazards that may be encountered during a hazardous materials emergency response. Administrative methods such as pre-planning with chemical manufacturers, businesses and agencies within your area, determining the type of suits to purchase, properly using and caring for the PPE, and training with the PPE will greatly reduce injuries.

Potential injuries that may occur can be of acute or chronic nature. Examples of acute injuries that occur are chemical burns, thermal burns, immediate reaction due to body absorption, extreme and excessive heat or cold, punctures, lacerations, and abrasions. Chronic injuries that might occur include hypersensitivity to chemicals, cancer, and damage of target organs. Chronic injuries could occur if the PPE is not properly decontaminated or if the wrong Chemical Protective Clothing (CPC) material is worn. For example, leather should never be used when pesticides are involved. Rubber is also inadequate against certain pesticides. Some pesticides will penetrate through rubber and leather as if it were not even there.

❑ Is there any legal basis for the use of PPE?

The use of PPE is required by the Occupational Safety and Health Administration to protect individuals from acute and chronic effects of exposures. NFPA also has developed standards for PPE use and has adopted NFPA 471 - *Recommended Practice for Responding to Hazardous Material Incidents* which has a chapter on personal protective equipment.

❑ What are some other types of PPE?

Properly selected chemical protective clothing can minimize risk of exposure to chemical materials, but may not protect against physical hazards. The use of other PPE must also be determined for safety purposes. Head protection is provided by hard hats even within CPC. Eye and face protection can be provided by goggles or impact resistant lenses in spectacles and face shields. Earplugs and earmuffs provide hearing protection and impact resistant and chemically resistant boots provide foot protection. (See Attachments)

❑ Are there any guidelines to go by when selecting PPE?

The National Fire Protection Association and the Environmental Protection Agency both classify levels of protection. The NFPA standards are written for fire fighting. The EPA standards are written for emergency response for all occupations. Figure 1 compares the two standards.

Figure 1

EMERGENCY RESPONSE PERSONAL PROTECTIVE EQUIPMENT

NFPA	EPA
Type 1 – Structural	Level D – Work Clothes, Hard Hat, Eye Protection, Steel-Toed Boots
Type 2 – Specialized High Temperature (Approach, Proximity, Fire Entry)	Level C – Chemical Resistant Clothing with Full-Face Air Purifying Respirator.
Type 3 – Chemical	Level B – Chemical Resistant Clothing with Positive Pressure SCBA.
(Non-encapsulated, Types I, II, III) Chemical Protective Clothing	Level A – Fully Encapsulating Suit with PP-SCBA Inside.

NOTE: In this training we will be concentrating only on EPA Levels A, B, C, and D classification for levels of protection.

❑ What is Level D protection and under what conditions should this level of protection be worn?

Level D is primarily a work uniform worn on any site where respiratory or skin hazards do not exist. Conditions during which Level D should be worn are when compounds of concern do not have adverse skin and eye effects; there are no hazardous air pollutants measured or anticipated; work function precludes splashes, immersion, or potential for unexpected respiratory hazards; and there are no exposures anticipated above the TLV levels.

❑ What is the recommended PPE for Level D protection?

- **COVERALLS/WORK CLOTHES:**
  - Boots/shoes, leather, or chemical-resistant steel toe and shank (also metatarsal if protection of top of foot required).
  - Hard hat (NFPA fire helmet)
  - Safety glasses or face-shield

- **OPTIONAL EQUIPMENT:**
  - Escape mask (air-supplied)
  - Rain suit (for precipitation)
  - Boots (outer), chemical-resistant (disposable)

❑ What is Level C protection and under what conditions should this level of protection be worn?

Level C protection is selected when the type of airborn substance is known, concentration measured and skin and eye exposure unlikely. Conditions which would require Level C protection are when limited direct skin and eye contact with hazardous compounds or air contaminants will not result in severe damage and/or irreversible effects; work function only involves potential for minor splashes and excludes total body splashes or immersion; and concentrations of skin-absorbing compounds are less than TLV levels.

❑ What is the recommended PPE for Level C protection?

- Negative-pressure respirator with proper cartridge filters.

- CHEMICAL-RESISTANT CLOTHING:
  - Hooded chemical-resistant coveralls (disposable)
  - Hooded two-piece chemical splash suit
  - Coveralls (outer) can protect individual from abrasions, punctures, etc.

- GLOVES:
  - Chemical-resistant outer gloves
  - Chemical-resistant inner gloves
  - Cloth or leather work gloves (disposed of after use)

- BOOTS:
  - Chemical-resistant, steel toe and shank

❑ What is Level B protection and under what conditions should this level of protection be worn?

Level B protection should be used when the type and atmospheric concentration of substances have been identified and require a high level of respiratory protection, but less skin protection. Level B would be appropriate when direct skin and eye contact with hazardous compounds or air contaminants may cause severe damage and/or irreversible effects.

Level B should also be used when materials being handled have been identified and do not present a severe skin hazard or when contaminants have not been completely identified but off-site investigations and observations do not indicate the presence of chemicals harmful to the skin or capable of being absorbed through the skin.

❑ What is the recommended PPE for Level B protection?

- RESPIRATORY PROTECTION:
  - Positive pressure, full face-piece SCBA or Positive pressure supplied air respirator with escape SCBA.
- CHEMICAL-RESISTANT CLOTHING OPTION:
  - Hooded chemical-resistant coveralls
  - One or two-piece chemical splash suit
  - Hooded, chemical-resistant rain suit
- GLOVES:
  - Chemical-resistant inner gloves (may be intrinsic to suit)
  - Chemical, abrasion-resistant outer glove (worn over glove attached to suit)
- BOOTS:
  - chemical-resistant, outer, steel toe and shank
- OPTIONAL:
  - Coveralls
  - Boot-covers, outer, chemical-resistant, disposable
  - Hard hat
  - Face shield

SCBA Checkout Outline

1. Before Proceeding, Check That:

- ❑ High-pressure hose connector is tight on cylinder fitting
- ❑ Bypass valve is closed
- ❑ Black level on breathing valve (on face piece) is in the "off" position (against the valve housing)

2. Backpack and Harness Assembly.

- ❑ Visually inspect straps for wear, damage, completeness.
- ❑ Check wear and function of buckle.
- ❑ Check backplate for damage and attachment to cylinder.

3. Cylinder and High-Pressure Hose Assembly

- ❑ Check cylinder to ensure it is firmly fastened to backplate, and the valve is snapped into its holder and locked.
- ❑ Open cylinder; listen and feel for leakage around packing and hose connection.
- ❑ Check high-pressure hose for damage or leaks.

4. Leakage and Function Test of Spiromatic.

- ❑ Make sure the bypass is off by turning the knob away from the mask (counter-clockwise) until you hear or feel a click.
- ❑ Check that the positive pressure switch on the breathing valve is off. The On/Off switch is "on" when the lever is away from the housing; "off" when the lever is against the housing.
- ❑ Fully open the cylinder valve to charge the system.

The Alarm Should Sound Until the Pressure Rises Above ¼ Full

- ❑ Check for a strong flow of air from the mask when you turn the positive pressure on (or turn the black lever away from the housing).
- ❑ Turn off positive pressure (or turn the black lever in against the housing).
- ❑ Close the cylinder valve.
- ❑ With the cylinder valve closed, turn the positive pressure switch on for 2 seconds, then turn it off.
- ❑ Notice when the alarm sounds, then evacuate the system by turning the switch back on.
- ❑ Always store the unit with the cylinder valve closed and the positive pressure valve "on" or "open"

5. Face Piece and Breathing Hose.

- ❑ Inspect head harness and face piece for damage, serrations and deteriorated rubber.

❑ What is Level A protection and under what conditions should this level of protection be worn?

Level A protection should be selected when the greatest level of skin, respiratory, and eye protection is required. It should be used when:

- Direct skin or eye contact with hazardous substances or air contaminants may cause severe damage and/or irreversible effects;
- Site conditions and work functions involve a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates;
- Entry is to be made into a poorly ventilated area or into a confined space;
- Contaminants are unknown; or
- Highly toxic compounds are suspected or known to be on site.

❑ What is recommended PPE for Level A protection?

- RESPIRATORY PROTECTION:
  - Positive pressure, full face-piece SCBA or Positive pressure supplied air respirator with escape SCBA
- CHEMICAL RESISTANT CLOTHING:
  - Totally encapsulating, chemical-protective suit
- GLOVES:
  - Chemical-resistant outer gloves
  - Chemical-resistant inner gloves
- BOOTS:
  - Chemical-resistant boots with steel toe and shank
- OPTIONAL:
  - Coveralls
  - Long underwear
  - Hard hat under suit
  - Disposable protective suit, gloves, and boots (may be worn over totally encapsulating suit)

❑ How do individuals wearing fully encapsulating suits communicate with other responders and themselves?

Normal communications do not work well in fully encapsulating suits. It is difficult to hear or be heard while wearing Level A CPC. Alternate ways of communicating must be devised to get around this problem. Two-way radios, sometimes utilizing sophisticated equipment, are used but are expensive. The radios, which have to be intrinsically safe and inside the suit, are difficult to operate because of reduced mobility. Hand signals can be used but a system must be developed. Reading and writing works but is quite slow due to the size and thickness of gloves worn with level A suits. Other forms of communication are audio signals such as horns, sirens, and whistles.

❑ Why is heat stress a major concern when wearing PPE?

Heat stress is a term used to describe the reaction to exposure to heat from both inside and outside the body. Within a fully encapsulating suit, metabolic heat is held, therefore heat stress can occur even in winter. As a result, it is important to acclimate to the heat especially during the summer and in hot climates. It is also important to monitor body temperature and replenish fluids when wearing PPE.

❑ What are the types of heat stress and how can they be treated?

A mild form of heat stress is HEAT CRAMPS. Heat cramps are painful and uncontrollable muscle contractions which occur most commonly in the legs, arms, and stomach area caused by high body temperature. Possible treatment for muscle cramps includes rest as well as replacement of salt and water lost from the body by providing saline solution (0.1%) by mouth and/or saline solution (0.9%) intravenously. (Route of saline administration should be determined by local procedures and regulations).

A more serious type of heat stress is HEAT EXHAUSTION. The symptoms of heat exhaustion are weakness, fatigue, dizziness, nausea, headache and clammy/moist skin. Possible treatment for heat exhaustion is to move the victim to a cooler place, elevate the victim's legs, replace water and salt as you would do with heat cramps, closely monitor the victim to make sure he/she does not slip into a heat stroke and seek medical attention.

The most serious form of heat stress is HEAT STROKE. Heat stroke occurs when the body fails to cope with the heat. A person with heat stroke will have dry, hot, red mottled or bluish skin. The victim will also be confused, lose consciousness, have convulsions and eventually die if not treated. To treat the heat stroke victim the responder should cool the victim by removing the clothing and dousing the victim in cold water or removing the victims clothing and wrapping him/her in a wet sheet while fanning. Medical attention should be sought immediately. Heat stroke is a true emergency.

❑ Are there any other limitations to the fully encapsulating suit?

A fully encapsulating suit reduces mobility, sight and hearing. It also increases the risk of heat stroke, heart failure and other injury because it is hot and cumbersome to wear. Finally, there is risk of equipment failure, which will increase the chance of contamination. Equipment failure includes holes, rips and tears from slips, trips, falls, nails, and other sharp objects. Zippers may fail and seams may separate from much use.

❑ How chemical-resistant to most chemical substances are the materials used to make chemical protective clothing (CPC)?

There are many types of protective clothing materials because there are so many types of chemicals. Anyone buying CPC must realize three important facts. First, no protective clothing is completely impermeable. Second, no one fabric or material protects the first responder against all chemical substances. Finally, for certain contaminants or chemical mixtures, no protective clothing will protect for an extended period of time (1 hour).

❑ How are chemical-resistant materials rated?

- PENETRATION - the flow of a chemical through zippers, stitched seams, pores, or imperfections in materials.
- DEGRADATION - the reduction in one or more physical properties of a protective material due to contact with a chemical.
- PERMEATION - the process by which a chemical moves through protective materials on a molecular level.

Chemical Permeation Performance

ASTM F-1001 Standard Test Battery

Challenge Chemical	Class	Average Breakthrough Time[1] (mins)	Average Permeation Rate[2] ($\mu g / cm^2 / min$)	SDL[3] (ppm)
Acetone	Ketone	>480	ND[4]	0.1
Acetonitrile	Nitrile	>480	ND	0.18
Carbon Disulfide	Organic Sulfur	>480	ND	0.99
Dichloromethane	Chlorinated Paraffin	369	.054	0.17
Diethylamine	Amine	>480	ND	0.71
Dimethylformamide	Amide	>480	ND	1.0
Ethyl Acetate	Ester	>480	ND	0.072
Hexane	Saturated Hydrocarbon	>480	ND	0.023
Methanol	Primary Alcohol	41	4.3	0.16
Nitrobenzene	Nitro Compound	>480	ND	1.0
Sodium Hydroxide	Inorganic Base	>480	ND	0.13
Sulfuric Acid	Inorganic Mineral Acid	>480	ND	0.0095
Tetrachloroethylene	Chlorinated Olefin	>480	ND	0.07
Tetrahydrofuran	Heterocyclic Ether	>480	ND	0.13
Toluene	Aromatic Hydrocarbon	>480	ND	0.036

These permeation tests were performed in accordance with ASTM standards by Radian Corporation.

[1] Average Breakthough Time (minutes) — Average time between contact of chemical on outside of material surface and detection of chemical on inside surface.

[2] Average Permeation Rate (micrograms per square centimeter per minute) — Average rate at which a chemical permeates the material after breakthrough has occurred and steady-state conditions have been reached.

[3] SDL — System Detection Limit (parts per million) — A measure of the sensitivity of the permeation test method and equipment. It is recommmended that the SDL value be no greater than 1.0 ppm.

[4] ND — None Detected — No breakthrough detected in the test period.

NOTE: This data is derived from tests performed on material samples only, not finished garments.

WARNING: There are uses, environments and chemicals for which these garments are unsuitable. It is the responsibility of the user to review available data and verify that the garment is appropriate for the intended use and meets all specified health standards.

CAUTION: Do not use for fire protection. Avoid open flame or intense heat.

HOW CHEMICALS AFFECT KEVLAR.®

Chemical	Concentration %	Temp. °C (°F)	Time, Hrs.	Strength Retained % KEVLAR® 29
Hydrochloric Acid	37	21 (70)	100	28
Hydrochloric Acid	37	21 (70)	1000	12
Hydrochloric Acid	10	21 (70)	100	90
Nitric Acid	1	21 (70)	100	84
Nitric Acid	10	21 (70)	100	21
Sulfuric Acid	10	21 (70)	100	91
Sulfuric Acid	10	21 (70)	1000	41
Sodium Hydroxide	10	21 (70)	1000	26
Ammonium Hydroxide	28	21 (70)	1000	91
Acetone	100	21 (70)	1000	97
Dimethyl Formamide	100	21 (70)	1000	100
Trichlorethylene	100	88 (190)	387	93
Ethyl Alcohol	100	21 (70)	1000	99
Jet Fuel (JP-4)	100	21 (70)	300	100
Jet Fuel (JP-4)	100	200 (392)	100	96
Brake Fluid	100	21 (70)	312	98
Brake Fluid	100	113 (235)	100	67
Transformer Oil (Texaco #55)	100	60 (140)	500	95
Kerosene	100	60 (140)	500	90
Freon** 11	100	60 (140)	500	100
Freon** 22	100	60 (140)	500	100
Tap Water	100	100 (212)	100	100
Sea Water (Ocean City, NJ)	100	*	1 yr.	99
Water at 10,000 psi	100	21 (70)	720	100
Water-Superheated	100	138 (280)	40	91
Steam-Saturated	100	150 (302)	48	72

*Indicates data not available
**DuPont registered trademark for fluorocarbon

2-35

Resistance to chemicals is another property of KEVLAR that sets it apart from other materials. The data in this chart shows how KEVLAR retains its strength when exposed to various common chemicals.

Polybenzimidazole

PBI
Trade names: Celazole

Goodfellow

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Metals, alloys, compounds, ceramics, polymers, and composites for research, design and industry

General Description : An infusible, black high performance polymer with a wholly aromatic molecule of high thermal stability. Semi-fabricated items are made, normally by the polymer manufacturer, by powder sintering processes.

It has excellent high temperature properties - probably on balance the best of any commercially available polymer - and is very expensive. It is strong, stiff, very hard, has a particularly high strength in and recovery from compression and a CTE similar to that of aluminium. It has good chemical resistance resisting many harsh chemical environments better than many other high performance polymers, but is attacked by polar aprotic solvents and, at elevated temperatures, by strong aqueous acids and (to a lesser extent) alkalis. Despite absorbing (slowly) a high percentage of water at saturation, it is stable to hydrolysis and resists high pressure steam.

Physical Properties

Density	1.3 g cm^{-3}
Flammability	Does not burn
Limiting Oxygen Index	58 %
Radiation resistance - Alpha	Good
Water Absorption - over 24 hours	0.4 %

Electrical Properties

Dielectric Constant @1MHz	3.2
Dielectric Strength	21 $kV.mm^{-1}$
Volume Resistivity	8×10^{14} Ωcm

Thermal Properties

Heat-Deflection Temperature - 0.45MPa	435 °C
Thermal Conductivity @23°C	0.41 W m^{-1} K^{-1}
Thermal Expansivity	23 $\times 10^{-6}$ K^{-1}
Upper Working Temperature	260-400 °C

Mechanical Properties

Coefficient of friction	0.19-0.27
Compressive Modulus	6.2 GPa
Compressive Strength	400 MPa
Elongation at break	3 %
Hardness - Rockwell	K115
Izod Impact Strength	590 unnotched J m^{-1}
Tensile Modulus	5.9 GPa
Tensile Strength	160 MPa

Chemical Resistance

Acids - concentrated	Fair
Acids - dilute	Good
Alcohols	Very Good
Alkalis	Good/Fair
Aromatic Hydrocarbons	Very Good
Greases and Oils	Very Good
Ketones	Very Good

TABLE III (Continued)

CHEMICAL RESISTANCE OF NOMEX® ARAMID FIBERS

Chemical	Concentration %	Temperature °F	Temperature (°C)	Time Hours	EFFECT ON BREAKING STRENGTH† None	Slight	Moderate	Appreciable	Degraded
Saturated Salt Solutions									
Aluminum chloride	—	70	21	1,000	X				
Ammonium chloride	—	70	21	1,000	X				
Ammonium Sulfate	—	70	21	1,000	X				
Calcium chloride	—	70	21	1,000	X				
" "	—	200	93	10	X				
Cobaltous sulfate	—	70	21	1,000	X				
Copper sulfate	—	70	21	1,000	X				
Ferric chloride	—	70	21	1,000	X				
" "	—	200	93	10			X		
Ferric nitrate	—	70	21	1,000			X		
Ferric sulfate	—	70	21	1,000	X				
Ferrous chloride	—	70	21	1,000	X				
Magnesium chloride	—	70	21	1,000	X				
Potassium chloride	—	70	21	1,000	X				
Silver nitrate	—	200	93	10	X				
Sodium bisulfate	—	70	21	1,000		X			
Sodium bromide	—	70	21	1,000	X				
Sodium chloride	—	200	93	10	X				
" "	—	70	21	1,000	X				
Sodium nitrate	—	70	21	1,000	X				
Stannic chloride	—	70	21	1,000		X			
Stannous chloride	—	70	21	1,000			X		
Zinc chloride	—	200	93	10	X				

*Registered Du Pont trademark
**Boiling point
†None ..... 90 thru 100% of original strength retained
Slight ..... 80 thru 89% of original strength retained
Moderate ..... 60 thru 79% of original strength retained
Appreciable ..... 20 thru 59% of original strength retained
Degraded ..... 0 thru 19% of original strength retained
††Percent by weight

TABLE III (Continued)

CHEMICAL RESISTANCE OF NOMEX® ARAMID FIBERS

Chemical	Concentration %	Temperature °F	Temperature (°C)	Time Hours	EFFECT ON BREAKING STRENGTH† None	Slight	Moderate	Appreciable	Degraded
Organic Chemicals									
Acetone	100	70	21	1,000	X				
"	100	133**	56	10	X				
Benzene	100	70	21	1,000	X				
"	100	176**	80	10	X				
Carbon disulfide	100	70	21	1,000	X				
Carbon tetrachloride	100	171**	77	10	X				
Cresol (meta-)	100	70	21	1,000	X				
" "	100	395**	202	10	X				
Dimethyl acetamide	100	70	21	1,000		X			
" "	100	200	93	10	X				
Dimethyl formamide	100	158	70	168	X				
" "	100	307**	153	10	X				
Dimethyl sulfoxide	100	70	21	1,000		X			
" "	100	200	93	10			X		
Ethyl alcohol	100	70	21	1,000	X				
Ethylene glycol	100	70	21	1,000	X				
" "	100	158	70	168	X				
" "	100	200	93	10	X				
Formaldehyde	10	70	21	1,000	X				
Freon* 113 refrigerant	100	70	21	1,000	X				
Gasoline (leaded)	100	70	21	1,000	X				
Glycerol	100	70	21	1,000	X				
Jet Fuel	100	158	70	168	X				
Methyl alcohol	100	70	21	1,000	X				
" "	100	148**	65	10	X				
Nitrobenzene	100	70	21	1,000	X				
"	100	200	93	10	X				
O-Phenylphenol	100	200	93	10	X				
Perchloroethylene	100	158	70	168	X				
Phenol	10	70	21	1,000	X				
"	100	200	93	10	X				
Propylene Carbonate	100	200	93	10	X				
Stoddard solvent	100	70	21	1,000	X				
Trichloroethylene	100	70	21	1,000	X				
Xylene (meta-)	100	158	70	168	X				
Sealed-Tube Exposures									
Air + 5% water + 5% sulfur dioxide††	—	347	175	100				X	
Freon* 22 refrigerant	—	356	180	1,000	X				
Sulfur hexafluoride	—	356	180	1,000		X			
Steam, saturated at 79 psi absolute (545 kPa)	—	311	155	100			X		

TABLE III

CHEMICAL RESISTANCE OF NOMEX® ARAMID FIBERS

Chemical	Concentration %	Temperature °F	Temperature (°C)	Time Hours	EFFECT ON BREAKING STRENGTH† None	Slight	Moderate	Appreciable	Degraded
Strong Mineral Acids									
Hydrochloric	10	203	95	8				X	
"	35	70	21	10		X			
"	35	70	21	100				X	
Nitric	10	70	21	100	X				
"	70	70	21	100				X	
Sulfuric	10	70	21	100	X				
"	10	140	60	1,000			X		
"	60	140	60	100				X	
"	70	70	21	100		X			
"	70	203	95	8					X
Hydrobromic	10	70	21	10	X				
Phosphoric	10	70	21	1,000	X				
"	10	203	95	10	X				
Organic Acids									
Acetic	100	70	21	1,000	X				
"	100	200	93	10	X				
Benzenesulfonic	100	200	93	10				X	
Benzoic	sat. sol.	200	93	10	X				
Formic	91	70	21	1,000	X				
"	91	200	93	10		X			
Lactic	75	70	21	1,000	X				
Oxalic	10	200	93	10		X			
"	sat. sol.	70	21	1,000		X			
Trifluoroacetic	100	70	21	1,000			X		
Tannic	10	70	21	1,000	X				
Strong Alkalis									
Ammonium hydroxide	28	70	21	100	X				
Sodium hydroxide	10	70	21	100	X				
" "	10	140	60	100		X			
" "	10	203	95	8				X	
" "	40	70	21	10	X				
" "	50	140	60	100					X
Sodium Carbonate	1.0	203	95	10	X				
Bleaching Agents									
Peracetic acid	100	70	21	10	X				
Sodium chlorite	0.5	70	21	10	X				
" "	0.5	140	60	100			X		
Sodium hypochlorite	0.4	70	21	10	X				

❑ What about materials that are most commonly used for firefighter turnouts?

Structural firefighter's protective clothing is designed for thermal protection, NOT chemical protection. The North American Emergency Response Guidebook states that this type of clothing will provide limited protection in some situations, meaning the responder wearing turnout gear and SCBA may be able to perform an expedient "in-and-out" operation. However this type of operation can put the responder at risk of exposure, injury, or death. The decision to make entry with this level of protection must not be made hastily. *(See Attachments K through N)*

Most turnout clothing is made of either Nomex or PBI in combination with leather. These materials provide little or no chemical protection and, in fact, could readily absorb many substances. If turnouts are contaminated, they may have to be disposed of due to breakdown of the material or the inability to decontaminate.

❑ What factors should be carefully considered before the selection and purchase of CPC?

- CHEMICAL RESISTANCE of the material. In determining the chemical resistance, one factor to be looked at is the permeation rate or the length of time break-through takes. You can find these ratings through ACGIH "Guidelines for the Selection of Chemical Protective Clothing", NIOSH 83-107, Equipment Manufacturers Rating Guide, and past experience.

- ABILITY OF THE MATERIAL TO WITHSTAND INSULTS OTHER THAN CHEMICAL EXPOSURE. Such insults include abrasion, resistance to tearing, cold and heat (suits may lose flexibility in coldness and degrade in heat), cleaning, and decontamination.

- COST OF THE MATERIAL TO USE. Cost of the material includes original cost, service life of material (a longer service life defers the number of times to have to pay original cost), cleaning cost (decontamination), and repair cost.

- OTHER PERFORMANCE REQUIREMENTS. Other requirements in the selection of CPC are flexibility (does the material allow you enough movement to get the job done?), design (where is the zipper? does it have a hard hat inside the suit or does one need to be provided?), color (you may want to color code the suits by material, rank, or size), and size (make sure your people can fit into them - one too large can be a hazard).

❑ What should the first responder do about decontamination of PPE?

Decontamination of PPE is necessary for protecting the responder from exposure during the removal of the PPE. Responsibility for each piece of PPE must be assigned and provisions should be made for personal hygiene. A written SOP must be implemented to ensure that different types of material are properly disposed of or decontaminated on a regular schedule. Some suits or equipment may not be able to be decontaminated. Therefore the responder should find out about decontamination from the manufacturer of the suit or the manufacturer of the chemical exposed to or by checking with NFPA, NIOSH, or ACGIH.

❑ How can the service life and the safety of the CPC be prolonged?

To prolong the service life of the CPC and ensure the safety of the wearer, good inspection, maintenance and storage procedures must be in place. Inspection of PPE is necessary for finding evidence of chemical break-through. Methods of inspection include visual inspection, use of black light, and pressure testing. Maintenance will correct PPE deficiencies and prolong the life of equipment. Storage of PPE must be proper in order to prevent equipment failure.

❑ When should PPE be inspected?

Before wearing personal protective clothing, it must be properly inspected. Other times inspection is necessary include when the equipment is stored, when the equipment is used for training, prior to maintenance, when the suitability of the equipment is questioned, after each use and/or monthly.

❑ What factors should be considered in the inspection of PPE?

An inspection checklist should be developed for each PPE item. Factors which should be considered in the development of this checklist include cuts, holes, tears, and abrasions in seams or fabrics; weakness in zipper or valve seals; signs of inhibited exhaust valves; signs of incomplete decontamination; and usage of pressure test per manufacturer's specification. However, some manufacturers do not have a testing procedure and will guarantee their products.

❑ What is a convenient classification system for maintenance of PPE?

A convenient classification system includes user/wearer maintenance which requires a few common tools or which can be performed without tools; shop maintenance which can be performed in-house; and specialized maintenance which can be done only by the manufacturer or by a specialist. For the maintenance of PPE, a detailed Standard Operating Procedure should be followed rigorously.

Whenever wearing, cleaning, testing or inspecting PPE, manufacturers recommendations should always be followed.

❑ What details should be written in the SOP for storage procedures?

A written SOP should detail:

1. Pre-issuance storing in a warehouse, on-site, or other location.
2. Post-issuance storing after actual usage.
3. Storage in a dust-free environment.
4. Storage in an area free from chemical explosion.
5. Storage in an area free from sunlight.
6. Storage in a location free from thermal extremes.

Conclusion

Chemical protective clothing is worn to prevent harmful chemicals from coming in contact with the skin or eyes. Protecting oneself from chemical exposure requires using the most effective personal protective equipment. Of primary importance is selecting clothing made from material that is most resistant to the attack chemical. By proper selection, use and training with personal protective equipment, the risks involved in working with hazardous materials can be greatly reduced.

MONITORING

After this section, students will be able to:

1. UNDERSTAND THE IMPORTANCE OF AIR MONITORING AT AN EMERGENCY INCIDENT.
2. SPECIFY MAJOR HAZARDS THAT CAN BE DETERMINED THROUGH AIR MONITORING.
3. UNDERSTAND THE PRINCIPLES OF CONCENTRATION MEASUREMENTS OF AIRBORNE HAZARDS.
4. DIFFERENTIATE BETWEEN LONG TERM MONITORING AND REAL TIME MONITORING.
5. RECOGNIZE DIFFERENT TYPES OF MONITORING INSTRUMENTS.
6. KNOW 5 BASIC RULES IN THE OPERATION OF MONITORING EQUIPMENT.

❑ What is monitoring?

Monitoring involves testing the air near a spill or fire to see if we can detect any hazardous materials or conditions. If a positive response is indicated through monitoring, the next step is to try to identify the material(s) involved. The third step is to determine what the concentration is. Monitoring has been broken down into these three steps because they really are three separate activities. It is not unusual for situations to occur where instruments tell us there is something in the air but we are unable to identify it or get an accurate measure of the concentration.

❑ What are some drawbacks of monitoring?

Everyone who goes into an emergency situation, or who works with hazardous materials, should understand that monitoring is not a perfect science. There are many materials that we cannot detect very easily, or if we can detect them, we may have a hard time identifying and measuring them. In a situation where there is a fire or a spill, it would not be unusual for a monitoring instrument to read zero even when you can see smoke in the air or feel the pollutant irritating your eyes, nose or throat. The point is that no instrument can detect all hazards. If you have the wrong instrument, or if the instrument fails, you may get a zero reading even though the air is unsafe. Referring to written records such as the driver's manifest, when responding to chemical emergencies, can help identify appropriate monitoring equipment and techniques.

❑ Why is monitoring important?

Although there are several good reasons to perform monitoring activities, the major one is because they effectively warn the user and others in the area of conditions that are classified as Immediately Dangerous to Life and Health (IDLH). Conditions that are classified as IDLH are those that can kill or injure you almost instantly. For example, if you were working around a chlorine tank that was leaking, the concentration of chlorine in the air could easily reach 10 ppm (IDLH) very quickly. That would be considered a situation that was immediately dangerous to life and health, and monitoring would warn you to leave the area. A decreased or increased supply of oxygen could also result in an IDLH condition.

Monitoring can be used as a tool to get a better idea of what the hazards are and what can be done to avoid them. One example is the use of monitoring data to help choose proper protective clothing and respiratory protection. In addition, monitoring will help the firefighter to determine the proper location of work zones at a hazardous material incident.

Monitoring can also be used to warn us of a sudden release of chemicals that would require us to evacuate responders, workers or residents from the area and provide an assessment of the environmental impact of a release. Levels of medical surveillance and treatment can also be determined using monitoring data.

❑ How can monitoring data be useful in medical surveillance?

A medical monitoring program, which might involve physicals or medical tests given on a regular basis, is required for workers exposed to certain chemicals or hazards. Although this kind of program is especially important for people who work at a hazardous waste site or with certain chemicals on a regular basis, it can also be important for emergency responders. Air monitoring data can be used to determine the need for medical surveillance and testing. The type of medical testing needed can be determined using air monitoring data.

❑ Why is it important to keep records of monitoring data collected?

In most cases it is important to keep records of exactly what materials were detected in the air and how much, in case there are any health problems that develop among people working at an emergency site. Knowing what the person may have been exposed to could be of value in determining what kind of treatment they might need.

Laws require us to keep exposure records for thirty years after an employee leaves the organization. It's especially important to maintain a record of the pollutants that might have migrated away from the site and include information like wind direction and weather conditions. This type of data can be useful if an incident results in litigation.

❑ What hazards are monitored?

It is important to know what to monitor for at the site of a spill or fire. The probable hazards and reasons for monitoring should be considered whenever air monitoring is needed. There are four major hazards that are frequently present and a fifth one that occasionally occurs.

Obviously the first thing that is thought of at a chemical spill is the danger from toxic materials. Usually a self-contained breathing apparatus (SCBA) is worn to protect the responder against many toxic chemicals. However, the concentration of toxic materials in the air still must be monitored to determine the need for isolation or evacuation. The monitoring data also aids in later evaluations of the incident.

Another hazard to consider is the danger of fire or explosions. Your SCBA and protective clothing is very effective against toxic materials, but provide almost no protection against explosions or fire balls. Explosive atmospheres can develop from evaporation of flammable chemicals, from gas leaks, or in some cases from dusts. If you are in a flammable atmosphere, just dropping a tool can make enough of a spark to cause an explosion that will kill you. It is important to have a good Combustible Gas Indicator (CGI) to determine explosive atmospheres. Oxygen concentration is critical to measure along with the CGI because the oxygen content can effect readings of the LEL (Lower Explosive Limit).

The third hazard to be monitored is oxygen deficiency. Normal air is made of about 21% oxygen, but fire as well as some chemical reactions can lower that to the point where there is not enough oxygen left to support life. Again, wearing an SCBA will protect you from oxygen deficiency, but you still need to be aware that the air outside your mask is lacking oxygen. If there is an oxygen deficiency, removing the respirator could be fatal.

The fourth hazard is just the opposite of the third. Some chemicals can release oxygen, or you could be called into a situation where there is a leaking oxygen tank. Too much oxygen can be just as dangerous as too little because it presents a fire hazard. Oxygen content in air above 25% should be considered dangerous. About 20 years ago NASA experienced an accident that resulted in three Apollo astronauts being killed when their capsule developed an oxygen leak in it. The elevated levels of oxygen made things that normally would not burn very well burst into flames. An oxygen enriched atmosphere can easily occur, making it important to use an oxygen meter to check for oxygen content.

The last hazard that occurs occasionally is radioactivity. Dangerous radioactive conditions do not occur frequently and usually provide some warning such as labels, packaging and emergency notifications. Because monitoring is essential to proper mitigation of radioactive incidents, and radiation monitoring is more complex, a course designed specifically for radiation monitoring is strongly recommended. *(See Radiation in the Recognition section, Unit I)*

❑ What are three forms of matter?

In order to understand air contamination, you first have to understand a little bit about the way things can get into the air and how they are measured. The first thing to realize is that most materials can exist in three forms, as solids, liquids, or gases. The easiest example is water, which can be ice at low temperatures, liquid at moderate temperatures, and vapor or steam at high temperatures. Most other materials, including hazardous chemicals, have similar properties. The major difference is the temperature at which they turn from a liquid to a gas. Many of the hazardous materials encountered turn to gases at very low temperatures, which is one of the reasons they are so dangerous. Many chemicals turn from liquids, or even from solids, to gases at temperatures that are common in the summer, especially if they are sitting out in the sun. As they turn to gases or evaporate, they form clouds or plumes that can be inhaled or easily ignited.

❑ What is a concentration?

Exposure to airborne chemicals can result in a wide range of health effects that depend on both the type of chemical and on the amount of exposure. The goal of an air monitoring program is to determine whether or not there is any danger by identifying what chemicals are in the air and then measuring their concentration.

The idea of measuring a concentration is probably familiar from everyday experiences. The units used in expressing chemical concentrations in the air are less likely to be familiar. In order to understand the results of monitoring activities there needs to be a basic understanding of this terminology.

In simple terms, a concentration is a measure of how much of the material of interest is present in certain volume. For example, the concentration of sugar in a soft drink could be expressed as the number of teaspoons of sugar per bottle of soft drink. In more scientific terms, it might be expressed as grams of sugar per liter of soft drink. Another example might be that of population density, expressed as a number of people per square mile.

- **Concentration of chemicals.**

Concentration of chemicals in the air are measured in the same way. For chemicals that are in the form of dusts, the metric system is used measuring the concentration in milligrams (a measure of weight) per cubic meter (a measure of volume). A milligram is very small. It would take about 400,000 milligrams to make a pound. A cubic meter is fairly large. It takes about 35 cubic feet to make up one cubic meter. Even though one milligram per cubic meter may sound like a very low level of dust, it's actually a dangerous concentration for some chemicals.

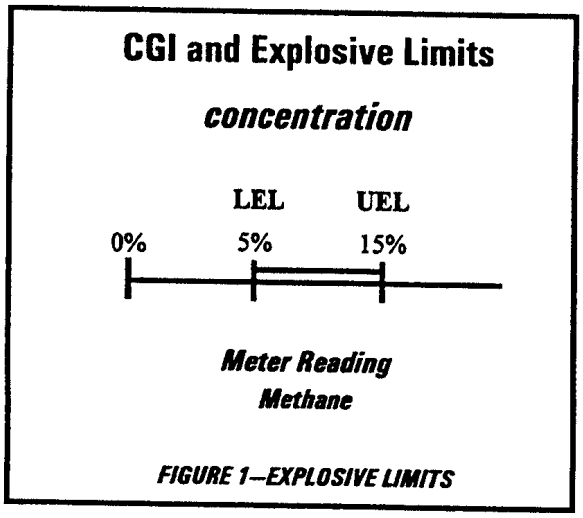


FIGURE 1—EXPLOSIVE LIMITS

Concentrations of gases and vapors are expressed in a similar fashion. Sometimes they are given in milligrams per cubic meter, but often other units, either parts per million (ppm), or parts per billion (ppb) are used. If there is a concentration of 1 ppm, that means that one millionth of the air is actually vapors of that chemical. 1 ppm doesn't seem like much, but it can be a dangerous concentration for some chemicals.

These special units are used for a couple of reasons. One reason is that the concentrations of most hazardous chemicals of concern in the air is very low. For example 100 ppm is considered a high level of air contamination for some chemicals, that would be equal to one teaspoon in over 1300 gallons. One ppm can be thought of as one shot of gin in about a 10,000 gallon tankard of vermouth. It is important to remember that some chemicals pose problems in very low concentrations.

- **Rules for working with concentrations.**

Gases and vapor concentrations are measured in parts per million, parts per billion, or milligrams per cubic meter (mg/m^3). Concentrations of aerosols are measured in terms of milligrams per cubic meter.

Asbestos fibers are a special case and concentrations are measured in fibers per cubic centimeter.

In order to compare monitoring results, both measurements must be made in the same units. You cannot compare mg per cubic meter to parts per million or parts per billion.

To compare exposures on the work site to the guidelines for safe exposure, compare the measured concentration to the standards issued by the federal government or other agencies. If the measured concentration is higher, there may have been an over-exposure.

Hazards of Oxygen

Normal Air = 20.966% Oxygen

Oxygen Deficiency: 19.5% or less

Oxygen Enrichment: 23.5% or more

FIGURE 2 –HAZARDS OF OXYGEN

In some situations or for some individuals, concentrations even lower than the standards may be hazardous. This is unlikely to be a problem in an emergency response situation because the exposures are normally short term and because the workers are usually wearing full protective equipment. If you develop symptoms that you think may be related to chemical exposures you should seek medical advice even if the monitoring results indicate that your exposures have been below the levels set by the standards.

❑ **Which standards are available for safe exposure determination?**

One reason to understand how concentrations are measured and reported is to be able to compare guidelines for safe exposure. There are several important sources of exposure standards or recommended limits for safe exposure. These sets of standards are expressed as the concentration of a chemical that one can be exposed to without much risk of a health problem.

- **Permissible Exposure Limit (PEL)**

Legal exposure standards are set by the federal Occupational Safety and Health Administration or OSHA. OSHA has set standards called Permissible Exposure Limits, or PELs, for several hundred chemicals. An employer must by law keep exposures below the PEL.

- **Immediately Dangerous to Life and Health (IDLH)**

A companion measurement to PELs, IDLH concentrations represent levels of toxicity that pose an immediate hazard to life or produce immediate, irreversible, debilitating effects on health, and require the use of respiratory protection. IDLH concentrations are expressed in ppm or mg/cu meter.

- **Threshold Limit Value (TLV)**

Another set of standards called Threshold Limit Values, or TLVs, has been developed by a group called the American Conference of Governmental Industrial Hygienists (ACGIH). TLVs have been set for about 500 chemicals and are reviewed and updated on an annual basis. In many cases, the TLVs are more restrictive than PELs. TLVs are recommendations and are intended by ACGIH to carry no legal weight, but many employers try to meet them voluntarily. Many states and foreign countries have adopted TLVs as law.

- **Recommended Exposure Limit (REL)**

Recommended Exposure Limits, or RELs, are standards developed by the National Institute of Occupational Safety and Health. RELs have been set for about 400 chemicals that are updated periodically.

❑ DOT's Table of Initial Isolation/Evacuation Distances

For the first responder, the Department of Transportation has developed guidelines that are limited specifically to the initial phase of a no-fire spill incident during transport. The "INTRODUCTION TO THE TABLE OF INITIAL ISOLATION AND PROTECTIVE ACTION DISTANCES" is found on page 311 of the 2000 Edition of the Emergency Response Guidebook.

❑ What are time weighted averages?

Most standards set by OSHA and the ACGIH are expressed as average exposures. PELs and TLVs are averaged over an 8-hour period and a 40 hour work week. These are referred to as TWAs or time weighted averages. In some cases, the standards may also specify maximum Short Term Exposure Limits (STELs) and Ceiling Limits, which are the maximum exposures that a responder may safely be exposed to for even a short time. STELs are maximum average concentrations for exposures of 15 minutes. Ceiling limits are concentrations that should never be exceeded for any amount of time.

❑ Explosive Limits

You probably know that the carburetor on a car takes gasoline and mixes it with air so that it will burn. In order for the car to run well, the mixture of air and gasoline has to be just right. If there is too much gas, you have a rich mixture and it will not burn well. If you have too little gas, the mixture is lean it won't burn well either. Vapors from a flammable chemical behave in a similar way. If the concentration is below a certain level, called the Lower Explosive Limit or LEL, the vapors won't burn. If the concentration goes above the LEL, then a spark of flame can ignite it and create a fire ball or explosion. In theory, if the concentration goes above a certain level, called the Upper Explosive Limit or UEL, then the vapors cannot ignite. In practice though, there is no safe upper limit.

The danger from this kind of fire is greatest in confined spaces or if working around a large volume of a flammable liquid, like gasoline. Whenever working around flammable chemicals you need to use an LEL/O_2 meter for warning of possible fire or explosion hazards.

❑ What are abnormal oxygen levels?

Normal air has 21% oxygen. As the concentration is decreased, there are symptoms that appear including headache, dizziness, and confusion, eventually leading to unconsciousness and death. In general, you can safely breath air with oxygen concentrations down to about 19.5%. Normally, levels below 12% result in death in under 5 minutes. Below 19.5% level a SCBA must be worn.

At the other extreme are oxygen enriched atmospheres. Oxygen levels up to 23.5% are usually considered safe, but at higher concentrations there is a serious danger of fire and you should evacuate the area.

❑ What are two types of air monitoring?

There are two basic types of monitoring, long term and real time. Both may be used at the site of an emergency. Long term monitoring is the more traditional type which usually involves use of a pump to collect an air sample. The equipment used in long term sampling is fairly simple, and may be familiar to those who have worked in industry. Real time monitoring is more important for the safety of emergency response personnel. Real time monitoring instruments are the ones that will be concentrated on in this section.

- **What are some limitations of long term sampling?**

The problem with long-term sampling is that it takes a long time. The samples have to be sent to a lab for analysis, which can take days or weeks. In an emergency situation the major concern is things that can kill or harm immediately, or IDLH conditions. Long-term sampling is not really done to protect the people working on the site. It is done so that later there will be records of what happened during an emergency.

- **Real Time Monitoring.**

In an emergency response situation, the biggest concern is avoiding any immediate dangers. To do that, direct reading instruments like LEL meters, oxygen meters and alarm systems should be used. Another class of instruments that have not been mentioned are total hydrocarbon or THC monitors. There are two very common types, the PID or photoionization detector, and the FID or flame ionization detector. Of these, the PID is the one seen most often.

All direct reading or real time instruments give results within a few seconds or at most a few minutes. There are many types of real time instruments, but only the more common, simpler ones will be discussed. These are used for detection of high concentrations of toxic materials, explosive atmospheres, and oxygen enrichment or deficiency.

❑ **What are five major classes of direct reading instruments?**

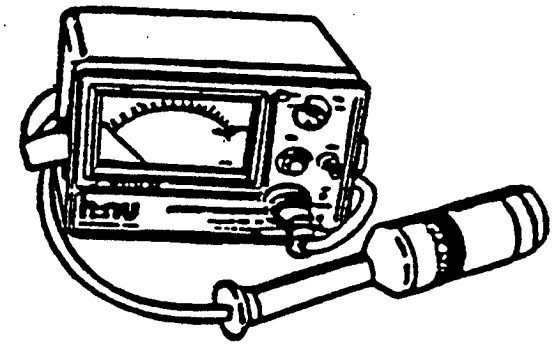
- **Total Hydrocarbon (THC) Monitors**

The THC monitors are the most common direct reading instruments on most waste sites. There are two common types of THC monitors, the flame ionization detector or FID, and the photoionization detector or PID. Both the PID and the FID can detect the most common kinds of chemicals found at emergency incidents, but they do not detect certain toxic materials including cyanides, sulfides, acids, asbestos, or any kind of dust. All of these instruments also have other limitations. For example, the PID is affected by water and loses its sensitivity if it's raining. The FID does not have that problem but it is harder to operate. Major problems with THC monitors that may keep them from emergency incidents are that they are very expensive and complicated to operate and interpret the data.

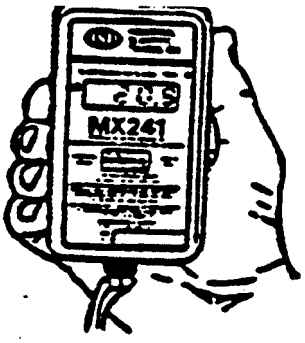
- **Oxygen meters** are one of the most important types of meters. These meters can detect both an oxygen deficit and an oxygen enriched atmosphere, either of which can be a hazard.

- **Combustible Gas Indicator (CGI)**

The combustible gas indicator is the other most important monitoring device you are likely to come in contact with. Explosion and fire balls are very hard to protect against, so any explosive or flammable conditions must be carefully monitored. Like oxygen meters the CGI meter must be used to check the atmosphere before entering a confined space. The CGI monitors the flammable gas present and provides a measurement of the LEL of that gas. The CGI meter will show a percentage of LEL, NOT the percentage of gas in the air. If the CGI shows a hazard (enters alarm mode), the responder should not enter the area until the hazard is removed.



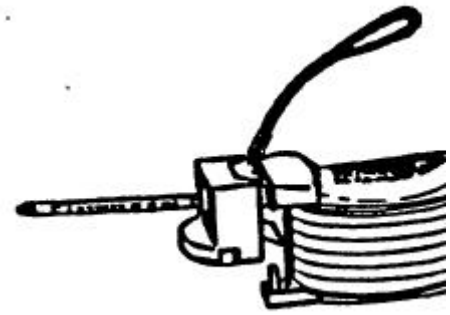
- **CGI/O2 Combination Meters**



More accurate than the oxygen meter and CGI is a CGI/O_2 meter. This meter monitors oxygen levels and explosive atmospheres simultaneously. It is a more accurate determiner of dangerous atmospheres than CGI alone because the oxygen content can effect readings of the LEL.

- **Colorometric Tubes**

Colorometric tubes are another common type of real time monitoring device. Although many first responders will not use them, safety officers or hygienists may have them at emergency incidents. These seem less sophisticated than the other direct reading instruments, but they have certain advantages. Colorometric tubes are about the only type of direct reading device that is easy to use and can provide information on both a pollutant's identity and its concentration. The operator selects a glass tube that is filled with a chemical that will change color when its exposed to certain pollutants. The tube is selected according to the class of pollutants expected to be present. The ends of the tube are broken off and connected to a hand pump as shown in Figure 5. Air is pulled through the tube and if the pollutant is in the air, the tube's color will change.



The tube is marked with a scale and the length of the color change gives an estimate of the concentration of the pollutant. Colorometric tubes can also be used with a large battery powered pump. When the large pump is used as many as six or eight different tubes may be run at once. A disadvantage of colorometric tubes is that other substances can give readings for a chemical that is being measured, e.g. toluene will give a reading on a benzene tube. Also the endpoint is often difficult to determine exactly; each different person may read different endpoints from the same tube. Finally, accuracy when measuring a concentration may vary by 25% or more.

- **Personal Alarms**

The last kind of direct reading instrument that may be relevant to the first responder is the personal alarm system. These are small instruments about the size of a cigarette package that can be worn on the belt. They are battery powered and run for several hours on one charge. If they detect a dangerous level of pollutant, an alarm sounds and the area should be evacuated by the responders. Most alarms can only detect one or a few different types of pollutant, so the correct one for the work situation must be given. One problem with these is the companies that make or sell them sometimes make exaggerated claims. One kind is called "toxic gas monitor", which might lead one to believe that it can detect all toxic gases. That is not the case as it can only detect certain gases and the responder has to be sure that it works for the particular gases of concern before trusting it.

❑ What are the major limitations of direct reading instruments?

First, direct reading instruments do not detect low levels of pollutants. That is a problem if one is working with extremely toxic materials. The responder must be aware that just because a direct reading instrument reads zero, it does not mean that the air is clean.

Second, direct reading instruments often cannot identify a pollutant, thus the toxicity of the material is unknown. Most of these instruments can only tell if there is something in the air.

Third, the instruments respond to many different pollutants, but they are more sensitive to some than to others. This means that you can not expect the readings to be very accurate. Direct reading instruments should not be used for exact reading, but instead to detect a response.

Another limitation is that it is possible to get false alarms. The danger in that is that some people do not react properly when the alarm goes off because they expect it to be a false alarm. Whenever an alarm goes off, you must react as you have been trained: your life can depend on it.

Finally, some of the most dangerous chemicals, like cyanide and sulfide, are not detected by the most common types of direct reading instruments. This can be one of the major problems with real time instruments; you have to know exactly which one to use. As a result, several different instruments need to be used at the same time.

❑ What are five basic rules of operation?

1. **Be Conservative**

If the instrument gives an unexpectedly high response, assume that it is correct. If the reading is suspiciously low, assume that there may be an instrument problem.

2. **Calibrate**

Before you use any direct reading instrument, check with the safety officer to be sure that it has been properly calibrated. Calibration involves exposing the instrument to a known pollutant and testing for the proper response. It is important that all instruments be calibrated on a regular basis. Most direct reading instruments have a built-in test system that you should know how to use.

3. **Read Even a Small Response as Positive**

Any response, even a small one, on a direct reading instrument should be interpreted as indicating a potentially dangerous situation. These instruments are usually not very sensitive, and the sensitivity varies for different chemicals. This makes it hard to get an accurate measurement of the concentration of a pollutant. Under those conditions, it is better not to try to judge the degree of hazard. It is far safer to assume that if the instrument can detect a pollutant, the concentration may be high enough to pose a health threat.

4. **A Zero Reading Does Not Mean Clean Air**

Always remember that a reading of zero does not mean that the air is clean. Some highly toxic materials are not detected by common direct reading instruments.

5. **Use Multiple Instrument Types**

Whenever possible, use more than one type of direct reading instrument. Remember that each type of instrument can only respond to one or a few pollutants so a reading of zero on one instrument could turn out to be a high reading on another instrument.

MONITORING

Every incident scene must be immediately and continuously monitored for toxic and volatile atmospheres. Technicians assigned to monitoring activities should always attempt to monitor contaminated or hazardous atmospheres from outside the affected area. The special precautions shall be followed when flammable products are involved.

Monitoring instruments shall be checked carefully prior to use. Batteries should be double checked prior to use.

Rechargeable batteries should be fully charged. New replaceable batteries should be installed immediately before use.

Instruments shall be zeroed in a known clear atmosphere.

Multiple instruments should be utilized when possible to provide redundancy. Additional instruments from other agencies shall be requested when needed. The EPA is one source for sophisticated monitoring instruments. EPA's telephone number is listed in the phone directory.

The water trap shall be in line every time the GASTECH 1641 Tri-Tector is used.

The hydrophobic filter shall be in line every time the GASTECH GX4000 is used.

The following monitoring limits are specified for confined space entry by OSHA.

STANDARDIZED MONITORING LIMITS

HYDROGEN SULFIDE - Less than 20 PPM

FLAMMABLE - Less than 20 % of the LEL

OXYGEN - Greater than 19.5 % but less than 23.5%

CARBON DIOXIDE - Less than 50 PPM

USE WATER TRAP OR HYDROPHOBIC FILTER AT ALL TIMES!

SOURCES OF INFORMATION

After this section, students will be able to:

1. LIST AT LEAST THREE WAYS OF OBTAINING INFORMATION ABOUT SPECIFIC HAZARDOUS MATERIALS.
2. GATHER INFORMATION FROM VARIOUS RESOURCE BOOKS.
3. BECOME FAMILIAR WITH ON-LINE COMPUTER SYSTEMS.
4. CALL FOR TECHNICAL ASSISTANCE IN CASE OF A HAZARDOUS MATERIALS INCIDENT.

❑ Why should technical and reference sources be used in an emergency situation?

A priority in an emergency response is to collect accurate information about all aspects of a situation. Throughout the lifetime of the incident, information obtained from technical and reference sources will assist the responder in making informed decisions about such things as evacuation and determination of levels of protection; confirming actions such as proper mitigative actions; and determining environmental impact. For any response operation, the responder will work with information ranging from too little to overwhelming amounts. This lecture will focus on reference sources, on-line computer systems and technical assistance from organizations.

❑ What are some reference sources available and what are their limitations?

Reference sources provide mostly chemical and physical properties of hazardous materials. (See Below) No one reference source will provide all the chemical and physical properties the first responder will need to know. In addition, the responder must be aware that different sources may provide contradictory information, e.g., Boiling point of a specific chemical may be listed as 307 degrees F in the NIOSH Pocket Guide to Chemical Hazards but 290 degrees F in the CHRIS manual. If this occurs, then the responder should choose the lowest number.

MSDS POCKET DICTIONARY

A Material Safety Data Sheet (MSDS) is designed to provide both workers and emergency personnel with the proper procedures for handling or working with that substance, MSDS will include information such as physical data (melting point, boiling point, flash point, etc.), toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, and spill/leak procedures. The objective of the MSDS is to concisely inform you about the hazards of the material you work with so that you can protect yourself and respond to emergency situations. The law states that you must have access to MSDS's and be taught to read and understand them.

NORTH AMERICAN - EMERGENCY RESPONSE GUIDEBOOK. Research & Special Programs Administration 202/366-4433 www.dot.gov/general/directory/rspaphone.html

This guidebook provides initial information necessary for an immediate size-up. It will identify hazardous materials utilizing the available four digit ID number from a placard or the shipping papers. The ID number can be found in the YELLOW part of the guidebook. The chemical name can be found in the Material Index in the BLUE section of the book. After identifying the ID number or name of material, a reference guide is provided in the ORANGE section. This section includes information regarding fire, explosion, health hazards, emergency action, spills or leaks mitigation, First Aid, and protective clothing. It must be remembered though, that the information given in the reference guide is for categories of chemicals and is not chemical specific. At the end of the book, a GREEN section gives the responder a guide for initial isolation and evacuation distances. (This guide should be used with caution.)

RAIL CAR IDENTIFICATION CHART* and ROAD TRAILER IDENTIFICATION CHART* have been added to the 2000 Edition of the ERG in addition to HAZARD IDENTIFICATIONI CODES DISPLAYED ON SOME INTERMODAL CONTAINERS. Three pages on CRIMINAL/TERRORIST USE OF CHEMICAL/BIOLOGICAL AGENTS have also been added in the back of the guide.

CHRIS: CHEMICAL HAZARD RESPONSE INFORMATION SYSTEM

CHRIS was developed by the U.S. Coast Guard and consists of four manuals, a contingency plan, a Hazard Assessment Computer System (HACS), and an organizational entity at Coast Guard Headquarters. Volume I (CG-446-1) is designed to be used by the first responders at an incident. Volumes II, III, and IV (CG-446-2, CG-446-3, and CG-446-4, respectively) are intended for use by the Incident Commander along with the Regional and National Response Centers. Main Coast Guard stations will usually have these manuals.

THRESHOLD LIMIT VALUES (TLV) AND BIOLOGICAL EXPOSURE INDICES, ACGIH Publications Office, 6500 Glenway Ave, Bldg D-5, Cincinnati,OH 45221
This reference includes important scientific information about each substance with references to literature sources used to determine each TLV. Each documentation also defines the type of toxic response for which the limit is used. This book should be consulted for a better understanding of TLVs.

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS (NIOSH Publication No. 85-114), 4676 Columbia Parkway, Cincinnati, OH 45226 Phone: 513-533-8287.
Information in this pocket guide comes from the NIOSH/OSHA Occupational Health Guidelines. Presented in a table form, it is a reference for industrial hygiene and medical surveillance practices. Included are chemical names and synonyms, permissible exposure limits, chemical and physical properties, signs and symptoms of overexposure, environmental and medical monitoring procedures, recommended respiratory and personal protective equipment, and procedures for treatment.

NIOSH/OSHA OCCUPATIONAL HEALTH GUIDELINES FOR CHEMICAL HAZARDS
This three-volume document provides technical data for most of the substances listed in the NIOSH Pocket Guide. The information is much more detailed and is designed primarily for use by industrial hygienists and medical surveillance personnel. In addition to the information found in the Pocket Guide, Occupational Health Guidelines includes recommended medical surveillance practices, air monitoring and measurement procedures, protective equipment, and spill and disposal techniques.

FIRE PREVENTION GUIDE ON HAZARDOUS MATERIALS, National Fire Protection Association (NFPA), Batterymarch Park, Quincy, MA 02269.
The NFPA has combined four manuals into one comprehensive guide on hazardous materials. These four sections present information on:

1. Fire hazards of 1,300 flammable liquids, gases, and solids are listed in alphabetical order with appropriate firefighting information. Various properties and facts listed include flash point, ignition temperature, flammable limits, specific gravity, vapor density, boiling point, water solubility, extinguishing methods and hazard identification.

2. Fire, explosion, and toxicity data for 416 chemicals arranged in alphabetical order. This section also includes recommendations on storage and firefighting along with Hazard Index markings for all entries.

3. Hazardous reactions of over 3,550 chemicals. Reactions may involve two or more chemicals that cause fires, explosions, or other problems. A chemical is listed followed by those chemicals that can cause a hazardous reaction.

4. Recommended system for identification of fire hazards of materials. The NFPA labeling system is described in detail, with a careful explanation of the ratings.

THE MERCK INDEX, Merck and Co., Inc., Rahway, NJ 07065
The Merck Index is a comprehensive, interdisciplinary encyclopedia of chemicals, drugs, and biological substances. It describes 9,856 chemicals in a structured format. An extensive index and cross-index make the manual easy to use. It is designed to serve a variety of purposes. For response personnel, it provides information on physical/chemical properties of chemicals and their toxicity.

DANGEROUS PROPERTIES OF INDUSTRIAL MATERIALS, Edited by N. Irving Sax, Van Nostrand Rienhold, Co., 135 W. 50th Street, NY, NY 10020.
This book provides a single source of concise information on the hazards of nearly 13,000 common industrial and laboratory materials. Descriptive information and technical data are given in the three sections of the book. The main section "General Information" is designed to speed up retrieval of hazard information. The three sections are:

1. "General Information": synonyms, descriptions, formulas, physical constants.
2. "Hazard Analysis": toxicity, fire hazards, explosive hazards.
3. "Countermeasures": handling, storage, shipping, first aid, firefighting, personal protection.

CONDENSED CHEMICAL DICTIONARY, Gessner G. Hawley, Van Nostrand Reinhold Co., 135 W. 50th Street, NY, NY 10020
This book is compiled of technical data and descriptive information covering many thousands of chemicals and reactions. It is designed for use in industrial situations and can be helpful in assessing a hazardous materials spill.

EMERGENCY HANDLING OF HAZARDOUS MATERIALS IN SURFACE TRANSPORTATION, Bureau of Explosives, Association of American Railroads, 1920 "L" Street, NW, Washington, DC 20036
This book contains information on over 2800 hazardous materials. Information includes basic physical and chemical properties of the materials along with initial emergency response recommendations.

❑ What does our fire department need to obtain access to On-Line Computer Systems?

To obtain direct access to on-line computer systems, your department will need or have access to a computer with a telephone modem to call the systems. Before buying a computer, make sure it has the capability to be equipped with a modem. Computer hardware is now much less expensive than it was five years ago. Shop around! You do not need a five or six thousand dollar computer system to provide you with the services. If your department is unable to afford a computer, creative ways of having access to one are within your reach (i.e., a member in your department owning a computer, someone in your community, or a university in your area).

❑ What kinds of information do On-Line computer systems provide and what are some that may assist in Hazardous Materials incident response?

OHMTADS: OIL AND HAZARDOUS MATERIALS TECHNICAL ASSISTANCE DATA SYSTEM
OHMTADS is a computerized data retrieval system developed by the Environmental Protection Agency (EPA) and available through CIS, Inc. and Information Consultants, Inc. It is available in the form of a computer printout, manuals, or microfiche. For each of more than 1,000 oil and hazardous substances, there are 126 possible information segments on, for example, **toxicity and associated hazards, personnel safety precautions, cleanup and disposal methods, materials handling, and firefighting.** However, not all information is available for all materials. This system is updated by the EPA every three years and is due to be updated within the year. To obtain initial access to the system, an annual fee of $300.00 is charged and $55.00 per hour thereafter.

CHRIS: CHEMICAL HAZARD RESPONSE INFORMATION SYSTEM
CHRIS computerized data retrieval system is also available through CIS, Inc. and is updated, though not regularly, by the U.S. Coast Guard. It provides much the same information as in the manuals mentioned previously. The cost of using CHRIS directly is $75.00 per hour and a $300.00 annual fee.

HAZARDLINE
HAZARDLINE computerized data system is available through BRS Information Technologies and contains information on chemical name, formula, synonyms, CAS number, RTEC number, physical description, chemical and physical properties, plus incompatibilities of chemicals, personal protective clothing, decontamination, handling, toxicity and emergency response. HAZARDLINE is updated monthly and has an initial fee of $95 and a maintainer fee of $20 per month. The actual user fee is $30 per hour during daytime hours and $20 per hour during nighttime hours.

HAZARDOUS SUBSTANCES DATA BANK (HSDB)
Hazardous Substances Data Bank is a comprehensive, scientifically reviewed database containing records for over 4,100 toxic or potentially toxic chemicals. This database provides information on the chemical and physical properties of the chemicals, regulatory information, handling, toxicity, and emergency response. HSDB is available through MEDLARS Management Section and can be accessed through TOXNET. It is updated regularly, has no initial or annual fee, and costs $18.60 per hour during nighttime hours and 25.70 per hour during daytime hours.

CHEMLINE
CHEMLINE is a chemical dictionary with over 700,000 records on chemical substances found in the TOXLINE, RTECS, MEDLINE, TOXNET and DIALOG databases. It contains chemical names, synonyms, molecular formulas, chemical properties, etc. This system is very expensive to use.

PESTICIDE DATABANK
Pesticide Databank is available through Pergamon Infoline, Inc. and contains information on nomenclature, properties, and toxicology of pesticides. It is updated quarterly and does not have an initial fee or annual fee. The cost of running the system is $85 per hour and $3.60 on-line print per copy.

COMPUTER-AIDED MANAGEMENT OF EMERGENCY OPERATIONS (CAMEO) - ON DISK.
CAMEO is available through the National Safety Council, (202)293-2270. It was designed by the National Oceanic and Atmospheric Administration in cooperation with the Environmental Protection Agency, to assist first responders to chemical accidents. CAMEO includes several parts, which are to be used interactively. Among these are: 1) detailed maps of the area that include specific industrial facilities that store or use highly toxic chemicals, 2) a chemical database that aids in the identification of chemicals, 3) response information, and 4) other databases for listing response resources.

- **What other resources may be helpful in assisting in emergency response work?**

Two other resources that could be utilized are aerial photography and U.S. Geological Survey Maps.

How can aerial photography maps help in emergency response work? EPA Region V: Environmental Monitoring and Support Laboratory, Las Vegas, NV 89114, Telephone (702)798-2237.

Environmental Photograph Interpretation Center, Warrenton, VA 22186, Telephone (703)557-3110.
Aerial photography can provide a means to watch facilities that produce or store chemicals. Spill and spill-threat conditions that exist in such facilities may also be photographically recorded. An airplane can fly over a large number of areas and facilities in a brief period of time. Once the photographs have been interpreted, spill prevention workers can use the results to inspect areas or facilities in a minimum amount of time because they can concentrate on those areas with the spill problem.

❑ What are three kinds of Geological Survey Maps and how are they helpful in emergency response work?

TOPOGRAPHIC QUANDRANGLE MAPS
Topographic maps are useful in that they show how the land is shaped, where the rivers, lakes, and other bodies of water are, and how hilly or flat the land is. They also show cities and rural areas and can be used to determine how close the spill is to a lake, river, stream, or populated area.

HYDROLOGIC MAPS.
Hydrologic maps show water in or beneath the land surface. They are very useful when assessing water supply and water-related hazards such as flooding. They also show drainage areas, how deep the ground water is, and the thickness of water-bearing formations. In the case of a spill, a hydrologic map can indicate any possible contamination of the ground water and/or drainage area.

LAND USE AND LAND COVER MAPS
Land use and land cover maps provide detailed information about the use of land or about the vegetation cover. This information could be useful at a spill. For example, if chemicals enter an area being used for crops, authorities should be advised of the chemical(s) involved, and their possible effects.

NOTE: 1:24,000' scale maps are the only scales with enough detail for emergency response work.

Where can I find the maps mentioned above?
In areas east of the Mississippi River, maps are available from:

Branch of Distribution
U.S. Geological Survey **Telephone: (703)557-2751**
1200 South Eads Street
Arlington, VA 22202

❑ What are some names and numbers of technical assistance organizations I can call in case of a hazardous materials incident?

American Petroleum Institute **1-202-682-8135**
This 24-hour emergency number can be used for assistance for hazardous materials incidents involving petroleum products.

Association of American Railroads **1-800-826-4662**
Bureau of Explosives **1-202-639-2222**
These 24-hour emergency numbers can be used for assistance for hazardous materials incidents involving railroads. CHEMTREC often contacts this agency when necessary.

CHEMTREC Emergency Numbers **1-800-424-9300**
1-202-483-7616
The Chemical Manufacturers Association set up the Chemical Transportation Emergency Center (CHEMTREC) to provide immediate assistance to those at the scene of an accident, 24 hours a day, seven days a week. This agency maintains an on-line librarian for assistance. Other requests will be referred back to appropriate states for handling.

CHEMTREC Chemical Referral **1-800-262-8200**
The Chemical Manufacturers Association provides a toll-free number for the general public to inquire about non-emergency health and safety information on chemicals. This service is available by calling the toll-free number Monday through Friday, 8 AM to 9 PM EST.

CHLOREP - Chlorine Institute **1-202-775-2790**
The Chlorine Institute established CHLOREP to handle chlorine emergencies in the U.S. and Canada. CHLOREP operates through CHEMTREC. Upon receiving a call, CHEMTREC notifies the nearest manufacturer in accordance with a mutual aid plan. This manufacturer then contacts the emergency scene to determine if a technical team should be sent to assist. Participating manufacturers should have trained personnel and equipment available for emergencies.

Compressed Gas Cylinders Association **1-800-527-8418**
Norris Industries, Longview, TX
This association provides general detailed information on how to handle compressed gas cylinders of any kind, i.e., tank cars, fixed facilities, or tank trucks. This is a good source to obtain such information in an emergency situation.

Coast Guard National Strike Force **1-800-424-8802**
National Response Center
The National Strike Force (NSF) is a part of the National Response Team. It consists of highly trained personnel with high seas oil cleanup equipment to assist the incident response with containment and confinement procedures; cleanup, mitigation, and disposal procedures; documentation and cost recovery, as defined in the National Contingency Plan. A Coast Guard Strike Team is located on the West and Gulf Coasts. Each is capable of responding to a pollution incident in its area with four or more men within two hours and of being at full strength in 12 hours.

Coast Guard Emergency Service (24 hour line)
Great Lakes Region **1-800-321-4400**
In Ohio **1-800-362-1033**
For spills involving navigable waters in the Midwest, these numbers may be called. At the time of the call, a team will be on its way within 20 minutes. Arrival time depends on the location of the incident to assist the responding unit.

Department of Energy - Radiation Incidents **1-516-282-2200**
This number can be used for assistance for hazardous materials incidents involving radiation.

National Pesticides Telephone Network **1-800-858-7378**
This number can be used for assistance for hazardous materials incidents involving pesticides.

❑ Why should the first responder use a Hazardous Substance Data Sheet?

The use of a Hazardous Substance Data Sheet allows the responder to condense the information on chemical/physical properties instead of continuously consulting different reference texts. It also speeds the briefing of any personnel arriving on the scene when time is a critical factor.

Conclusion

First Responders need not be alone at any incident involving hazardous materials. This chapter should assist you in familiarizing yourselves not only with reference books, but computer systems and technical agencies as well. It is important to remember that you MUST be familiar with such assistance and use of assistance BEFORE an incident occurs.

HAZARDOUS MATERIALS EMERGENCY RESPONSE
FIRST RESPONDER - Operations Level

North American Emergency Response Guidebook Recognition Exercise

1. The NAERG Emergency Response Guidebook instructions are found on page:

2. If DANGEROUS GOODS are suspected to be involved in an incident but cannot be readily identified, emergency responders should follow Guide Number:

3. Products that are HIGHLIGHTED indicate the emergency responder should:

4. The emergency responder can locate the four digit UN/NA ID number in the following locations:

   a.

   b.

5. Structural firefighter's protective clothing is effective in spill situations for a product identified with the four-digit ID number of 1017.

   TRUE **FALSE**

6. A release of Anhydrous Ammonia (UN 1005) should be isolated **?_____?** feet in all directions for a spill from a drum or small container.

7. An orange placard with a bursting ball and "1" printed on the bottom of the placard would suggest the emergency responder should follow Guide number:

8. The BLUE pages of the Guidebook list products by their:

9. Firefighter protective clothing can be utilized for short-term exposure to Sulfur Tetrafluoride.

   TRUE **FALSE**

UNIT THREE: CONTROL

HAZARDOUS MATERIALS
OPERATIONS-LEVEL TRAINING
FOR THE FIRST RESPONDER

DECONTAMINATION

After this section, students will be able to:

1. DEFINE DECONTAMINATION
2. KNOW THE IMPORTANCE OF DECONTAMINATION
3. UNDERSTAND DECONTAMINATION PLANNING AND THE SEVEN POINTS OF CONSIDERATION
4. IDENTIFY DIFFERENT TYPES OF CONTAMINANTS
5. LIST FOUR GENERAL METHODS OF DECONTAMINATION
6. KNOW THE DIFFERENCE BETWEEN PHYSICAL AND CHEMICAL REMOVAL OF CONTAMINANTS
7. DESCRIBE THE POSSIBLE HAZARDS OF DECONTAMINATION
8. ASSEMBLE A DECONTAMINATION LINE
9. PERFORM EMERGENCY DECONTAMINATION
10. PERFORM DRY DECONTAMINATION
11. KNOW PROCEDURES FOR DISPOSAL OF CONTAMINANTS

❑ What is the definition of Decontamination?

Decontamination is defined as the chemical and/or physical process of reducing and preventing the spread of contamination from persons and equipment used at a hazardous materials incident.

❑ Why is decontamination important to the first responder?

Decontamination is the most critical element in the control of hazards to ensure the health and safety of responders. Decontamination is necessary to protect responders from excessive exposures that may contaminate and eventually permeate the protective clothing, as well as respiratory equipment, tools, vehicles, and other equipment used at the scene. It protects all scene personnel by minimizing the transfer of harmful materials into clean areas.

❑ Is a decontamination plan required?

Standard health and safety regulations require the development of a decontamination plan (as part of the Site Safety Plan) and that it be implemented before any personnel or equipment enter any areas where the potential for exposure to hazardous substances exists.

NOTE: This means that the plan must be developed, and in working order, before any hot zone activities begin.

❑ What are the seven points to consider for the development of a decontamination plan?

1. Determine the number and layout of decontamination stations.
2. Determine the decontamination equipment needed (e.g., chemicals to neutralize, brushes).
3. Determine the appropriate decontamination methods.
4. Establish procedures to prevent contamination of clean areas.
5. Establish methods and procedures to minimize responder contact with contaminants during removal of personal protective equipment (PPE).
6. Establish methods for disposing of clothing and equipment that are not completely decontaminated.
7. Undergo revision whenever the type of personal protective clothing or equipment changes, the scene conditions change, or the scene hazards are reassessed based on new information.

❑ What SOP's should be established to minimize material contact?

The first step in decontamination planning is to establish a set of Standard Operating Procedures that minimize contact with material and thus the potential for contamination.

These procedures should be understood and practiced by all employees at the work scene. If they are followed, these procedures will help prevent contamination on the scene. Being aware of small measures to prevent contamination will help control the amounts of contamination that will normally occur on the scene. Take precautionary measures such as:

1. Stress work practices that minimize contact with hazardous substances (e.g., do not walk through areas of obvious contamination; do not directly touch potentially hazardous substances).

2. Use remote sampling, handling, and container-opening techniques (e.g., drum grapplers, pneumatic impact wrenches).

3. Protect monitoring and sampling instruments by bagging. Make openings in the bags for sample ports and sensors that must contact scene materials.

4. Wear disposable outer garments and use disposable equipment where appropriate.

5. Cover equipment and tools with a strippable coating which can be removed during decontamination.

6. Encase the source of contaminants (e.g., with plastic sheeting or overpacks).

❑ What SOP's maximize responder protection?

Standard Operating Procedures should be established that maximizes responder protection. For example, proper procedures for dressing prior to entering the Hot Zone will minimize the potential for contaminants to bypass the protective clothing and escape decontamination. In general, all fasteners should be used (i.e., zippers fully closed, all buttons used, all snaps closed, etc.). Gloves and boots should be tucked under the sleeves and legs of outer clothing, all hoods (if not attached) should be worn outside the collar. Another pair of tough outer gloves is often worn over the sleeves. All junctures should be taped to prevent contaminants from running inside the gloves, boots, and jackets (or suits, if one-piece construction).

Prior to each use, the personal protective equipment (PPE) should be checked to ensure it contains no cuts or punctures that could expose responders to materials. Similarly, any injuries to the skin surface, such as cuts and scratches, may enhance the potential for chemicals or infectious agents that directly contact the responder's skin to penetrate into the body. Particular care should be taken to protect these areas. Responders with large areas of damaged skin should be kept from working on scene until the skin heals.

All personnel should be trained in the Standard Operating Procedures for minimizing contact and maximizing work protection, and these procedures should be enforced throughout scene operations.

❑ What are the different types of contaminants?

The more responders know about the contaminants they are working with, the safer the environment will be and the less chance there will be for accidents and mass contaminations to occur. Everyone needs to be aware of the different types of contaminants.

The type of contamination to which responders may be exposed is dependent on the physical state of the materials involved. The potential for dispersion and subsequent exposures is different for different physical states. In addition, concentration of the contaminants will also impact the risks of responder exposures. This is due to the increased potential for permeation of personal protective materials when the concentration gradient of materials to exposed surface areas is increased. It is also important to recognize that the physical state of a material may be changed by changes in temperature.

GASES AND VAPORS

Responders and equipment at hazardous materials incidents most frequently contact chemical materials in their gaseous stages. Because of the greater migration potential and the difficulty of containment of gases and vapors, for most practical considerations, all people and all equipment at a scene should be considered to have been exposed when vapors are involved. Gaseous compounds are usually dissipated quickly as they leave their source; however, such compounds also present greater reactivity potentials. Gases and vapors are often very flammable, corrode equipment quickly, and penetrate even the smallest openings and crevices.

LIQUIDS

Contact with liquid materials is frequent where materials have been spilled or leaked onto the ground, and especially wherever pools of surface water are present, which result in dilution and greater migration. Other ways to contact liquid materials are splashing, and/or sprays and mists, which usually occur during material handling operations. The greater concentration gradients encountered with liquid materials may require immediate attention and concern when direct contact occurs. As with gaseous materials, liquids have sufficient fluid characteristics to penetrate small openings, crevices, and imperfections in equipment and protective materials.

SOLIDS

Solid materials are easily containerized and controlled and, therefore, can be deceptive relative to potential for contact while on-scene. Probably the most frequently encountered solids, while on scene, are the airborne particulate which contain various types and amounts of chemical contaminants. Dust and particulate are moderately difficult to control and are similar to gaseous compounds in that they migrate easily. Solids can also be underestimated when there is failure to consider their solubility in water (rain) and their melting points (at which point controllable solids can become less controllable liquids).

INFECTIOUS WASTES

Infectious wastes include solids and liquids containing infectious agents, such as viruses and bacteria. Potentials for contact, as with liquid and solid chemical materials, involve direct contact with materials during handling or contact with contaminated clothing and equipment, aerosols and particulate in the air, water-borne agents in rain run-off, and soils contaminated by spills and run-off. Those infectious wastes which include sharp objects (i.e., needles, broken glass, staples, etc.) present an additional risk of exposure resulting from potential cuts and punctures of protective gloves and sleeves of protective clothing which allow direct contact with skin surfaces. If the responder is injured (i.e., cut or punctured), the infectious agent and possibly chemical contaminants can be directly injected into the responder.

❑ How does the rate of permeation affect contamination?

It is also important to note that these chemicals, in addition to coming into contact with contaminants on the surface of personal protective equipment, can penetrate into the PPE material. Surface contaminants may be easy to detect and remove; however, contaminants that have permeated a material are difficult or impossible to detect and remove. If contaminants that have permeated a material are not removed by decontamination, they may continue to permeate either surface of the material, where they can cause unexpected exposure.

Metals with a more rigid molecular structure, such as those that would be used for equipment, are less subject to permeation than the elastomer used for personal protective clothing. It is important to realize that all materials are subject to permeation, differing primarily in the rate of permeation. Therefore, responders and authority figures must be conscious of the number of hours the responders have been exposed. The responders must calculate the number of hours safe for them to be in contact with the hazardous material while they are on the work scene without any risk of exposure resulting from permeation.

NOTE: Elastomers are polymers with elastic properties, like rubber.

EMERGENCY ASSISTANCE GUIDELINES

In the event of a chemical emergency, CHEMTREC can execute a thorough emergency response even with very little information. While it is not necessary to have all of the following information to receive assistance, please provide us with as much detail as possible.

- ❑ CALLER'S NAME AND TITLE _____
- ❑ CALLER'S COMPANY OR ORGANIZATION _____
- ❑ CALLER'S LOCATION _____
- ❑ AT LEASE ONE CALLBACK NUMBER, WITH AREA CODE (_____)_____
- (IF YOU USE A CELLULAR PHONE, POST THE NUMBER IN CASE THE CALLER IS NOT FAMILIAR WITH IT.) (_____)_____
- ❑ DISPATCH CENTER NUMBER IF AVAILABLE/ APPROPRIATE (_____)_____
- ❑ FAX NUMBER (_____)_____
- ❑ LOCATION OF THE INCIDENT/WEATHER CONDITIONS _____
- ❑ TIME INCIDENT OCCURRED (OR ESTIMATE) _____
- ❑ SHIPPING PAPERS _____
  - ❑ UN, NA (PLACARD) OR STCC NUMBER OF THE PRODUCT(S) _____
  - ❑ NAME OF THE PRODUCT(S), PREFERABLY A TRADE NAME _____
  - ❑ CARRIER _____
  - ❑ SHIPPER AND POINT OF ORIGIN _____
  - ❑ COSIGNEE AND DESTINATION _____
- ❑ TYPE OR DESCRIPTION OF CONTAINER/PACKAGE _____
- ❑ CONTAINER NUMBERS AND/OR MARKINGS _____
- ❑ BRIEF DESCRIPTION OF INCIDENT AND ACTIONS TAKEN _____
- ❑ NUMBER AND TYPE OF INJURIED/EXPOSURES _____
- ❑ AMOUNT OF PRODUCT(S) INVOVLED AND RELEASED _____
- ❑ IS THERE SPECIFIC INFORMATION NEEDED AS A PRIORITY? (MSDS, PROTECTIVE CLOTHING INFO., MEDICAL ASSISTANCE) _____
- ❑ ARE ANY INDUSTRY REPRESENATATIVES ON SCNE OR HAVE ANY BEEN CONTACTED? (DRIVER, PLANT MANAGER, ETC.) _____

For Chemical Emergency Spill, Leak, Fire or Exposure

(800) 424-9300 (24 hrs.) (703) 527-3887 (Outside the U.S.)

❑ What factors affect the rate of permeation?

The rate of permeation is dependent on five major factors. These include:

Contact time.
The longer a contaminant is in contact with an object, the greater the probability and extent of permeation. For this reason, minimizing contact time is one of the most important objectives of a decontamination program.

Concentration.
Molecules flow from areas of high concentration to areas of low concentration. As concentrations of materials increase, the potential for permeation of personal protective clothing increases.

Temperature.
An increase in temperature generally increases the permeation rate of contaminants.

Size of contaminant's molecules and pore space.
Permeation increases as the contaminant molecule becomes smaller, and as the pore space of the material to be permeated increases.

Physical state of materials.
As a rule, gases, vapors, and low-viscosity liquids tend to permeate more readily than high-viscosity liquids or solids.

❑ What are the general methods of decontamination?

DILUTION
A method of reducing the concentration of a contaminant to a safe level.

ABSORPTION
A process of picking up the hazardous substance with an absorbent material such as powdered lime, soil, or clay absorbent.

DEGRADATION
A method of decontamination in which the chemical structure of the hazardous material is altered by mixing with another reactive chemical to lessen the danger of the hazardous materials.

ISOLATION / DISPOSAL
Methods used for any equipment that cannot be successfully decontaminated by other methods.

❑ What are physical methods of removal of contaminants?

In many cases, gross contamination can be removed by physical means involving dislodging/displacement, rinsing, wiping off, and evaporation. Physical methods involving high pressure and/or heat should be used only as necessary and with caution since they can spread contamination and cause burns. Contaminants that can be removed by physical means can be categorized as follows:

Loose contaminants. Dusts and vapors that cling to equipment and responders or become trapped in small openings, such as the weave of the clothing fabrics, can be removed with water or a liquid rinse. Materials that are reactive or incompatible with water must be identified prior to wet decon. Removal of electrostatically attached materials can be enhanced by coating the clothing or equipment with anti-static solutions. These are available commercially as wash additives or anti-static sprays.

Adhering contaminants. Some contaminants adhere by forces other than electrostatic attraction. Adhesive qualities vary greatly with the specific contaminants and the temperature. For example, contaminants such as glues, cements, resins, and mud have much greater adhesive properties than elemental mercury and, consequently, are difficult to remove by physical means. Physical removal methods for gross contaminants include scraping, brushing, and wiping. Removal of adhesive contaminants can be enhanced through certain methods such as solidifying, freezing (e.g., using dry ice or ice water), adsorption or absorption (e.g., with powdered lime or clay absorbent), or melting.

Volatile liquids. Volatile liquid contaminants can be removed from protective clothing or equipment by evaporation followed by a water rinse. Evaporation of volatile liquids can be enhanced by using steam jets. With an evaporation or vaporization process, care must be taken to prevent responder inhalation of the vaporized chemicals.

❑ What are chemical methods of contaminant removal?

Physical removal of gross contamination should be followed by a wash/rinse process using cleaning solutions. These cleaning solutions normally utilize one or more of the following methods:

Dissolving contaminants.
Chemical removal of surface contaminants can be accomplished by dissolving them in a solvent. The solvent must be chemically compatible with the equipment being cleaned. This is particularly important when decontaminating personal protective clothing constructed of organic materials that could be damaged or dissolved by organic solvents. In addition, care must be taken in selecting, using, and disposing of any organic solvents that may be flammable or potentially toxic. Organic solvents include alcohols, ethers, ketones, aromatics, straight-chain alkanes, and common petroleum products. Halogenated solvents generally are incompatible with personal protective equipment and are toxic. They should only be used for decontamination in extreme cases when other cleaning agents will not remove the contaminant.

Surfactants.
Surfactants augment physical cleaning methods by reducing adhesion forces between contaminants and the surface being cleaned, and by preventing redeposit of the contaminants. Household detergents can be used with organic solvents to improve the dissolving and dispersal of contaminants into the solvent.

Solidification.
Solidifying liquid or gel contaminants can enhance their physical removal. The mechanisms of solidification are: 1) moisture removal through the use of absorbents such as grounded clay or powdered lime; 2) chemical reactions via polymerization catalysts and chemical reagents; and 3) freezing using ice water.

Rinsing.
Rinsing removes contaminants through dilution, physical attraction, and solubilization. Multiple rinses with clean solutions remove more contaminants than a single rinse with the same volume of solution. Continuous rinsing with large volumes will remove even more contaminants than multiple rinsing with a lesser total volume.

Disinfection/Sterilization.
Chemical disinfectants are a practical means of inactivating infectious agents. Unfortunately, standard sterilization techniques are generally impractical for large equipment and for personal protective clothing and equipment. For this reason, disposable PPE is recommended for use with infectious agents. Many factors, such as cost, availability, and ease of implementation, influence the selection of a decontamination method.

❑ What is dry decon?

Operational Level trained responders who have entered a potentially contaminated area and have conducted themselves so as to limit exposure and avoid contamination can perform dry decon by systematic removal of their PPE. They do so by turning their PPE inside-out as they undress, being careful not to allow contaminants to contact their body. The PPE must be left in the warm zone and treated the same as other contaminated equipment. Some responders may wear multiple layers of PPE which are then removed at separate stations in the decon line. Dry decon can then be followed by a secondary wash and other normal decon activities or can be provided without the formal establishment of a contamination reduction corridor, as in the case of emergency decontamination.

❑ What are some possible hazards of decontamination?

While decontamination is performed to protect health and safety, it can pose hazards under certain circumstances. Decontamination methods may:

1. Be incompatible with the hazardous substances being removed (e.g., a decontamination method may react with contaminants to produce an explosion, heat, or toxic products).

2. Be incompatible with the clothing or equipment being decontaminated (e.g., some organic solvents can permeate and/or degrade protective clothing).

3. Pose a direct health hazard to responders (e.g., vapors from chemical decontamination solutions may be hazardous if inhaled, or they may be flammable).

❑ Where should the decontamination take place?

At a hazardous material scene, decontamination facilities should be located in the Contamination Reduction Zone (CRZ), i.e., the area between the Hot Zone (the contaminated area) and the Cold Zone (the clean area). *(See Attachments P, Q, and R).*

❑ What factors determine the levels and type of decontamination?

The level and type of decontamination procedures required depend on several scene-specific factors including:

1. The chemical, physical, and toxicological properties of the materials.

2. The pathogenicity of infectious wastes.

3. The amount, location, and containment of contaminants.

4. The potential for, and location of, exposure based on assigned responder duties, activities, and functions.

5. The potential for materials to permeate, degrade, or penetrate materials used for personal protective clothing and equipment, vehicles, tools, buildings, and structures.

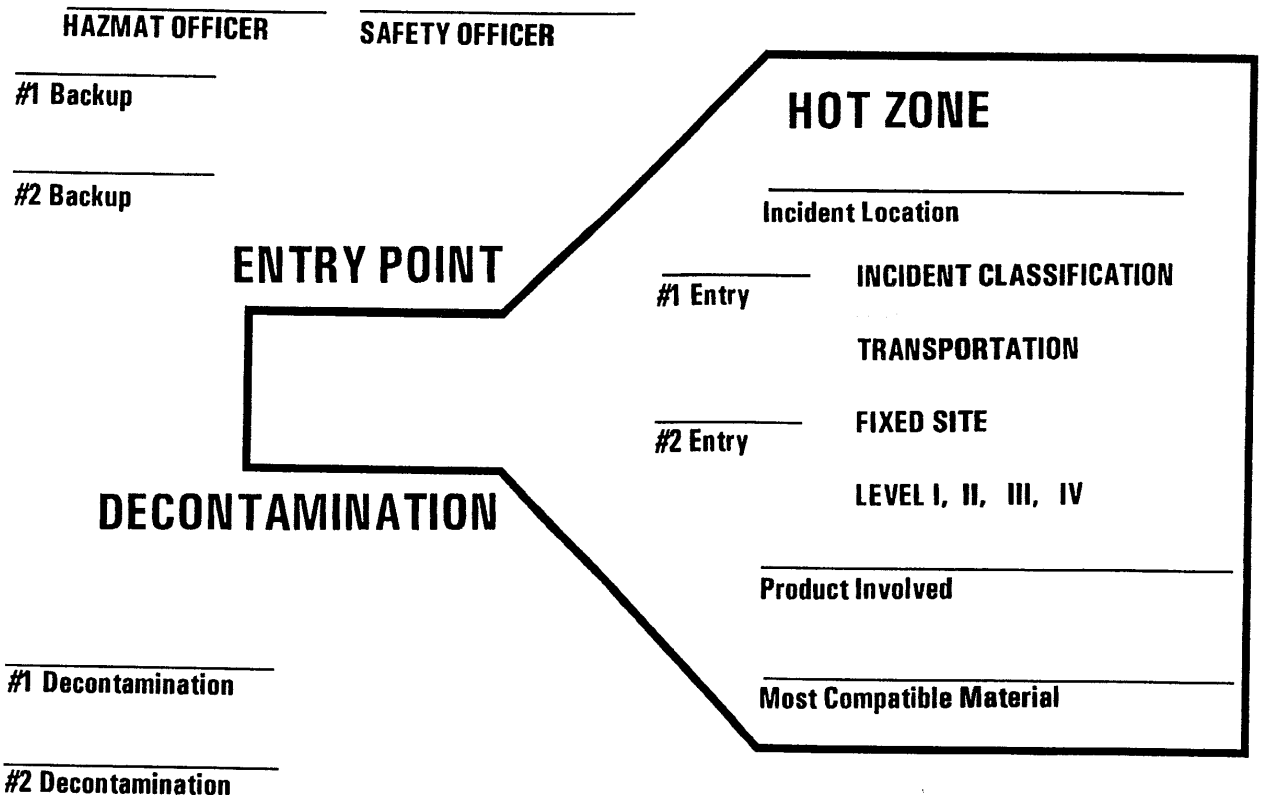
6. The proximity of incompatible materials.

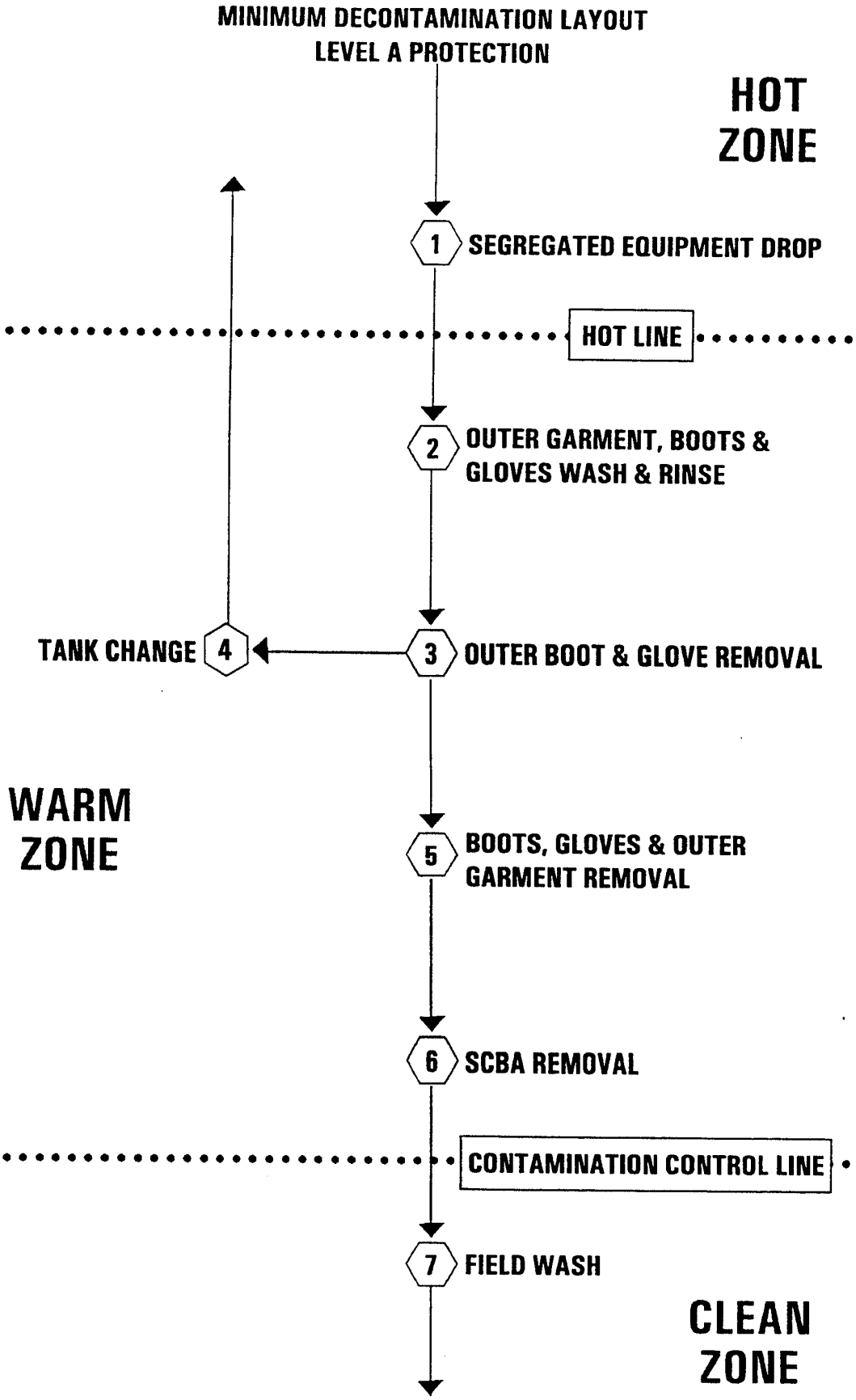
7. The movement of personnel and/or equipment among different zones.

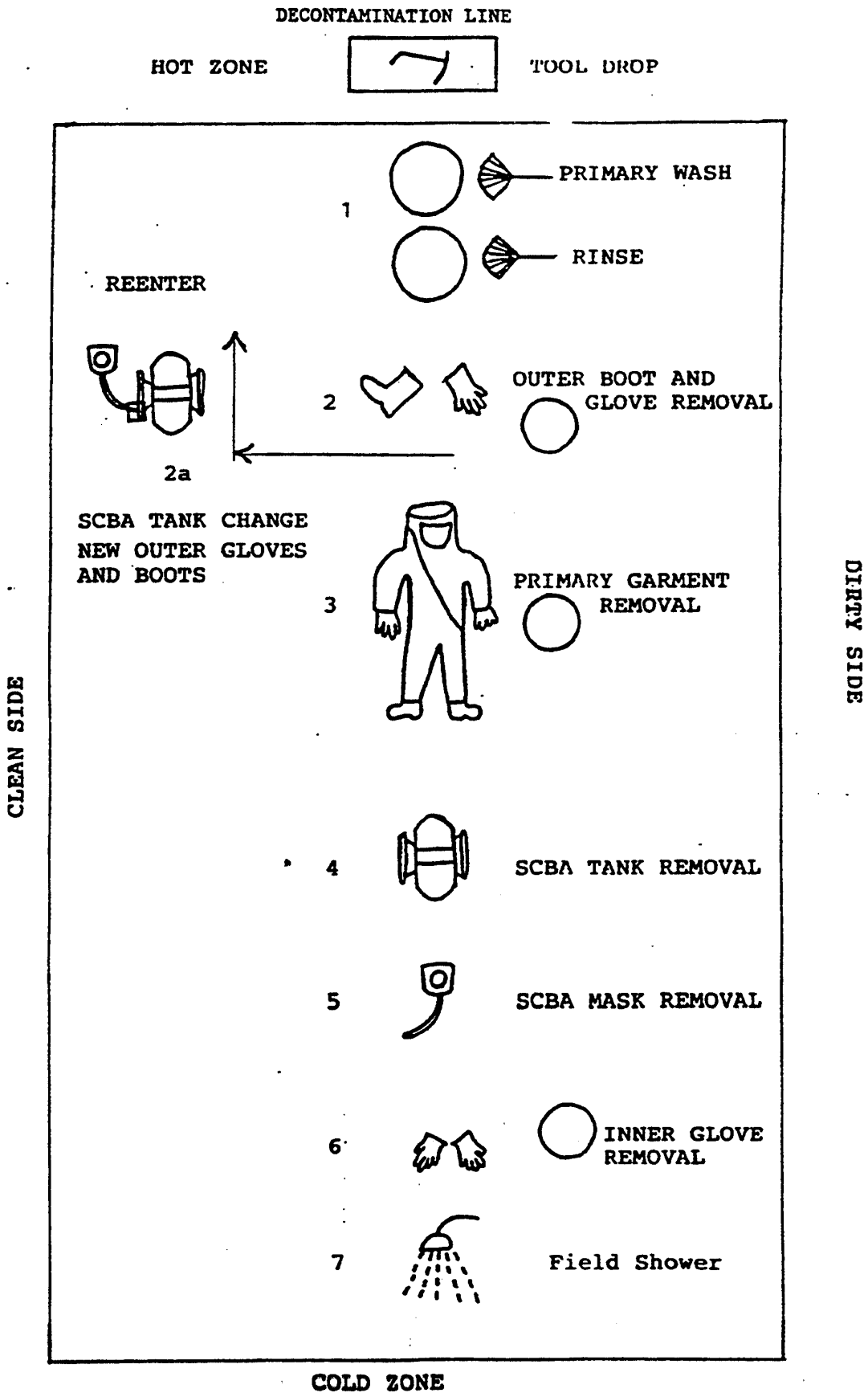
8. Emergencies.

9. The methods available for protecting responders during decontamination.

10. The impact of the decontamination process and compounds on responder safety and health.


HAZMAT OFFICER
SAFETY OFFICER
#1 Backup
#2 Backup
ENTRY POINT
HOT ZONE
Incident Location
#1 Entry
INCIDENT CLASSIFICATION
TRANSPORTATION
#2 Entry
FIXED SITE
LEVEL I, II, III, IV
DECONTAMINATION
Product Involved
#1 Decontamination
Most Compatible Material
#2 Decontamination


MINIMUM DECONTAMINATION LAYOUT
LEVEL A PROTECTION
HOT ZONE
1 SEGREGATED EQUIPMENT DROP
HOT LINE
2 OUTER GARMENT, BOOTS & GLOVES WASH & RINSE
TANK CHANGE 4
3 OUTER BOOT & GLOVE REMOVAL
WARM ZONE
5 BOOTS, GLOVES & OUTER GARMENT REMOVAL
6 SCBA REMOVAL
CONTAMINATION CONTROL LINE
7 FIELD WASH
CLEAN ZONE


DECONTAMINATION LINE
HOT ZONE
TOOL DROP
1
PRIMARY WASH
RINSE
REENTER
2
OUTER BOOT AND GLOVE REMOVAL
2a
SCBA TANK CHANGE
NEW OUTER GLOVES
AND BOOTS
3
PRIMARY GARMENT REMOVAL
CLEAN SIDE
DIRTY SIDE
4
SCBA TANK REMOVAL
5
SCBA MASK REMOVAL
6
INNER GLOVE REMOVAL
7
Field Shower
COLD ZONE

❑ What are the procedures for decontamination?

Decontamination procedures must provide an organized process by which levels of contamination are reduced. The decontamination process should consist of a series of procedures performed in a specific sequence. For example, outer, more heavily contaminated items (e.g., outer boots and gloves) should be decontaminated and removed first, followed by decontamination and removal of inner, less contaminated items (e.g., jackets and pants). Each procedure should be performed at a separate station in order to prevent cross contamination. The sequence of stations is called the decontamination line.

Stations should be separated physically to prevent cross contamination and should be arranged in order of decreasing contamination, preferably in a straight line. Separate flow patterns and stations should be provided to isolate responders from different contamination zones containing incompatible materials. Entry and exit points should be conspicuously marked, and the entry to the Contamination Reduction Zone (CRZ) from the Hot Zone should be separate from the entry to the Hot Zone from the CRZ. Dressing stations for entry to the CRZ should be separate from redressing areas for exit from the CRZ. Personnel who wish to enter clean areas of the decontamination facility, such as locker rooms, should be completely decontaminated.

Decontamination workers who initially come in contact with personnel and equipment leaving the Hot Zone will require more protection from contaminants than decontamination workers who are assigned to the later stations in the decontamination line. In some cases, decontamination personnel should wear the same levels of PPE as responders in the Hot Zone. In other cases, decontamination personnel may be sufficiently protected by wearing one level of protection lower (e.g., wearing Level C protection while decontaminating workers who are wearing level B).

The level of protection required will vary with the type of decontamination equipment used. For example, responders using a steam jet may need a different type of respiratory protection than other decontamination personnel because of the high moisture levels produced by steam jets. In some situations, the cleaning solutions used and materials removed during decontamination may generate harmful vapors. Appropriate equipment and clothing for protecting decontamination personnel should be selected by a qualified health and safety expert. All decontamination workers are in a contaminated area and must be decontaminated before entering the clean Support Zone. The extent of their decontamination should be determined by the types of contaminants they may have contacted and the type of work they performed.

❑ What about emergency decontamination?

There are times when responders and/or victims must be decontaminated quickly. However, to prevent the spread of contaminants the procedures used must be thorough. Emergency decon could be provided in a "Refuge Area" without formal establishment of a contamination reduction corridor, either by use of dry decon procedures or by dilution if the contaminant is water compatible. In either case, spread of the contaminants must be minimized by the containment of runoff and/or the proper handling and disposal of potentially contaminated garments. The refuge area should be located at least twice the minimum initial isolation distance (NAERG 100') from the release site in an "upwind, uphill, upstream" position. Containment pools made from tarps formed with ladders or inflated hose can be assembled quickly, while some fire departments may choose to use portable folding water tanks. (See Attachments S & T)

❑ How is decontamination of equipment done?

Insofar as possible, measures should be taken to prevent contamination of sampling and monitoring equipment. Sampling devices become contaminated, but monitoring instruments, unless they are splashed, usually do not. Once contaminated, instruments are difficult to clean without damaging them. Any delicate instrument that cannot be easily decontaminated should be protected while it is being used. It should be placed in a clear plastic bag, and the bag taped and secured around the instrument. Openings are made in the bag for sample intake.

Decontamination Procedures - Equipment

Sampling Devices.
Sampling devices require special cleaning. The EPA Regional Laboratories can provide information on proper decontamination methods.

Tools.
Wooden tools are difficult to decontaminate because they absorb chemicals. They should be kept on scene and handled only by protected responders. At the end of the response, wooden tools should be properly discarded. Regional Laboratories should be consulted for decontaminating other tools.

SCBA's.
Certain parts of contaminated SCBA's such as the harness assembly and leather or cloth components, are difficult to decontaminate. If grossly contaminated, they may have to be discarded. Rubber components can be soaked in soap and water and scrubbed with a brush. Regulators must be maintained according to manufacturer's recommendations. Persons responsible for decontaminating SCBA's should be thoroughly trained in SCBA maintenance.

Heavy Equipment.
Bulldozers, trucks, backhoes, bulking chambers, and other heavy equipment are difficult to decontaminate. The method generally used is to wash them with water under high pressure and/or to scrub accessible parts with detergent/water solution under pressure, if possible. In some cases, shovels, scoops, and lifts have been sand blasted or steam cleaned. Particular care must be given to those components in direct contact with contaminants such as tires and scoops. Wipe tests should be utilized to measure effectiveness.

❑ How should contaminated materials be disposed of?

All materials and equipment used for decontamination must be disposed of properly. Clothing, tools, buckets, brushes, and all other contaminated equipment must be secured in drums or other containers and labeled. Clothing not completely decontaminated on scene should be secured in plastic bags before being removed from the scene.

Contaminated wash and rinse solutions should be contained by using step containers (for example, child's wading pool) to hold spent solutions. Another containment method is to dig a trench about 4 inches deep and line it with plastic. In both cases, the spent solutions are transferred to drums, which are labeled and disposed of with other substances on scene. This becomes part of the clean-up contractor responsibility. The clean-up contractor is chosen at the discretion of the party responsible for the release.

Conclusion

Decontamination is an important part of the first responder’s role when dealing with hazardous material incidents. The process requires planning, and must be thorough and effective. The extent of the impact of the event upon the environment, as well as, people can be affected by decontamination procedures.

HAZMAT 1ST RESPONDER
OPERATIONAL LEVEL
EMERGENCY DECONTAMINATION PROCEDURE

PURPOSE: This procedure is implemented to minimize personnel contact with hazardous substances or with equipment that has contacted hazardous substances.

SCOPE: This procedure covers all employees who function as emergency responders "Operational Level" for the ???????, Michigan Fire Department.

PROCEDURE:

1. This procedure shall be implemented at the discretion of the Incident Commander when releases or potential releases of Hazardous Waste or Substances are present prior to the arrival of the HAZMAT Team and when for significant advantages tactical and strategically reasons Operational personnel made quick entry into the HOT ZONE.

2. It is the responsibility of each individual to conduct themselves in a manner consistent with their level of training as provided by the ?????? Fire Department to minimize exposure to and avoid contamination by Hazardous Waste or Substances.

3. The U.S. Department of Transportation, Emergency Guide Book (DOT/ERG) shall be utilized to evaluate the appropriate level of Personal Protective Equipment for entering into a contaminated or potentially contaminated area by emergency responders consistent with their level of training.

4. When entry into a HOT ZONE is made it shall be made in teams of two utilizing the **"Buddy System"** [MIOSHA, R.325.52103, 325.52131(6)].

HAZMAT 1ST RESPONDER
OPERATIONAL LEVEL
EMERGENCY DECONTAMINATION PROCEDURE

5. Operational level trained personnel who have made entry into potentially contaminated areas for the purposes of reconnoitering, rescue, or defensive control procedures, shall exit to a ***"Refuge Area"*** at least two times the minimum initial isolation distance {DOT/ERG 150'} from the release site in an "***upwind, uphill, & upstream***" position. Responders who have entered the HOT ZONE and have been contaminated shall report to the ***"Refuge Area"*** for evaluation of the contamination.

6. Decontamination of this initial entry crew and/or potentially contaminated victims or patients shall require the implementation of procedure "A" or "B" as determined by the Incident Commander:

A. Dry Decontamination

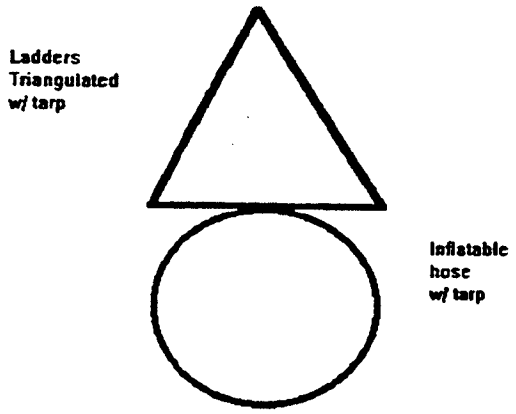
1. Minimal Exposure & Contamination

a. An intact salvage tarp shall be layed out with an inflated fire hose or triangulated ladders bermed for contaminant containment as necessary.

b. Operational Level trained responders who have entered the potentially contaminated area and have conducted themselves so as to limit exposure and avoid contamination shall doff their PPE by turning their turnouts inside/out as they undress and leave potentially contaminated garb inside the bermed area.

c. Victims or patients who have sustained exposure or limited contamination shall be removed from the HOT ZONE following a similar process and assisted by personnel who are protected by PPE and positive pressure self contained breathing apparatus (PP/SCBA).

HAZMAT 1ST RESPONDER
OPERATIONAL LEVEL
EMERGENCY DECONTAMINATION PROCEDURE



2. Gross Exposure & Contamination

a. For contamination that is not compatible with a water dilution procedure, responders will utilize a dry decon procedure removing PPE and turning the garments inside/out so as to limit potential contamination extension. A second bermed area should be available so as to allow the responder to step out of the contaminated berm and provide confinement for a secondary wash or under garment removal.

B. Wet Decontamination

1. If dilution is an appropriate decontamination procedure for the Hazardous Waste or Substance, a fire hose may be utilized to wash off contaminants, confining any water run-off to the bermed area as described in A.1.a. above. Another bermed area should be available next to the first so as to allow the responder to step out of the contaminated confinement pool and allow for a secondary wash or under garment removal.

HAZARDOUS MATERIALS EMERGENCY RESPONSE
FIRST RESPONDER - OPERATIONS LEVEL

Speed - a Case for Exception? *

Decontamination should emphasize thoroughness, not speed. Under non-critical conditions certain commonsense actions should be taken, such as decontaminating the firefighter with the lowest air reserve first.

Speed is only important where a victim is involved and even then decontamination should be as thorough as is practicable.

Circumstances may dictate that emergency decontamination becomes necessary, examples of such situations being where a protective suit has become split or damaged, or when a firefighter is injured. Emergency decontamination may also be applicable when contaminated civilians or other emergency workers (police, ambulance, etc.) are involved.

Emergency Decontamination Procedure

Paragraphs 1 to 6 below, although arranged in a basic chronological order, do not necessarily have to be undertaken in the exact sequence outlined. The officer-in-charge should act in the most expedient manner appropriate without worsening the situation.

The procedure outlined should be carried out as quickly as possible.

To protect the ambulance crew and hospital staff as well as the victim, every attempt must be made to perform at least this emergency procedure prior to transporting the victim to the hospital.

1. Remove the victim from the contaminated area into the decontamination zone and ensure he/she is supplied with uncontaminated air or oxygen.

2. Remove fire helmet if worn and immediately wash with flooding quantities of water any exposed parts of the body that may have been contaminated.

3. If the victim is wearing SCBA, release the harness and remove the set leaving the face mask in position.

4. Remove contaminated fire gear or clothing (if necessary by cutting it off the victim) ensuring where practicable that the victim does not come into further

contact with any contaminant. Maintain the washing of the victim while the clothing removal is taking place.

5. Remove the victim to a clean area. Render first aid as required, but do not apply mouth-to-mouth resuscitation. Send victim for medical treatment as soon as this emergency decontamination procedure has been completed.

6. Ensure hospital/ambulance personnel are informed of the contaminant involved.

*** NFPA Hazardous Materials Response Handbook**

CONFINEMENT, CONTAINMENT

After this section, students will be able to:

1. DEFINE CONFINEMENT.

2. DEFINE CONTAINMENT.

3. DEFINE THE PROPER ROLE FOR PERSONNEL TRAINED AT THE OPERATIONAL LEVEL.

4. DESCRIBE METHODS AND PROCEDURES FOR THE FOLLOWING CONTROL ACTIVITIES:

    - ISOLATION OF CONTAINER
    - CONFINEMENT OF LAND RELEASES
    - CONFINEMENT OF AIR RELEASES
    - CONFINEMENT OF WATER RELEASES
    - EVACUATION
    - DETERMINATION OF SOURCE AND SIZE OF LEAK
    - BONDING AND TRANSFERRING OF MATERIALS

❑ How are confinement and containment defined in this section and why is it important?

No two hazardous materials spill-related emergencies are the same. They can occur at fixed facilities during processing or loading/offloading of the material or during the transportation of the hazardous materials. Confinement and containment as defined in this section are procedures of confining and containing releases or spread of hazardous materials away from the incident site. In order to assess the best method for containment and confinement, the nature of the material must be understood. A minimum assessment should include the identification of the material, its physical properties, the current and forecasted weather, and the local geography. This will allow the first responder to size up where the material will go, now that it has been released; and what can be done to reduce the hazards associated with the spilled materials. Before performing containment and confinement procedures, the first responders should assess their protection and capabilities. In other words, **KNOW YOUR LIMITATIONS!!!!**

❑ WHAT IS CONFINEMENT?

Confinement activities as defined by NFPA 471, Recommended Practice for Responding to Hazardous Materials Incidents, are those procedures taken to keep a material in a defined or local area.

NOTE: MIOSHA regulations for first responders at the operations level limit their response to activities that are defensive in nature. Confinement activities are defensive, while containment procedures are considered offensive. Containment activities require personnel trained at the technician level or higher. Operations-level trained personnel may assist technicians if they have had additional training for the specific task being performed.

❑ What are some possible confinement activities for first responders?

1. Evacuation.
2. Confinement of land releases.
3. Confinement of air releases.
4. Determination of source and size of leak.
5. Isolation of leaking container.
6. Confining releases of hazardous materials in water bodies.

❑ Why is confinement of land releases very important?

Until the released materials are contained, the environment will continue to be damaged, the area of involvement will grow larger, and cleanup will become more difficult. Confinement is the first step toward containing the materials.

Confinement of Land Releases

Confinement of releases on land usually refers to confining liquids to a particular area (i.e. road surface), and preventing the hazardous runoff from entering and contaminating soil. Releases must be prevented from entering, contaminating, and spreading through storm sewers, rivers, lakes, and groundwater. In general, a smaller area is much more easily decontaminated than is a large area.

Control of runoff may be accomplished by:

- **DIKING**
  Dikes may be built of sand, earth, straw, sorbent, or similar material around the source of the leak or runoff area to prevent the spread of the material. However, over time, both vertical and horizontal seepage through and around the dike will occur. This process can be slowed by the use of "visqueen" or "poly" plastics, (a form of Polyethylene). The Polyethylene is used as a base in the construction of a dike or a drainage ditch.

- **BLOCKING OPENINGS OF STORM SEWERS, DRAINS OR DITCHES**
  Blocking openings of storm sewers or drains can be as simple as placing a plug rug, or inserting a sewer plug or even placing visqueen or a lid over the drain. Flammable materials flushed into drains or storm sewers may ignite downstream. However, toxic materials flushed into storm sewers may be transported to the municipal sewage treatment plant where they may be able to treat the water that is contaminated. Thus the importance of calling them immediately if hazardous materials escaped into the sewage system.

- **CATCH RUNOFF IN BUCKETS OR BASINS**
  If an approach can be made safely, a well-placed bucket or basin can minimize the impact of the release.

- **ABSORB OR NEUTRALIZE RUNOFF**
  Runoff may be absorbed or neutralized by placing dirt, sand, sawdust, wood chips, peat moss, or other sorbents on liquids. Sorbent materials may be positioned so the escaping liquid runs onto the sorbent. Vermiculite is a very good sorbent for small amounts of many chemicals. First responders must know the nature of the hazardous material so that organic materials sorbents do not appreciably increase fire hazards when they are used to absorb hazardous liquids. Neutralizers such as soda ash or Portland Cement (Calcium oxide is a strong base and will neutralize many acids.), may also be used if specialized training is received that is product specific and the necessary equipment is present to monitor the process. NOTE: When neutralizing a substance, a chemical reaction occurs which may release heat. It is recommended that the proper expert technical advice is sought prior to initiation of the task.

❑ How would the first responder confine air releases?

Covering large pools of flammable liquid with foam or water fog to suppress flammable fumes and prevent ignition of fires is often done at a hazardous materials incident. Different liquids require different kinds of foam. Alcohol foam is often used with polar solvents and regular foam (AFFF) is used with hydrocarbons. Water is most often available but is not always safe or effective. Again, it is important to identify the material to determine if water will react with the product. Other disadvantages of using water is that water may spread the product over a larger area, thus compounding cleanup activities; and water may combine with the material to yield a toxic or hazardous product.

❑ Performing evacuations

Many times a release of a hazardous substance necessitates the evacuation of people from the surrounding area. If an evacuation is required, it should be conducted in a thorough and safe manner. One of the first resources the Incident Commander may use to help him determine the need for an evacuation is the 2000 Emergency Response Guidebook. When the ERG highlights an indexed entry, the Operations Level responder must determine whether to evacuate or direct In-Place Sheltering. The Green section of the guidebook provides suggested distances for ISOLATING unprotected people from spill areas involving the hazardous material highlighted due to the potentially poisonous effects of the vapors they could produce. These distances are for incidents when the products involved ARE NOT ON FIRE. Should the products involved be on fire, the emergency responder should refer to the three-digit guide. The table has multiple columns, one for small spills and another for large spills. The Operations Level responder must understand that the quantity involved is only a single consideration when performing this evaluation and should evaluate the potential harm presented by the product(s). In all cases when a hazardous material is spilled or could potentially be released, the smallest isolation distance should be 150 feet. For a more complete understanding of ISOLATION distance and PROTECTIVE ACTION distance, the Operations Level responder should read and comprehend the information presented in the "INTRODUCTION TO THE INITIAL ISOLATION AND PROTECTIVE ACTION DISTANCES TABLE" which precedes the green section of the EMERGENCY RESPONSE GUIDEBOOK.

A well-coordinated evacuation requires several tasks to be performed such as assigning personnel, informing evacuees, providing transportation and emergency medical care, security for evacuated areas, and shelter areas located. Decisions as to evacuation methods must also be made, i.e.-door-to-door vs. public address system. Door-to-door notification is slow and requires significant manpower. Using a public address system is quicker but less thorough. A combination of both may be appropriate. When an incident has been mitigated and the decision to allow re-entry has been made, proper procedures must be followed to ensure a safe and orderly return of the evacuees. Those evacuated must be notified and provided with any special instructions or information required. Transportation may be needed for some, and utilities may need to be turned on. Planning for possible evacuations helps to ensure a safe and thorough procedure.

An alternative to evacuation is In-Place Sheltering. If time is not available to perform an evacuation, or the risks associated with an evacuation are outweighed by the benefits of in-place sheltering, then the latter may be the proper choice. However, the people affected must be provided proper and thorough instructions to ensure maximum protection.

❑ Identifying the Type and Location of a Leak

In many incidents, the first responder may be able to identify the product through shipping papers, labels, or placards, and will be able to approach the vehicle safely with available SCBA/personal protective equipment. Before he or she attempts identifying the source of any leak, the responder must have the approval of the incident commander, must wear appropriate SCBA/personal protective equipment, and must enter the hot zone with a buddy, from upwind, uphill, and upstream whenever possible. The first responder should always have a backup team equipped and ready to make entry in the event of an emergency.

❑ Confining releases of Hazardous Materials in Water Bodies

This form of contamination has been researched longest and because of that, there are more ways to contain spills in, on and under water. The best method for confinement is an overflow dam. Additional staging of material and manpower downstream will need to occur. This is in case the first dam breaks and allows the release of the contaminants downstream. This system works best on slow moving waterways. Also you could evacuate a depression in the waterway and allow the spilled material to collect there. However, the faster the waterway, the less likely for this method to work.

If the spilled material has a specific gravity <1, is insoluble or slightly soluble in water, the best method of confinement is a floating boom. There are several different types of booms on the market. Also, there are sorbent booms on the market. Instead of confining the spill, these booms absorb the spill. Neither product works well in rough water or fast currents. Another option is the use of an underflow dam or siphon dam. An underflow dam is a dike constructed with a pipe placed in the dike. The pipe is placed lower on the upstream side. As with the overflow dam, the siphon dam will be necessary to have additional manpower and supplies downstream in case of a break in the dam. Chicken wire fencing and hay can be used to create a fixed barrier. This method is generally limited to smaller waterways and creates special problems in disposal.

If the material spilled has a specific gravity equal to 1, is soluble or insoluble in water, there is very little that the first responder can do. If the waterway is small, you can dam the waterway and recover or filter the water. The other option is to neutralize the chemical, rendering the chemical inert. This will require the resources of the EPA, State DNR for technical assistance before it is attempted.

❑ Isolation of Leaking Container

In a train accident, or in some accidents in which small numbers (i.e. one or two drums or less) of containers are leaking, it may be possible to isolate the defective tank car or container from other undamaged cars or containers by removing those that are undamaged from the incident scene. During this process, a cooling spray of water may be used to keep undamaged tank cars from failing or to confine any flames to a single tank car. In most instances, outside advice or assistance should be sought prior to attempting the task.

❑ Why should first responders insure that vehicles or containers are grounded and bonded?

In most instances involving hazardous materials incidents, fire is a critical concern. First responders approaching a vehicle should insure that the vehicle and/or container is properly grounded and bonded to conduct static electricity away from the hazardous material so as to minimize the threat of ignition. This should be done before product transfer or repair of the vehicle/container is attempted. This procedure may be performed by personnel trained to the Operations level, only after specialized and specific training on this procedure.

❑ WHAT IS CONTAINMENT?

Containment activities, according to NFPA 471, are those procedures taken to keep a material in its container. What are some containment activities?

1. Grounding and bonding vehicles or containers before fixing or transferring leaking material.
    - **a.** Note: responders usually transfer only amounts that will fit into drum size containers or smaller quantities.
    - **b.** Transporters usually transfer larger amounts of product from a leaking vehicle or tank car to an undamaged vehicle or tank car.
2. Overpacking containers.
3. Plugging holes.
4. Patching container leaks.

❑ Containment of a Leak

Until the release is stopped or slowed, it will be difficult or impossible to properly contain the material. Mitigating the release may be as simple as uprighting an overturned drum or turning off a valve. It may also be as difficult as plugging a hole in an acid tank or patching a high-pressure transfer line. These activities are for personnel trained at a higher level.

❑ Types of containment

Overpack
Overpacking is the process of putting a small damaged container into a larger, undamaged container.

Plugging
Plug material (e.g. wedges of house shingles, wood chips, stakes wrapped with cloth, soap) may be shoved or pounded into the hole to slow or stop the leak.

Patching
Patching materials (e.g. putty or clay) may be applied to the leak. These should be checked for breaking down or decomposition. Patches are especially vulnerable to internal pressure from contents that are expanding from heating by the sun on the drum.

Patch or wrap
Air bags or inner tubes can be positioned over the hole, secured in place, and inflated.

It must be emphasized again that the procedures mentioned above or other related procedures CANNOT be conducted without specialized formal training that is well documented. This can be in the form of a technician level training class or classes specific to each of the tasks, meeting the objective requirements of each.

Close valve
Valves may be tightened to control a leak however; quick tightening of a valve may lead to a stripped valve and a worse leak. Pressure should be applied slowly and cautiously. If the leak cannot be stopped by closing a valve, other means (e.g. plug up opening, patch and wrap) should be tried. Valve stripping and rupture caused by tightening the valve too tightly is a common occurrence.

Hand pump
Material may be pumped from one container to another or (in the case of piping) the piping may be drained. Steps that occur in hand pumping are as follows:

1. Check that all internal valves are closed.
2. Estimate volume.
3. Obtain holding vessel twice the size of estimated volume.
4. Have backup plan if volume exceeds estimate.
5. Open outer valve; if flow does not decrease as estimated volume is reached, close valve.
6. If draining is not successful, use backup plan.

STANDARD OPERATING PROCEDURES IN A HAZARDOUS MATERIALS EMERGENCY RESPONSE

After this section, students will be able to:

1. UNDERSTAND THE NEED FOR ESTABLISHING STANDARD OPERATING PROCEDURES (SOPS) FOR HAZMAT INCIDENTS.
2. SPECIFY OBJECTIVES THAT COULD BE ESTABLISHED BY SOPS.
3. IDENTIFY EFFECTIVE SAFETY PROCEDURES.
4. UNDERSTAND ORGANIZATIONAL FACTORS CONDUCIVE TO A SUCCESSFUL SAFETY PROGRAM.

❑ WHY DO FIRST RESONDERS NEED STANDARD OPERATING PROCEDURES (Sop's) FOR HAZARDOUS MATERIALS INCIDENTS?

The purpose of SOPs is to ensure responder protection at hazardous materials incidents. The plan allows for a more controlled environment that is secure and monitored in order to minimize potential contamination of responders, protect the public from the incident hazards, and prevent vandalism and unwanted observers.

To ensure safety, adequate planning is the first and most critical element of responding to a hazardous materials incident. By anticipating and taking steps to prevent potential hazards to health and safety before they occur, response at a hazardous materials incident can proceed with minimum risk to responders and the public. (See Attachment A for a sample SOP)

❑ What are some objectives that SOPs should accomplish?

1. Establish a strong workable incident command system.
2. Establish a communications network.
3. Establish documentation procedures.
4. Establish emergency procedures.
5. Establish route to nearest medical facility.
6. Establish an incident off-site information checklist (Information dispatcher should try to receive.).
7. Size up situation.
8. Establish apparatus placement procedure.
9. Establish command post.
10. Establish work zones and site security.
11. Develop initial site survey procedures.
12. Establish decontamination procedures.
13. Select an objective using D.E.C.I.D.E. Process.
14. Evaluate effectiveness and safety of objective chosen.
15. Establish termination procedures.

❑ What can an organization do to have the most effective safety procedures?

First and foremost, effective safety procedures for first responders are required to be prepared in advance. Safety procedures need to be based on the best available information, operations principles, and technical guidance. As responders respond to hazardous materials incidents or participate in "mock disasters" or "simulations", they will find that original safety procedures are not very effective. Therefore, safety procedures need to be revised and field tested and revised as appropriate. Those who develop and implement SOPs should make them easy to understand and practice and provide them in writing to all emergency response personnel. Finally, safety procedures must be included in initial personnel training and periodic refresher course training programs.

❑ What organizational factors are important for a successful safety program?

1. Strong management commitment to safety.
2. Close contact and interaction among responders, supervisors and management.
3. Well-developed selection, job placement and advancement procedures.
4. Training practices emphasizing early indoctrination and follow-up instruction in job safety procedures.
5. Added features or variations in conventional safety practices.
6. Effective disciplinary plan to encourage employees to adhere to safety practices.

❑ TERMINOLOGY

• INCIDENT CATEGORIES

Incident Site - The specific area surrounding the incident that the incident commander has determined poses a threat to life or property. May also be referred to as the incident scene or dangerous area.

Affected Community - The outlying area that may be directly or indirectly affected by incident site hazards such as toxic releases or explosions.

• DEFINITIONS

Transportation Incident - Incidents involving transport vehicles (motor vehicles, aircraft, watercraft, pipelines, or rail cars) that carry hazardous material as cargo. The cargo may be transported in bulk or packages/containers.

Fixed Site Incident - Incidents involving hazardous materials at a site used for storage, manufacture, processing, or handling of hazardous materials.

Hazardous Materials Incident - A hazardous materials incident is any sudden, unexpected spill, leak, fire, explosion, accident, or similar occurrence which involves the transportation, storage, handling, manufacturing, sale, use, disposal or processing of a hazardous material.

Outside Assistance - Refers to assistance from federal, state, or local agencies that is requested from a firm or community to handle a hazardous materials incident.

In-Place Shelter - Personnel are required to remain in building or seek shelter in a building or structure in lieu of evacuation for protection from a lifesafety threat, i.e., vapor cloud or explosion. For protection from toxic vapors all air moving equipment, such as furnace blowers, should be shut off and all windows, doors, vents, and fire place dampers should be closed.

Evacuation - Removal of occupants from an area to protect them from a lifesafety threat, such as a vapor cloud or explosion. For protection from toxic vapors, evacuation route should be cross wind if possible.

❑ NOTIFICATION PROCEDURES

Notification of state agencies can be accomplished through Michigan State Police Operations by contacting the nearest Michigan State Police Post. The post will then use their L.E.I.N. machine "Hazardous Materials, Chemicals, Flammables, Toxic Materials Accident/Spill Report" form to distribute the incident information. Attachment B contains a sample of this form. When contacting the post, you should provide as much of this information as possible. Notification of the State Police is required for all incidents except those classified as minor. Each state agency will inform MSP Operations of which categories of incidents they want to be informed of and the type of response to be expected. Community and organizational response plans should include the incident classification system in their notification and alert procedures. THIS NOTIFICATION SYSTEM IS FOR RESPONSE PURPOSES ONLY AND SHOULD NOT BE CONFUSED WITH REPORTING REQUIRED BY OTHER AGENCY RULES OR REGULATIONS.

Attachment T1

HAZ/MAT INCIDENT NOTIFICATION MESSAGE FORM

(LEIN: ACCCHEMICAL)

(PLACE X IN APPROPRIATE BOX(S) AND ENTER AVAILABLE INFORMATION)

LINE 1 - DATE: _____ REPORTING TIME: _____ HRS.

LINE 2 - REPORTED BY: _____ TELEPHONE: _____

LINE 3 - TIME OF INCIDENT: _____ HRS. INITIAL REPORT ☐ FOLLOW-UP ☐

LINE 4 - INCIDENT DESCRIPTION: _____

LINE 5 - _____

LINE 6 - TRANSPORTATION ☐ FIXED SITE ☐

LINE 7 - FACILITY OR CARRIER INVOLVED: _____

LINE 8 - FACILITY/CARRIER CONTACT: _____ TELEPHONE: _____

LINE 9 - ADDRESS OF INCIDENT: _____

LINE 10 - CITY OR TOWNSHIP: _____ COUNTY NAME: _____

LINE 11 - SPILL ☐ LEAK ☐ FIRE ☐ EXPLOSION ☐ OTHER ☐

LINE 12 - RELEASED INTO: AIR ☐ WATER ☐ GROUND ☐

LINE 13 - CLASS: MINOR ☐ ALERT ☐ SITE AREA EMERGENCY ☐ COMMUNITY EMERGENCY ☐

LINE 14 - INCIDENT STATUS: ESCALATING ☐ STABLE ☐ DE-ESCALATING ☐ TERMINATED ☐

LINE 15 - PROTECTIVE ACTION RECOMMENDATION: IN-PLACE SHELTER ☐ EVACUATION ☐ NONE ☐

LINE 16 - PROTECTIVE ACTION STATUS: IN-PLACE SHELTER ☐ EVACUATION ☐ NONE ☐

LINE 17 - NUMBER OF INJURIES: _____ NUMBER OF DEATHS: _____

LINE 18 - MATERIAL NAME: _____

LINE 19 - LIQUID ☐ GAS ☐ SOLID ☐

LINE 20 - EXTREMELY HAZARDOUS SUBSTANCE: YES ☐ NO ☐ UNKNOWN ☐

LINE 21 - AMOUNT OF MATERIAL RELEASED: _____

LINE 22 - DURATION OF RELEASE: _____

LINE 23 - TOTAL AMOUNT WHICH COULD BE RELEASED: _____

LINE 24 - OTHER CHEMICALS OR INCOMPATIBLES INVOLVED: _____

LINE 25 - HEALTH RISKS AND PRECAUTIONS: _____

LINE 26 - _____

LINE 27 - EMERGENCY MEDICAL TREATMENT RECOMMENDED: _____

LINE 28 - _____

LINE 29 - WIND DIRECTION (FROM): _____ (i.e. N, NW) WIND SPEED: _____ MPH

LINE 30 - AIR TEMP (F): _____ CLEAR ☐ PTLY CLOUDY ☐ OVERCAST ☐

LINE 31 - AREA OF RELEASE: RURAL ☐ RESIDENTIAL ☐ COMMERCIAL ☐

LINE 32 - INDUSTRIAL ☐ OPEN WATER ☐

LINE 33 - RELEASE IMPACT - NUMBER OF PERSONS AFFECTED: _____

LINE 34 - SPECIAL POPULATION OF CONCERN: SCHOOLS ☐ REST HOMES ☐ HOSPITALS ☐

LINE 35 - SHOPPING CENTERS ☐ JAILS ☐ OTHER: _____

LINE 36 - RESPONSE STATUS (LIST JURISDICTIONS RESPONDING: PD, FD, HAZMAT TEAM, ETC.): _____

LINE 37 - _____

LINE 38 - INVESTIGATING AGENCY: _____ TELEPHONE: _____

LINE 39 - LOCAL FIRE DEPARTMENT/POLICE DEPARTMENT ☐ FACILITY OR CARRIER ☐

LINE 40 - LOCAL EMERGENCY MANAGEMENT COORDINATOR ☐ LOCAL HEALTH DEPT. ☐

LINE 41 - MICHIGAN STATE POLICE DISTRICT FMD/MCD ☐ DNR PEAS HOTLINE ☐

LINE 42 - NATIONAL RESPONSE CENTER ☐ OTHER: _____

EMERGENCY RESPONSE

After this section, students will be able to:

1. DESCRIBE THE INCIDENT COMMAND SYSTEM, THE PLAYERS WITHIN THE SYSTEM AND THEIR ROLES
2. BE FAMILIAR WITH THE COMMUNICATIONS NETWORK
3. UNDERSTAND THE IMPORTANCE OF DOCUMENTATION
4. DESCRIBE INFORMATION THE DISPATCHER SHOULD TRY TO RECEIVE DURING A CALL
5. DISCUSS THE PROCEDURES AND INFORMATION OBTAINED IN SIZE-UP
6. ACCOMPLISH AND MAINTAIN SCENE SECURITY
7. DESCRIBE PROCEDURES, PURPOSE, AND INFORMATION GATHERED IN THE INITIAL SCENE SURVEY
8. PREDICT THE BEHAVIOR OF A MATERIAL AND ITS CONTAINER
9. ESTIMATE THE POTENTIAL HARM AT A HAZARDOUS MATERIAL INCIDENT
10. DESCRIBE IN DETAIL THE THREE WORK ZONES AND PRIMARY ACTIVITIES WITHIN EACH ZONE: HOT, WARM, AND CLEAN
11. DISCUSS OBJECTIVES TO CHOOSE AND EVALUATION OF OBJECTIVES CHOSEN

❑ What is the Incident Command organization responsible for?

One of the first objectives when arriving on the scene should be to establish a strong, workable organization structure. The on-scene team or incident command organization should include an incident commander, health and safety personnel, and work supervisors. This team is responsible for developing the safety plan and procedures; providing responders with appropriate training, equipment and PPE; and ensuring compliance with safety requirements established in the safety plan and applicable regulations.

❑ Who are the members of the Incident Command Organization and what are their roles?

Most hazardous materials incidents require a multidisciplinary approach. The on-scene technical specialties often needed include chemistry, industrial hygiene, geology, hydrology (water), engineering and life sciences. The Incident Command member roles should be filled by personnel that meet the scene requirements.

INCIDENT COMMANDER

The Incident Commander (IC) is usually the highest-ranking Fire Officer on the scene. The IC administers the scene activities, develops the work plan, organizes the field team, manages and directs all response activities.

OPERATIONS OFFICER

The Operations Officer directs activities of team leaders and coordinates these operations with the Science Officer and Safety Officer.

SAFETY OFFICER

The person responsible for all safety procedures and operations on-scene is the Safety Officer. This person is designated by and advises the IC on health and safety of responders working at the incident. He/she shall be authorized to modify levels of protection based on scene observations and new information. In addition, the Safety Officer shall know emergency procedures and implement the safety plan; notify local public emergency systems; provide emergency medical care as necessary; enforce safety procedures; control scene entry and exit at the various zones; and ensure proper decontamination procedures are in place before entry. Finally, the Safety Officer responsibilities include monitoring entry teams for sign of stress; determining team members' suitability for work in the hot zone or contaminated area; and coordinating these activities with the science officer. Ultimately, the Safety Officer shall be authorized to stop work if operations threaten responder and/or public health and/or safety. To fulfill his/her responsibilities, the Safety Officer must monitor and maintain communications between the entry personnel and himself, and with the Incident Commander.

LOGISTICS OFFICER

The Logistics Officer reports directly to the Incident Commander. This person is responsible for providing facilities, services, and material in support of the incident.

DECONTAMINATION STATION OPERATOR

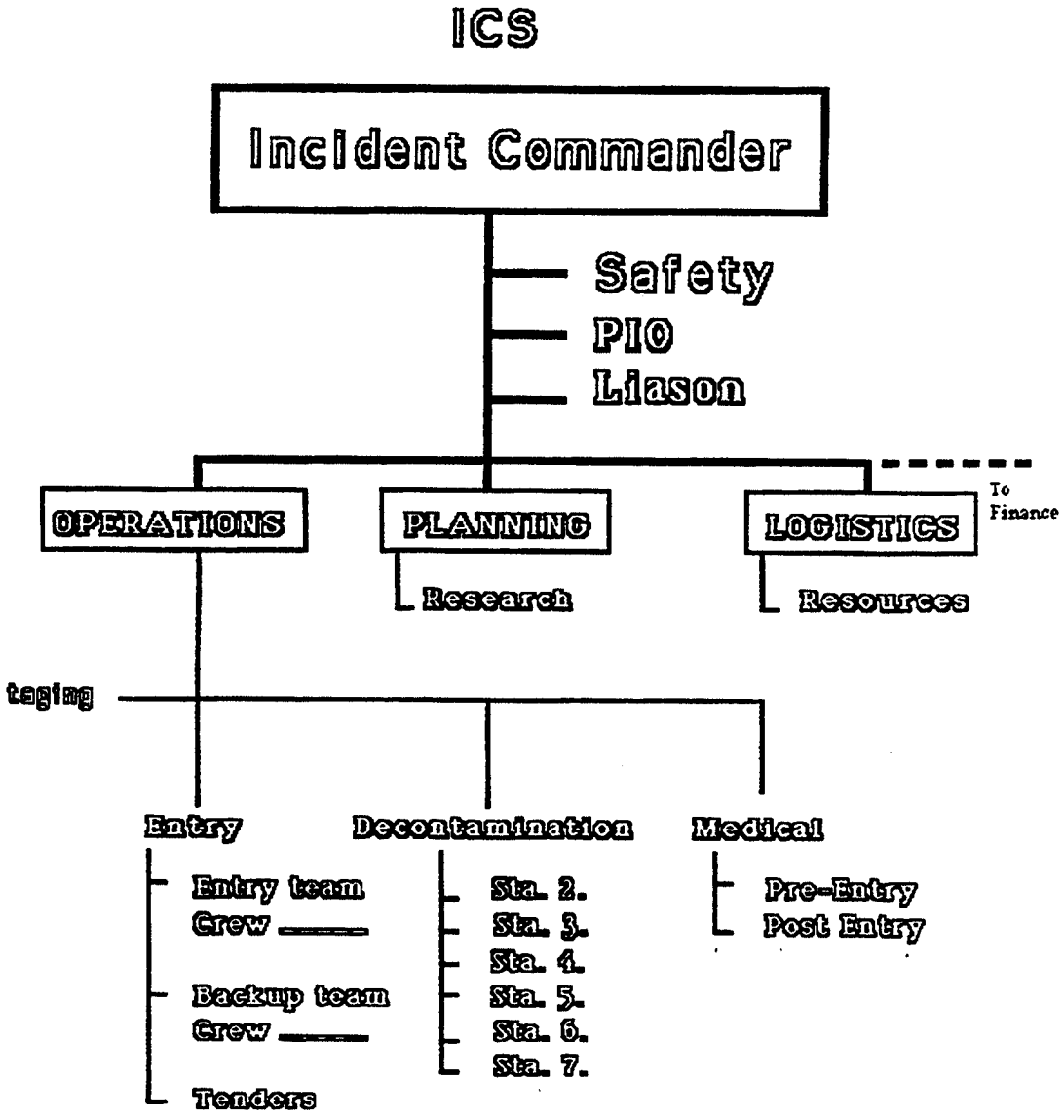
The decontamination station operator is responsible for decontamination procedures and equipment requirements. This person sees that all required equipment is available and inspects the equipment to ensure that it is properly operating and maintained.

SCIENCE OFFICER

The person who directs and coordinates scientific studies, sample collection and field monitoring is the science officer. The science officer also analyzes samples, interprets sample results, and advises the IC on remedial plans.

LIAISON OFFICER

This person is the point of contact for the assisting and cooperating agency representatives.


ICS
Incident Commander
Safety
PIO
Liason
OPERATIONS
PLANNING
LOGISTICS
To Finance
Research
Resources
taging
Entry
Decontamination
Medical
Entry team
Crew ____
Backup team
Crew ____
Tenders
Sta. 2.
Sta. 3.
Sta. 4.
Sta. 5.
Sta. 6.
Sta. 7.
Pre-Entry
Post Entry

PUBLIC INFORMATION OFFICER
At most hazardous materials incidents, the responders will encounter people from the news media. Therefore it is important that someone is designated as the public information officer. This person is responsible for press releases and interviews.

RECORDKEEPER
The recordkeeper maintains an official record of scene activities.

SECURITY OFFICER
The security officer manages general scene security and acts as a liaison with local law enforcement and fire department to control scene access.

COMMUNICATIONS OFFICER
The person who coordinates communications from field officers to other needed agencies is the communications officer.

MEDICAL OFFICER
The medical officer provides medical support and acts as liaison with the medical community.

❑ Who are the key members of the internal communications network and what is its purpose?

The internal (on-scene) communications network is used among those in the designated work zones. Key members in internal communications are the operations officer, safety officer, and the entry teams. The purpose of the Internal Communication Network is to:

1. Alert the team to emergencies
2. Pass along safety information
3. Tell changes in work scope
4. Maintain scene control

❑ What are some internal communication systems?

Any communication device used on-scene must be intrinsically safe to avoid creating a spark in a potentially explosive atmosphere. Visual cues include hand signals and whole body movements plus color warnings. Color warnings should be established in advance. Examples of color warnings are lights that should be intrinsically safe, flags and flares.

Audio cues must be developed because you cannot understand regular speech while wearing a respirator. Radios are used but with limited speech the responder hears messages but does not send many. Noisemakers or alarms are frequently used for emergency evacuation of the responders. These noisemakers include bells, compressed air horns, sirens, whistles, and megaphones.

❑ What are external communications?

The purpose of external communications is to communicate between on-scene and off-scene personnel during an emergency. External communications - telephone, radio, or computer - assist the first responder in the coordination of emergency response and obtaining technical advice (i.e. CHEMTREC, chemist). This type of communication also allows the on-scene personnel to inform the dispatcher as well as backup units of wind direction, safe approach routes, and other pertinent data.

Regardless of what is used there should be a primary and a back-up system. Also the responders must be trained in the systems before an emergency occurs.

❑ Why is documentation necessary?

Proper documentation and document control are important for ensuring accurate communication; ensuring the quality of the data collected; providing the rationale for safety decisions; and substantiating possible legal actions. Documentation can be accomplished by recording information pertinent to field activities, sample analysis, and scene conditions in one of several ways.

❑ What are types of documentation?

Types of documentation includes, logbooks, field data reports, graphs, photographs, sample labels, analytical records, and medical records.

❑ Who is responsible for the documents?

The documents listed above should be controlled to ensure that they are all accounted for when the project is completed. The task of document control should be assigned to one individual of the incident command team, the recordkeeper, and should include the following responsibilities:

1. Numbering each document.
2. Listing each document in a document inventory.
3. Recording whereabouts of each document.
4. Collecting all documents at the end of incident day.
5. Making sure entries are made in waterproof ink.
6. Filing all documents in a central file at the completion of the incident.

❑ What response activities and observations should be recorded in a field logbook?

Field personnel should record all on-scene activities and observations in a field logbook (bound, with consecutively numbered pages). Entries should be made during or just after completing a task to ensure thoroughness and accuracy.

PHOTOGRAPHS

Photographs can be an accurate, objective addition to a field worker's written observations. For each photograph taken, the following information should be recorded in the field logbook:

1. Date, time and place of incident.
2. Name of photographer.
3. Location of the subject within the scene.
4. General compass direction of the orientation of the photograph.
5. Sequential number of photograph and the film roll number.
6. Camera, lens and film type used for photography

SERIALLY NUMBERED SAMPLE LABELS OR TAGS

Serially numbered sample labels or tags should be assigned to sampling team personnel and recorded in the field logbook. Labels should be firmly affixed to the sample containers using either gummed labels or tags attached by string or wire. Information should be recorded on the tag in waterproof ink and should include items such as:

1. The unique sample log number.
2. Date and time that the sample was collected.
3. Source of the sample.
4. Preservative used.
5. Analysis required.
6. Name of collector.
7. Pertinent field data.

❑ What information should the Dispatcher try to receive before first responders respond to an emergency incident?

As much data as possible should be collected before any personnel arrives upon the scene of an accident. However, during an emergency, much of the information acquired by the first responders is at the emergency scene. Where possible, the exact location of the incident should be obtained. First responders will need to know the accessibility to the accident, and initial and alternate access points. A detailed description of the incident is also important. Other information which the dispatcher should try to receive (any amount will benefit the first responder) are duration of the incident activity before notification; wind direction, current weather conditions, temperature; proximity of population centers or population at risk, i.e. schools, residences, businesses, companies; present status of response and who has responded; ongoing processes effected, i.e. power plant, water plant, chemical process; hazardous substances involved and their physical and chemical properties, and; quantities of hazardous substances involved. (See Attachment C for example of MSP L.E.I.N. machine "Hazardous Materials Chemical, Flammables, Toxic Materials Accident/Spill Report" form.)

❑ How should an emergency vehicle approach a hazardous materials incident?

Upon arriving at the scene of an incident involving hazardous materials, the emergency vehicle should take care to approach upwind and remain at a distance. The vehicle should be placed to allow a rapid egress from the scene.

❑ What kind of information should be obtained during the size-up of an incident?

As much information as possible should be obtained before entering the scene so that the hazards can be evaluated and procedures to properly protect the entry team can be provided. Initial information-gathering missions should focus on identifying all potential or suspected conditions that may pose inhalation hazards immediately dangerous to life or health (IDLH), or other conditions that may cause death or serious harm.

At the scene in which the hazards are largely unknown or there is no need to go on the scene immediately, visual observations should be made through the use of field glasses. With field glasses, the responder should note any labels, markings or placards on containers or vehicles; type of container or vehicle; the amount of deterioration or damage of containers or vehicles; the presence of the incident scene in relation to population and property exposure; and any unusual conditions such as clouds, discolored liquids, oil slicks, vapors or other suspicious substances and their quantities involved. Other things to note would be any biological indicators, such as dead animals, people, or plants; weather conditions; presence of a fire; pathways or dispersion; and any unusual odors.

❑ What conditions should be monitored at the scene perimeter during size-up?

The ambient air at the scene perimeter should be monitored for toxic substances, combustible and flammable gases or vapors, oxygen deficiency, ionizing radiation, and specific materials if known.

❑ What off scene samples should be collected and analyzed?

If possible, samples to determine the extent of contamination should be taken from the soil, drinking water, ground water, scene runoff, and surface water around the scene of an incident.

❑ How can the first responder assist in a hazardous materials response without entering the scene?

The first responder from the scene perimeters could develop a preliminary scene map with location of buildings, containers, impoundments, pits, ponds, and tanks to assist the entry team's initial entry.

❑ Where should the first responder place the apparatus upon arrival at an emergency scene?

The first responder should have their vehicle placed so that a quick means of escape is provided. The apparatus must not be driven into the hot zone or any hazard area and it should be placed in a protected and/or remote position if possible.

❑ How can the scene of a hazardous materials incident be secured?

Make certain that public access has been restricted. Protective barriers (fences, etc.) and posted signs ("danger", "keep out") allow for the public to understand where safe and unsafe zones are located. Effective management at hazardous materials incidents requires a commitment to the health and safety of the general public as well as on-scene personnel.

Prevention and containment of contaminant release into the surrounding community should be addressed in the beginning stages of an incident. Not only must the public be protected, they must also be made aware of and have confidence in the response of an emergency incident. To accomplish these goals the Operations Officer or Public Information Officers under the supervision of the Incident Commander should establish community liaison well before any response action is begun, and should be in continuous contact with community leaders. The people of the community have a right to know what is taking place in their community, especially in regard to the dangerous chemicals present. It is especially important if the inhabitants of the community have children, because children play outside (e.g., climbing trees and fences). Parents need to be informed as to areas from which children should be restricted from playing.

In addition to these precautions for the outside community, interior precautions also need to be taken into account. Essential is a strict log in/out station staffed with an enforcement officer using a timetable sheet. Authority figures need to know who and how many people are on the scene in case of any emergencies, as well as to ensure all personnel are qualified to be on the scene. The scene needs to have an identification system to ensure against unauthorized personnel wandering around the scene. An identification system also ensures that the buddy system will be enforced. The buddy system can save lives – if an emergency occurs on the scene the buddy is able to call for help.

❑ What methods can be established to control entry onto the scene?

Unauthorized personnel should be excluded from the scene to prevent exposure of unprotected persons and to avoid interference with safe and effective working procedures. Traffic routes for personnel and vehicles should be clearly identified (e.g., signs, painted lines, ropes, etc.). Work zones should be clearly marked. Enforcement authority should be established for entry and exit requirements, and unauthorized personnel should be excluded from the scene.

❑ What is the purpose of an initial on-scene survey?

The initial scene survey is generally made to accomplish one or more of the following objectives:

1. Confirm the existence of a suspected hazardous situation.
2. Verify existing information and/or collect added data about the scene.
3. Characterize existing hazards affecting public health and environment.
4. Determine mitigation actions.
5. Further assess safety requirements for personnel entering the scene.
6. Determine types of sampling methods required.
7. Establish on-scene entry point(s) to meet above objectives.
8. Select personal protective equipment on the basis of information collected.

Predicting the Behavior of a Material and Its Container

When responding to a hazardous material incident, an operational level first responder needs to be able to predict the likely behavior of that material as well as its container. Using tools such as the Emergency Response Guidebook, MSDS information, Chemtrec, and other resources, the responder must determine the probable affect the material as well as the container's environment will have on the container and the surrounding area. If the container is impinged by fire, will it BLEVE? Will the material burn? What is its flash point? Is the material pyrophoric? If so, what will happen if the container cracks or ruptures? What will happen if water is used to disperse vapors? Is it water reactive? As first responders charged with protecting the surrounding environment and population we must ask these kinds of questions and be able to provide the answers. The physical and chemical properties previously discussed in the course can all pose significant hazards to containers, the environment, and responders.

There are three types of stress that could cause a container to release its contents; thermal, mechanical, and chemical. The consequence of a container being exposed to any of these forces could be a breach of the container. A breach could occur in a pressurized as well as a non-pressurized container. There are five ways a container could breach; disintegration, runaway cracking, closures opening up, punctures, and splits or tears. If a container is breached the contents will be allowed to escape. This release will vary in type and speed. The different types of releases are: detonation, violent rupture, rapid relief, and spill or leak. When released, a pattern will be formed by the escaping product that will possibly expose people, the environment, or property, creating physical or health hazards. Upon release, there are seven possible dispersion patterns that may be created; hemisphere, cloud, plume, cone, stream, pool, or irregular.

❑ Estimating the Potential Harm

After analyzing the behavior of the material and its container, the first responder must estimate the potential harm within the endangered area. There are many resources available for determining the size of an endangered area at a hazardous material incident, such as the Emergency Response Guidebook, CAMEO, and ARCHIE (see Sources of Information). Once the endangered area or vulnerability zone has been established, the number and type of exposures within that zone must be identified, and a course of action must be determined for safely dealing with those exposures.

Following the establishment of an endangered area, concentration levels of the released hazardous material within that area must be determined. If the responding organization does not have the capability of measuring the concentration, alternate resources should be identified and utilized. After the responder establishes the concentration levels, the extent of physical, health, and safety hazards within the vulnerability zone needs to be determined. The factors used to make that determination are: surrounding conditions, an indication of the behavior of the hazardous material and its container, and the degree of hazard.

❑ Why should the entry team always consist of at least four persons?

Because team members may be entering a largely unknown environment, caution and conservative actions are appropriate. The composition of the entry team depends on the scene characteristics but should always consist of at least four persons: two responders who will enter the scene and two outside support persons, suited in personal protective equipment and prepared to enter the scene in case of emergency.

What are the tasks of the entry team upon entering the scene?

Monitor

Upon entry, the team members should monitor the air for IDLH conditions as well as levels of toxicity which exceed exposure limits such as PEL, STEL, REL, and TLV values. Death or serious injury could result if monitoring is not complete and accurate. (In this case combustible or explosive atmospheres, oxygen deficiency, and toxic substances would be monitored.) In addition, the entry team should monitor for ionizing radiation. Team members would survey for gamma and beta radiation with a Geiger-Mueller detection tube or a gamma scintillation tube; if alpha radiation is expected, use a proportional counter.

Visual Observation

The entry team member should visually observe for signs of actual or potential IDLH or other dangerous conditions. Any indication of IDLH hazards or other dangerous conditions should be regarded as a sign to proceed with care and deliberation. Extreme caution should be exercised in continuing the scene survey when such hazards are indicated. If IDLH or other dangerous conditions are not present, or if proper precautions can be taken, continue the survey.

Conduct further air monitoring as necessary

Observe storage

Note the types of containers, impoundment's, or other storage systems such as:

1. Paper or wood packages.
2. Metal or plastic barrels or drums.
3. Underground tanks.
4. Aboveground tanks.
5. Compressed gas cylinders.
6. Pits, ponds, or lagoons.
7. Other.

Note the condition of containers and storage systems:

1. Sound (undamaged).
2. Visibly rusted or corroded.
3. Leaking.
4. Bulging.
5. Types and quantities of material in containers.
6. Labels on containers indicating corrosive, explosive, flammable, radioactive, or toxic materials.

Note the condition of semi-trailers:

1. Evidence of possible container damage inside.
2. Leakage through cracks and damage to trailer floor.
3. Other evidence of container damage.

Note the condition of tank trailers/rail tank cars:

1. Leaking pipes or valves.
2. Leaking seams.
3. Dome leakage.
4. Tank temperature.
5. Relief valve operating.

Observe materials

Note the physical condition of the materials:

1. Gas, liquid, or solid.
2. Color and turbidity.
3. Behavior, e.g., corroding, foaming, or vaporizing.
4. Conditions conducive to splash or contact.

Determine the potential pathways of dispersion:

1. Air.
2. Biologic routes, such as animals and food chains.
3. Ground water.
4. Land surface.
5. Surface water.

Note any indicators of potential exposure to hazardous substances:

1. Dead fish, animals or vegetation.
2. Dust or spray in the air.
3. Fissures or cracks in solid surfaces that expose deep waste layers.
4. Pools or liquid.
5. Foams or oils on liquid surfaces.
6. Gas generation or effervescence.
7. Deteriorating containers.
8. Cleared land areas or possible landfilled areas.

Identify natural wind barriers such as buildings, hills, or tanks

Note any safety hazards

Consider the following:

1. Conditions of scene structures.
2. Obstacles to entry and exit.
3. Terrain homogeneity.
4. Terrain stability.
5. Stability of stacked material.

Identify any reactive, incompatible, flammable, or highly corrosive wastes

Note land features

1. Hills, valleys.
2. Trees.
3. Slope.
4. Natural irritants.

Note the presence of any potential naturally occurring skin irritants or dermatitis-inducing agents, such as:

1. Poison ivy.
2. Poison oak.
3. Poison sumac.

Note any tags, labels, markings, or other identifying indicators

Collect samples

Collect samples from:

1. Air.
2. Drainage ditches.
3. Soil (surface and subsurface).
4. Standing pools of liquids.
5. Storage containers.
6. Streams and ponds.
7. Ground water (upgradient, beneath scene, downgradient).

❑ What is the purpose of work zones?

Once the initial scene entries have been completed, there should be enough knowledge to determine certain scene work zones, otherwise called zone delineation. Clean areas and contaminated areas must be established to reduce the accidental spread of hazardous substances by responders from the contaminated area to the clean area. Zones should be delineated based on where different types of operations will occur, and the flow of personnel among zones should be controlled. The establishment of work zones will help ensure that personnel are properly protected against the hazards present, work activities and contamination are confined to the appropriate areas, and personnel can be located and evacuated in an emergency.

❑ How are the work zones separated?

Hazardous materials incidents' scenes should be divided into three different zones to meet operational and safety objectives: 1) Hot Zone, the contaminated area; 2) Warm Zone, the area where decontamination takes place; and 3) Cold Zone, the uncontaminated area where responders should not be exposed to hazardous conditions.

Delineation of these three zones should be based on sampling and monitoring results and on an evaluation of potential routes and amount of contaminant dispersion in the event of a release. Movement of personnel and equipment among these zones should be minimized and restricted to specific Access Control Points to prevent cross-contamination from contaminated areas to clean areas. See Figure 1 below.

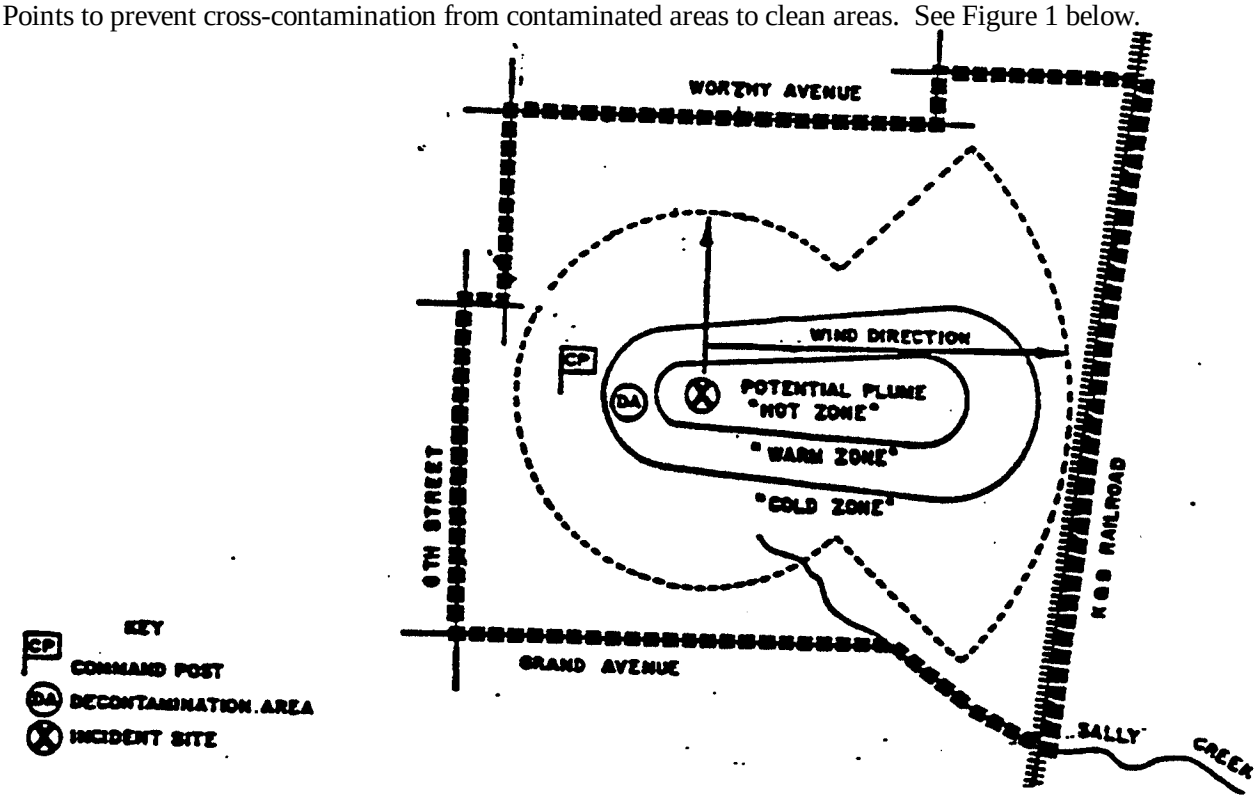


Figure 1 - WORK ZONES

What are the primary activities that occur in the hot zone?

The Hot Zone is the area where contamination does or could occur. The primary activities performed in the Hot Zone are:

1. Scene characterization, such as mapping, photographing, and sampling.
2. Installation of wells for ground water monitoring.
3. Incident mitigation.
4. Clean-up work, such as drum movement, drum staging, and materials bulking.

❑ What is the outer boundary for the Hot Zone?

The outer boundary of the Hot Zone, called the Hotline, should be established. It should be clearly marked by lines, placards, hazard tape and/or signs; or enclosed by physical barriers, such as chains, fences, or ropes. Access Control Points should be established at the periphery of the Hot Zone to regulate the flow of personnel and equipment into and out of the zone and to help verify that proper procedures for entering and exiting are followed. If feasible, separate entrances and exits should be established for personnel and equipment movement into and out of the Hot Zone.

The Hot Zone can be subdivided into different areas of contamination based on the known or expected type and degree of hazard or on the incompatibility of waste streams. This allows more flexibility in safety requirements, operations, decontamination procedures, and use of resources.

❑ Who works within the Hot Zone?

The personnel working in the Hot Zone may include the Field Team Leader, the work parties, and specialized personnel such as heavy equipment operators. All personnel within the Hot Zone should wear the level of protection required by the Scene Safety Plan. Within the zone, different levels of protection may be justified based on the degree of hazard presented. The level of personal protection required in each sub-area should be specified and marked.

❑ What is the Warm Zone?

The Warm Zone is the transition area between the contaminated area and the clean area. This zone is designed to reduce the probability that the Clean Zone will become contaminated or affected by other scene hazards. The distance between the Hot and Clean Zones provided by the Warm Zone, together with decontamination of responders and equipment, limits the physical transfer of hazardous substances into clean areas. The boundary between the Warm Zone and the Hot Zone is called the Hotline. The degree of contamination in the Warm Zone decreases as one moves from the Hotline to the Clean Zone, due both to the distance and the decontamination procedures.

Decontamination procedures take place in a designated area within the Warm Zone called the Contamination Reduction Corridor (CRC). They begin at the Hotline. At least two lines of decontamination stations should be set up in the CRC: one for personnel and one for heavy equipment. There may possibly be a third line for emergency decontamination. A large operation may require more than two lines. Access into and out of the Warm Zone from the Hot Zone is through Access Control Points: one each for personnel and equipment entrance, one each for personnel and equipment exit, if feasible.

❑ What personnel may be found in the Warm Zone?

The personnel stationed in the Warm Zone are usually the Scene Safety Officer, a Personnel Decontamination Station (PDS) Operator, and the emergency response personnel. Additional personnel may assist the PDS Operator by conducting abbreviated decontamination procedures from sample containers.

❑ What duties are performed in the Warm Zone?

The Warm Zone must be well designed to facilitate decontamination of equipment, PDS operators, personnel, and samples. Also, emergency response activities such as: transport for injured personnel (safety harness, stretcher), first-aid equipment (such as bandages, blankets, eyewash, splints, and water), containment equipment (absorbent, fire extinguisher). In addition, equipment resupply activities may take place, for example: air tank changes, personal protective clothing and equipment (such as booties and gloves), sampling equipment (such as bottles and glass rods), and tools. Sample packaging and preparation for on-scene or off-scene laboratories can be done in the warm zone.

Responder temporary rest area: toilet facilities, bench, chair, liquids, and shade. Water and other potable liquids should be clearly marked and stored properly to ensure that all glasses and cups are clean. Wash facilities should be located near drinking facilities to allow employees to wash before drinking. Drinking, washing, and toilet facilities should be located in a safe area where protective clothing can be removed. Facilities should be cleaned and inspected regularly. Appropriate protective measures should be taken by maintenance workers.

Water and other liquids used during decontamination activities is drained or pumped off and either stored or disposed of.

❑ What are the other required duties to be done in the Warm Zone?

Personnel within the Warm Zone should be required to maintain internal communications, line-of-sight contact with entry teams, work party monitoring (e.g., for air time left, fatigue, heat stress, hypothermia), and scene security. (See Attachment E for example of first aid needs.)

❑ What is the Cold Zone?

NOTE: (Other references may refer to this area as the Clean Zone.)

The Cold Zone is the location of the administrative and other support functions needed to keep the operations in the Hot and Warm Zones running smoothly. Any function that need not or cannot be performed in a hazardous or potentially hazardous area is performed here. The Command Post Supervisor should be present in the Cold Zone. Other personnel present will depend on the functions being performed, and may include the Project Team Leader and field team members who are preparing to enter or who have returned from the Hot Zone.

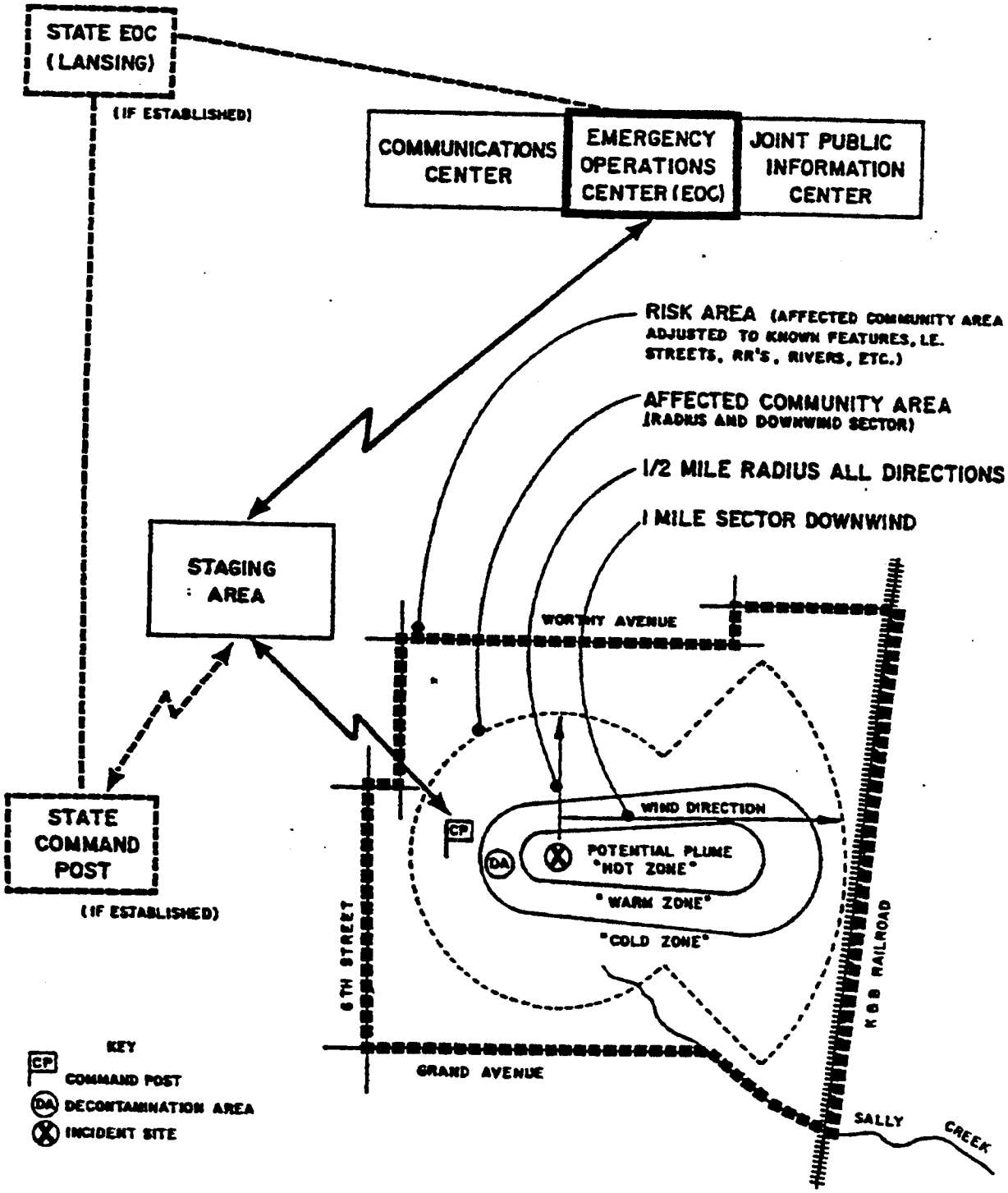
Personnel may wear normal work clothes within this zone. Any potentially contaminated clothing, equipment, and samples must remain in the Warm Zone until decontaminated.

❑ What activities do the responders perform in the Cold Zone?

Cold Zone personnel are responsible for alerting the proper agency in the event of an emergency. All emergency telephone numbers, change for the telephone (if necessary), evacuation route maps, and vehicle keys should be kept in the Cold Zone.

TYPE HAZMAT RESPONSE INSTALLATIONS AND ZONES

(ACTUAL CONFIGURATION WILL VARY WITH SITUATION)



❑ What factors should be considered in the location of the Cold Zone?

Support facilities are located in the Cold Zone. To place these facilities, consider factors such as:

Accessibility: topography, open space available, locations of highways and railroad tracks, ease of access for emergency vehicles.

Resources: adequate roads, powerlines, telephones, shelter, and water.

Visibility: line-of-sight to all activities in the Hot Zone.

Wind direction: upwind of the Hot Zone, if possible.

Distance: as far from the Hot Zone as practicable.

❑ What objectives should be considered when responding to Hazmat incidents?

After arrival at the scene of a hazardous material emergency, the incident commander must identify the possible objectives for his organization to mitigate the incident. These objectives could include but are not limited to the following:

1. Evacuation and withdrawal.
2. Rescue.
3. Exposure protection.
4. Confinement.
5. Containment (additional resources may be required).
6. Extinguishment.
7. Temporary holding action (until evacuation is complete).

Following the identification of possible objectives, the most appropriate one(s) should be chosen and resources directed toward accomplishment. The D.E.C.I.D.E process can be used for this task.

❑ Decision Making Model

To guide your intervention during an emergency, certain basic decisions must be made. Decision-making calls for emergency response personnel to:

1. **D**etect hazardous materials presence.
2. **E**stimate likely harm without intervention.
3. **C**hoose response objectives.
4. **I**dentify action options.
5. **D**o best option.
6. **E**valuate progress.

DETECT HAZARDOUS MATERIAL PRESENCE

Critical to any emergency! If you are not aware that a hazardous material problem exists, how can you protect against a nasty surprise?

ESTIMATE LIKELY HARM WITHOUT INTERVENTION

This is a difficult but indispensable step. If you don't know what is going to happen, how can you define your problem and how to deal with that problem? How can you choose your objectives?

CHOOSE RESPONSE OBJECTIVES
You have to identify the harm you want to prevent (the exposures you want to protect) before you can act in a rational manner.

IDENTIFY ACTION OPTIONS
With your objectives, what options do you have to accomplish those objectives? You must consider your practical options before you act.

DO BEST OPTION
When you have multiple options, you should pick the option that provides a solution to your problem, one with the greatest gain and the least loss.

EVALUATE PROGRESS
After you decide what to do, you have to make sure that what you expected to happen is actually happening. If not, you must review the problem and select another option to lead to the desired results.

❑ DECISION PRIORITIES

Priority I Decisions
Decisions that should be made immediately after an incident occurs.

Priority II Decisions
Decisions that should be made in the first half-hour after an incident occurs. Actions to stabilize the incident's affect on human safety and the environment.

Priority III Decisions
Decisions that usually are made during the first 24 hours after an incident occurs to safely resolve the incident.

Priority IV Decisions
Decisions made after the incident has been safely resolved to restore the incident site and the affected community to normal.

Reference:

BENNER, L., "D.E.C.I.D.E. in Hazardous Materials Emergencies", Fire Journal, July 1975.

Glossary of Hazardous Material Terminology

Abatement — The actions taken to reduce the amount, degree of the hazard, or intensity of the release or threatened release of a hazard.

Absolute Pressure — Gauge pressure plus atmospheric pressure, abbreviated P.S.I.A. (true pressure).

Absorbent Material — A material designed to pick up and hold liquid hazardous material to prevent contamination spread.

Absorption — Taking in toxic material by contact with the skin.

The process of "picking up" a liquid hazardous material to prevent enlargement of the contaminated area.

Acceptable Risk — A risk, judged to be outweighed by corresponding benefits, or one that is of such a degree that it is considered to pose diminished potential for adverse effects.

Access Control Point — The point of entry and exit which regulates access to and from control zones.

ACGIH — American Conference of Governmental Industrial Hygienist; an organization of professional personnel in governmental agencies or educational institutions engaged in occupational safety and health programs. ACGIH develops and publishes recommended occupational exposure limits (see TLV) for hundreds of chemical substances and physical agents.

Acid — One of a large class of chemical substances whose water solutions have one or more of the following properties: sour taste, ability to make litmus dye turn red and to cause other indicator dyes to change to characteristic colors, ability to react with and dissolve certain metals to form salts. All acids contain hydrogen. In water, ionization or splitting of the molecule occurs, so that some or most of this hydrogen forms H_3O+ ions (hydronium ions), usually written more simply as H (hydrogen ion).

Acid Suits — Special protective clothing that prevents toxic or corrosive substances or vapors from coming in contact with the body.

Acute — Intense. Reaching a crisis rapidly.

Acute Effect — An intense effect to a human or animal body, caused by exposure to a chemical or physical agent, with symptoms developing rapidly. Also see 'chronic'.

Acute Toxicity — The extreme effects resulting from a single dose or exposure to a substance. Acute effects are defined by the American National Standard Institute (ANSI) Standards for Precautionary Labeling of Hazardous Industrial Chemicals (Z129.1-1982).

Adjuvant	A subsidiary ingredient or additive in a mixture (medicine, flavoring, perfume, etc.,) which contributes to the effectiveness of the primary ingredient.
Adsorption	Process of adhering to a surface.
Aerosol	A dispersion of particles of microscopic size in a gaseous medium. Particles may be solid (dust, fume, smoke) or liquid (mist, fog).
Agency Representative	Individual assigned to an incident from an assisting or cooperating agency who has been delegated full authority to make decisions on all matters affecting that agency's participation at the incident. Agency representatives report to the incident liaison officer.
Air Bill	A shipping paper prepared from a bill of lading that accompanies each piece of an air shipment.
Air Inversion	A meteorological condition in the earth's atmosphere in which the temperature of the air some distance above the earth's surface is higher than the air temperature of the surface. Normally, air temperatures decrease progressively as altitude increases. Such a condition traps air and released gases and vapors near the earth's surface, thus impeding their dispersion.
Air Modeling	Mathematical models used to predict movement and concentrations of chemicals in the atmosphere.
Air Monitoring	The observations, recording, and/or detection of pollutants in ambient air.
Air-Reactive Materials	Substances that will ignite at normal temperatures when exposed to air.
Airborne Pollutants	Pollutants that are carried in air.
Allocated Resources	Resources dispatched to an incident that have not yet checked in with the incident communications system.
Ambient Temperature	The normal temperature of the environment.
ANSI	American National Standards Institute; a privately funded, voluntary membership organization that identifies industrial and public needs for national consensus standards and coordinates development of such standards. Many ANSI standards relate to safe design/performance of equipment such as safety shoes, eyeglasses, etc. and safe practices or procedures, such as noise measurements, testing of fire extinguishers and flame arrestors, etc.
API	American Petroleum Institute; voluntary membership organization of the petroleum industry. Among its services, API assists member committees in developing by the consensus process, and publishing, recommended practices for drilling and well servicing, storage tank installation, tank cleaning, piping and fittings, other industry-related design, installation and operating practices; also funds and publishes basic references books and manuals.

Asphyxiant	A vapor or gas which can cause unconsciousness or death by suffocation (lack of oxygen). Asphyxiants are harmful to the body when they become so concentrated that they reduce the oxygen content in the air (normally about 21%) to dangerous levels (OSHA-19.5% or lower), or prevent the body from utilizing the oxygen breathed. Asphyxiants are one of the principal potential hazards of working in a confined space.
Asphyxiating Materials	Substances that can cause death through displacement of the oxygen in the air.
Assigned Protection Factor	see "Protection Factor"
Assigned Resources	Resources checked in and assigned work tasks on an accident.
Assisting Agency	An agency directly contributing suppression, rescue, support, or service resources to another agency.
ASTM	American Society for Testing and Materials; voluntary membership organization with members from a broad spectrum of individuals, agencies, and industries concerned with materials. The world's largest source of voluntary consensus standards for materials, products, systems, and services. ASTM is a resource for sampling and testing methods, health and safety aspects of materials, safe performance guidelines, effects of physical and biological agents and chemicals.
Available Resources	Resources assigned to an incident, available for assignment.
Barrel	42 U.S. gallons
BLEVE	Boiling Liquid Expanding Vapor Explosion. A container failure with a release of energy, often rapidly and violently, accompanied by a release of gas to the atmosphere, followed by ignition (fireball) and propulsion of the container or container pieces.
Boiling Point	The temperature at which liquid changes to a vapor state, at a given pressure; usually expressed in degrees Fahrenheit at sea level pressure (760 mm Hg, or one atmosphere). For mixtures, the initial boiling point or the boiling range may be given. Flammable materials with low boiling points generally present extreme fire hazards.
Boilover	The violent expulsion of oil and froth from a tank due to the rapid expansion of water into steam when the heat wave in the oil reaches the water layer, usually suspended toward the bottom of a tank of heavy or unrefined oil.
BOM or BuMines	Bureau of Mines of the U.S. Department of Interior. BuMines began approving air breathing apparatus in 1918; later added all types of respirators. BOM's respirators testing/approval activities have been discontinued; NIOSH now has this responsibility.
Branch	That organizational level having functional/geographic responsibility for major segments of incident operations. The branch level is organizationally between the section and division group.

Breakthrough	The penetration of challenge material(s) through a gas or a vapor air-purifying element or fabric. The quantity or extent of breakthrough during service life is often referred to as the percentage of the input concentration.
Bulk Container	A cargo container such as that attached to a tank truck or tank car, used for transporting materials in bulk quantities.
Bulk Plant	That portion of a property where flammable or combustible liquids are received by tank vessel, pipe line, tank cars, or tank vehicles, and are stored or blended in bulk for the purpose of distributing such liquids by tank vessel.
Bung	A cap or screw used to cover the small opening in the top of a metal drum or barrel.
'C' or Ceiling	The maximum allowable human exposure limit (not to be exceeded) for an airborne substance. Also see "PEL" and "TLV".
CAA	Clean Air Act; Federal law enacted to regulate/reduce air pollution. Administered by the Environmental Protection Agency (EPA).
CAS	Chemical Abstract Service; A Columbus, Ohio organization that indexes information published in 'Chemical Abstracts' by the American Chemical Society, and provides index guides by which information about particular substances may be located in the " Abstracts" when needed. CAS numbers identify specific chemicals.
Camp	A geographical site, within the general incident area, separate from the base, equipped and staffed to provide food, water, and sanitary services to incident personnel.
Carboy	A bottle or rectangular container for liquids of 5 to 15 gallons capacity that is made of glass, plastic, or metal and is often cushioned in a protective container.
Carcinogen	A substance or agent capable of causing or producing cancer in mammals. (See also 'Potential Occupational Carcinogen')
Carcinogenisis	The growth process of cancer as a result of exposure to a particular substance or agent.
Cargo Manifest	A shipping paper that contains all of the contents being carried by the transporting vehicle or vessel.
cc	Cubic centimeter; a volume measurement in the metric system, equal in capacity to one milliliter (ml). One quart is about 946 cc.
Check-in	Locations where assigned resources check-in at an incident. The locations are: incident command post (resources unit), incident base, camps, staging areas, helibases, and division supervisors (for direct assignments).

Chemical Family	A group of single elements or compounds with a common name. Example: acetone, methyl ethyl ketone (MEK), and methyl isobutyl ketone (MIBK) are of the ketone family.
CHEMTREC	Chemical Transportation Emergency Center; a national center established by the Chemical Manufacturers Association (CMA) in Washington, DC, in 1970, to relay pertinent emergency information concerning specific chemicals on request.
Chronic Effect	An adverse effect on a human or animal body, with symptoms which develop slowly over a long period of time and exposure to a chemical or physical agent. Also see "acute".
Chronic Toxicity	Adverse effects resulting from repeated doses of or exposures to a substance over a relatively prolonged period of time. Ordinarily used to denote effects in experimental animals.
Class A Explosive	A material or device that presents a maximum hazard and functions by detonation.
Class A Poison	A poisonous gas or liquid of such nature that a very small amount of the gas, or vapor of the liquid, is dangerous to life.
Class B Explosive	A materials or device that presents a flammable hazard and functions by deflagration.
Class B Poison	Liquids or solids (other than Class A Poisons or Irritating Materials) which are known to be so toxic to humans as to afford a hazard to health during transportation.
Class C Explosive	A material or device that contains restricted quantities of either Class A or Class B explosives or both, but presents a minimum hazard.
Clear Text	The use of plain English in radio communications transmissions. No ten codes, or agency specific codes, are used when using clear text.
CO	Carbon Monoxide, a colorless, odorless, flammable and very toxic gas produced by the incomplete combustion of carbon; also a by-product of many chemical processes; an asphyxiant.
CO_2	Carbon Dioxide, a heavy, colorless gas produced by incomplete combustion and decomposition of organic substances, and as a by-product of many chemical processes. CO_2 will not burn and is relatively non-toxic (although high concentrations, especially in confined spaces, can create hazardous oxygen deficient environments).
COC	Cleveland Open Cup; a flash point test method.
Code of Federal Regulations (CFR)	The formal name given to those books or documents that contain the specific regulations provided for by the law.

Cold Zone	This area contains the command post and such other support functions as are deemed necessary to control the incident. This is also referred to as the clean zone or support zone.
Combustible	A term used by NFPA, DOT, and others to classify certain liquids that will burn, on the basis of flash points. In the Hazard Communication Rules, a combustible liquid has a flash point at or above 100ºF (37.8ºC), but below 200ºF. Also, see combustible liquid in OAR 437-155-005(6).
Combustible Liquid	Any Liquid having a flash point at or above 100ºF.
Combustion explosion	Sudden fracture of a container or structure accompanied by a shock wave (sounds). Combustion of a flammable mixture within a container or structure producing a gas pressure greater than the container or structure can withstand.
Communications (Comm) Unit	A vehicle (trailer or mobile van) used to provide the major part of an incident communications center.
Command	The act of directing, ordering, and/or controlling resources by virtue of explicit legal, agency, or delegated authority.
Command Staff	The Command Staff consists of the Information Officer, Safety Officer, and Liaison Officer. They all report directly to the Incident Commander.
Company	Any piece of equipment having a full complement of personnel.
Compressed Gas	Any materials which, when enclosed in a container, has an absolute pressure exceeding 40 psi at 70 degrees Fahrenheit (or) exceeding 140 psi at 130 degrees Fahrenheit.
Compressed gas in Solution	A non-liquefied gas that is dissolved in a solvent, but in a solution at high pressures (e.g., acetylene).
Concentration	The relative amount of a substance when combined or mixed with other substances, (e.g., 2 parts per million (ppm) hydrogen sulfide in air; or a 50 percent caustic solution).
Confinement	Those procedures taken to keep a material in a defined or local area.
Consignee	The person who is to receive a shipment.
Consist	A rail shipping paper similar to a cargo manifest. It may contain a list of the cars in the train, in order, or a list of those cars carrying hazmats and their locations on the train.
Container	Any bag, barrel, bottle, box can, cylinder, drum, reaction vessel, storage tank, or the like that contains a hazardous material.
Container Specification No.	A number found on a shipping container preceded by the initials "DOT" which indicate that the container has been built according to Federal specifications.

Containment	Those procedures taken to keep a material in its container.
Contamination	Staining or polluting that occurs by physical contact with another substance.
Control	The procedures, techniques, and methods used in the mitigation of a hazardous materials incident, including containment, extinguishment and confinement.
Control Agent	Any material that is used to contain or extinguish a hazardous material or its vapors.
Control Zones	The designation of areas at a hazardous materials incident based upon safety and the degree of hazard.
Cooperating Agency	An agency supplying assistance other than direct suppression, rescue, support or service function to the incident control effort (e.g., Red Cross, law enforcement agency, telephone company, etc.).
Coordination	The process of systematically analyzing a situation, developing relevant information, and informing appropriate command authority (for its decision) of viable alternatives for selection of the most effective combination of available resources to meet specific objectives. The coordination process (which can either be intra- or inter-agency) does not in and of itself involve command dispatch actions. However, personnel responsible for coordination may perform command or dispatch functions within limits as established by specific agency delegations, procedures, legal authority, etc.
Corrective Actions	Actions taken by the Incident Commander to correct the problem at hand during a hazmat emergency.
Corrosive	As defined by DOT in *Appendix A to 49 CFR Part 173,* a corrosive material is "…a liquid or solid that causes visible destruction or irreversible alterations in human skin tissue at the site of contact; or, in the case of leakage from its packaging, a liquid that has a severe corrosion rate on steel." *See Appendix A in Hazard Communication Rule, Section 2, page 19.*
CPSC	*Consumer Products Safety Commission,* a federal agency with responsibility for regulating hazmats when they appear in consumer goods. For CPSC purposes, hazards are defined in the *Hazardous Substances Act* and the *Poison Prevention Packaging Act of 1970.*
Cryogenic Liquid	Gases which must be cooled to a very low temperature to bring about a change from gas to liquid. Stored at temperatures from -150ºF to absolute zero (-459ºF).
Cutaneous Toxicity	See "Dermal Toxicity."
CWA	Clean Water Act. Federal law enacted to regulate/reduce water pollution. Administered by EPA.
Dangerous Cargo Manifest	A cargo manifest used on ships that contains a list of all the hazardous materials on board, including their locations.

Decomposition	Breakdown of a material or substance (by heat, chemical reaction, electrolysis, decay, or other processes) into parts, elements or simpler compounds.
Decontamination (contamination reduction)	The physical and/or chemical process of reducing and preventing the spread of contamination from persons and equipment used at a hazmat incident.
Decontamination Area	The area, usually located within the *warm zone,* where decontamination takes place.
Deflagration	Burning which takes place at a speed below the speed of sound.
Degradation	A chemical action involving the molecular breakdown of protective clothing materials due to contact with a chemical. The term "degradation" may also refer to the molecular breakdown of the spilled or released material to render it less hazardous.
Demonstrate	To show, by actual use. This may be supplemented by simulation, explanation, illustration or a combination of these.
Dermal Toxicity	Adverse effects resulting from skin exposure to a substance used once, or applied to, the skin.
Detonation	The extremely rapid, self-propagating decomposition of an explosive accompanied by a high-pressure-temperature wave that moves at 1000-9000 m/sec.
DHHS	US Department of Health and Human Services, which was created in 1980 to replace the US Department of Health, Education and Welfare (DHEW) as 'parent' for NIOSH, Public Health Service, and other agencies related to health and safety.
Dikes	Temporary walls constructed to halt the flow of a liquid substance. Also, earthen or concrete walls surrounding oil tanks, designated to catch overflow from the tanks and relieve the danger of flowing flammable liquids spreading to other exposures.
Dispatch	The implementation of a command decision to move a resource or resources from one place to another.
Dispatch Center	A facility from which resources are directly assigned to an incident.
Disposable Respirators	A respirator that is discarded after the end of its recommended period of use, after excessive resistance or physical damage, or when odor-breakthrough or other warning indicators render the respirator unsuitable for further use.
Division	That organization level having responsibility for operations within a defined geographic area or with function responsibility. The division level is organizationally between the strike team and the branch. (see also Group)

DOL	US Department of Labor; includes the Occupational Safety and Health Administration (OSHA).
Dome	The circular cover on the top of a tank car that contains valves and relief valves.
DOT	US Department of Transportation; regulates transportation of chemicals and other substances for the protection of the public; law enforcement, and emergency response personnel, particularly when transportation incidents occur.
Dozer Company	Any dozer with a minimum complement of two persons.
Dust	A solid, mechanically produced particle with a size ranging from submicroscopic to macroscopic.
Dust and Mist Respirators	Respirators approved for the use against dusts or mists that may cause pneumoconiosis and fibrosis.
Emergency Respirator Use Situation	A situation that requires the use of respirators due to the unplanned generation of a hazardous atmosphere (often of unknown composition) caused by an accident, mechanical failure, or other means and that requires evacuation of personnel or immediate entry for rescue or corrective action.
Emergency Shut-Off Lever	A means of operating a valve that stops the flow of substance.
Endangered Persons	Those persons who are in the exposure area created by a hazardous materials incident.
Engine	Any ground vehicle providing specified levels of pumping, water, hose capacity, and personnel.
EPA	US Environmental Protection Agency; Federal agency with environmental protection regulatory and enforcement authority. Administers CAA, CWAct, FIFRA, RCRA, TSCA, CERCLA, and other federal environmental laws.
Epidemiology	The science that deals with the study of disease in a general population. Determination of the incidence (rate of occurrence) and distribution of a particular disease (as by age, sex, race, or occupation) may provide information about the causes of the disease.
Equilibrium	(1) Chemical equilibrium is a condition in which a reaction and it's opposite or reverse reaction occur at the same rate, resulting in a constant concentration of reactants; for example, ammonia synthesis is at equilibrium when ammonia molecules form and decompose at equal velocities ($N_2 + 3H_2$ U $2NH_3$). (2) Physical equilibrium is exhibited when two or more phases of a system are changing at the same rate so that the net change in the system is zero.
Exposures	People, the environment or property that are or that may be exposed to the harmful effects of a hazardous materials emergency.

FDA The U.S. Food and Drug Administration; under the provisions of the Federal Food, Drug and Cosmetic Act, the FDA establishes requirements for the labeling of foods and drugs to protect consumers from misbranded, unwholesome, ineffective, and hazardous products. FDA also regulates materials for food contact service and the conditions under which such materials are approved.

Feedback An element of a system that is the return of a portion of the output to the input. This allows the system to evaluate itself.

FIFRA Federal Insecticide and Rodenticide Act; regulations administered by EPA under this Act require that certain useful poisons, such as chemical pesticides, sold to the public, contain labels that carry health hazard warnings to protect users.

Filtering Facepiece A particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium. (See "Single-use dust" or "Dust and mist respirators" and "Disposable respirators")

Fire Point The lowest temperature of a liquid at which vapors are evolved fast enough to support continuous combustion.

Fit Factor A quantitative measure of the fit of a specific respirator facepiece to a particular individual.

Flame Impingement The points where flames contact the surface of a container.

Flammable A "flammable liquid" is defined by NFPA and DOT as a liquid with a flash point below 100ºF (37.8ºC). Solids that will ignite readily or are liable to cause fires under ordinary conditions of transportation through friction or retained heat from manufacturing or processing, and which burn so vigorously and persistently as to create a serious transportation hazard, are classified by DOT as "flammable solids." Also see "Combustible." See OAR 437-155-055(16).

Flammable Gas In order to be considered a 'flammable' gas, a chemical must have an LFL of 13% or below, or a flammable range of 12%. (U.S. DOT)

Flammable Limits See "explosive limits"

Flammable Liquid Any liquid having a flash point below 100ºF.

Flammable Material A substance that is capable of being easily ignited and of burning rapidly.

Flammable Solid Any material, other than an explosive, that is liable to cause fires through friction, retained heat from manufacturing or processing, or that can be ignited readily and when ignited burns so vigorously and persistently as to create a serious transportation hazard.

Flash Point The lowest temperature at which a liquid substance gives off flammable vapors sufficient to form an ignitable mixture with air near the surface of the liquid. Combustion is not continuous at the flash point. There are several

flash point test methods, and flash points may vary for the same material depending on the method used, so the test method is indicated when the flash point is given (e.g., 150º PMCC, 200º TCC, etc.). See OAR 437-155-005(17).

Flashback Re-ignition of flammable liquid caused by exposure of its vapors to an ignition source.

Flashing Roof A type of roof used on oil tanks to stop evaporation loss and reduce the fire hazard by reducing the vapor space over the liquid.

Food Dispenser Any vehicle capable of dispensing food to incident personnel.

Formula The conventional scientific designation for a material (Water is H_2O, sulfuric acid is H_2SO_4, sulfur dioxide is SO_2, etc.).

Frothover A steady, slow frothing over of a tank without the sudden action that occurs in a boilover.

Fuel Tender Any vehicle capable of supplying fuel to ground or airborne equipment.

Fume A solid condensation particulate, usually of vaporized metal.

Fusible Plugs A safety device in the form of a plug of low melting metal. The plugs close the safety relief device channel under normal conditions, and are intended to yield or melt at a set temperature to permit the escape of gas.

g/kg Grams per kilogram. An expression of dose used in oral and dermal toxicology testing, to indicate the grams of substance dosed per kilogram of animal body weight. Also see “kg” (kilogram).

Gas A formless atmosphere which occupies completely a space or an enclosure. An aeriform fluid that is in a gaseous state at a standard temperature and pressure.

Gauge Pressure The pressure read of a gauge, which does not take atmospheric pressure into account. The abbreviation for this pressure is “PSIG”.

General Exhaust A system for exhausting air-containing contaminants from a general work area. Also see “local exhaust.”

General Staff The group of incident management personnel comprising *Incident Commander, Logistics Chief, Operations Chief, Finance Chief, Planning Chief.*

g Gram. A metric unit of weight. One ounce UIS (avoirdupois) is about 28.4 grams.

Group A functional division (e.g., *air support, salvage, structure protection,* etc.,)

Half-Life	The time required for an unstable element or nuclide to lose one-half of its radioactive intensity in the form of alpha, beta and gamma radiation. It is a constant for each radioactive element or nuclide. Half-lives vary from fractions of a second for some artificially produced radioactive elements to millions of years. The half-life of Uranium 235, for example, is 710,000,000 years.
Hatch Plan	A schematic drawing of the location of all cargo on a ship (Also referred to as a stowage plan).
Hazard Class	A group of materials as designated by US DOT, that share a common major hazardous property, e.g., radioactivity, flammability.
Hazard Sector	That function of an overall Incident Command System that deals with the actual mitigation of a hazardous materials incident. It is directed by a sector officer and principally deals with the technical aspects of the incident. *(Note: this term is not consistent with NIIMS terminology.)*
Hazard Sector Officer	The person responsible for the management of the hazard sector. *(Note: this term is not consistent with NIIMS terminology.)*
Hazard/Hazardous	Capable of posing an unreasonable risk to health, safety, or the environment. Capable of doing harm.
Hazardous Chemical	Any chemical which is a physical or health hazard. *In the Hazard Communications rules, see the definition for health hazards in OAR 437-155-005(21) and Appendix A, "Health Hazard Definitions."*
Hazardous Material	A substance that poses an unreasonable risk to life, the environment, or property, when released from its container. *(See specific regulatory definitions in Appendix A of NFPA 472.)*
Hazardous Materials Response Team	A group of trained response personnel operating under an emergency response plan and appropriate standard operating procedures to control or otherwise minimize or eliminate the hazards to people, property, or the environment from a released hazardous material.
Heat Wave	A layer of hot liquid in a tank produced by the heat of the burning vapors at the top of the tank. As the burning progresses, this layer becomes thicker, extending down into the liquid in the tank.
Heavy Equipment Transport	Any ground vehicle capable of transporting a dozer.
Helibase	A location within the general incident-area for parking, fueling, maintenance and loading of helicopters.
Helibase Crew	A crew of three or more individuals who may be assigned to operations or to support helicopter operations.
Helicopter Tender	A ground service vehicle capable of supplying fuel and support equipment to helicopters.

Helispot	A location where a helicopter can take off and land. Some helispots may be used for temporary retardant loading.
High Temperature Protective Clothing	Protective clothing designed to protect the wearer for short-term high-temperature exposures. This type of clothing is usually of limited use in dealing with chemical commodities.
Hot Zone	The area immediately surrounding a hazardous materials incident, which extends far enough to prevent adverse effects from hazardous materials releases to personnel outside the zone. The zone is also referred to as the *exclusion zone* or *restricted zone.*
IDLH	*Immediately Dangerous to Life and Health.* The maximum level of concentration from which one could escape within thirty minutes.
Ignitable	Capable of being set afire.
Ignition Temperature	The minimum temperature to which a substance must be heated in order to initiate self-sustained combustion (burning).
Incident	An occurrence or event – either human-caused or natural phenomenon – that requires action by emergency service personnel to prevent or minimize loss of life or damage to property and/or natural resources.
Incident Action Plan	The incident action plan that is prepared at the initial meeting of incident command, contains general control objectives reflecting the overall incident strategy and specific action plans for the subsequent operational period. When complete, the incident action plan will have a number of attachments.
Incident Base	That location at which the primary logistics functions are coordinated and administered. (The specific incident name or other designator will be added to "base" at the time of an incident.) The incident command post may be co-located with the base. There is only ever one base per incident.
Incident Command Post (ICP)	That location at which the primary functions are executed and usually co-located with the incident base.
Incident Command System (ICS)	The combination of facilities, equipment, personnel, procedures and communications, operating within a common organizational structure, with responsibility for the management of assigned resources to effectively accomplish stated objectives pertaining to an incident.
Incident Commander	The person responsible (and accountable) for all decisions relating to the management of an incident. The Incident Commander is in charge of an incident.
Incipient Fires	Fires that are in the beginning stages.
Incompatible	Materials which could cause dangerous reactions from direct contact with one another are described as "incompatible".

Individual Container A cargo container such as a box or a drum, used to transport materials in small quantities.

Infrared (IR) A heat detection system used for fire detection, mapping and hot spot identification.

Ingestion The intake of a substance through the mouth.

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

Inhibitor A chemical which is added to another substance to prevent an unwanted chemical change from occurring involving hazardous materials. Detailed US DOT classification lists specify appropriate warning labels such as *Oxidizing Agent* or *Flammable Liquid* which must be used for various substances during transport.

Initial Attack Resources initially committed to an incident.

Irritant A substance which, by contact in sufficient concentration for a sufficient period of time, will cause an inflammatory response or reaction of the eye, skin or respiratory system. The contact may be a single exposure or multiple exposures. *See Appendix A, Hazard Communication Rule, Section 4.*

Irritating An irritating material as defined by US DOT, is a liquid or solid substance which, upon contact with fire, or when exposed to air, gives off dangerous or intensely irritating fumes (not including poisonous materials).

Jurisdictional Agency The agency having jurisdiction and responsibility for a specific geographical area.

kg Kilogram. A metric unit of weight…equivalent of about 2.2 US pounds.

I Liter. A metric unit of volume. A US quart is about 9/10 of a liter.

Labels Four-inch-square diamond-shaped markers required on individual shipping containers smaller than 640 cu. Ft.

LC Lethal Concentration. A concentration of a substance that will kill an animal upon inhalation.

LC_{50} Lethal Concentration 50. The concentration of a material in air, which, on the basis of laboratory tests, is expected to kill 50 percent of a group of test animals when administered as a single exposure (usually one to four hours). The LC_{50} is expressed as parts of material per million parts of air (ppm), by volume for gases and vapors, or as micrograms of material per liter of air (mg/l), or milligrams of material per cubic meter of air (mg/m) for dusts, mists, gases and vapors.

LD Lethal Dose. A concentration of a substance which will kill an animal by ingestion or skin contact.

LD_{50}	Lethal Dose 50. A single dose of a material, which, on the basis of laboratory tests, is expected to kill 50 percent of a group of test animals. The LD_{50} is expressed as milligrams or grams, or material per kilogram of animal weight (mg/kg or g/kg).
LEL	Lower Explosive Limit. (also known as "LFL" or "Lower Flammable Limit") of a gas or vapor. The lowest concentration (lowest percentage of the substance in air) that will produce a flash of fire when an ignition source (heat, arc or flame) is present. At concentration lower than the LEL, the mixture is too "lean" to burn. *See, also, "UEL"*
LFL	Lower Flammable Limit. *(See LEL)*
Light Ends	Petroleum products which have relatively low flashpoints and high vapor pressure. Common light ends are methane, ethane, propane and butane.
Liquefied Gas	A gas that is partially liquid at a temperature of 70ºF.
Liquefied Petroleum Gas	Gases that can be liquefied under moderate pressures. Common LPGs are butane and propane.
Local Exhaust	A system for capturing and exhausting contaminants from the air at the point where the contaminants are produced (e.g., during welding, grinding, sanding). *(See also "General Exhaust")*
Low Pressure Tank	A storage tank which has been designed to operate at pressures above 0.5 psi but not more than 15 psi.
Lower Explosive Limit	See "LEL"
Lower Flammable Limit	See "LFL"
m_3	Cubic Meter, or stere. A metric measure of volume equivalent to about 35.3 cubic feet or 1.3 cubic yards.
Management By Objective (MBO)	Top-down management designed so that all involved know and understand the objectives of the operation.
Material Safety Date Sheets (MSDS)	Documentation provided by manufacturers and compounders of chemicals with minimum information about chemical composition, physical and chemical properties, health and safety hazards, emergency response, and waste disposal, as required by OSHA 29 CFR 1910.120.
Mechanical Exhaust	A powered device – such as a motor-driven fan or air-stream Venturi tube – for exhausting contaminants from a workplace, vessel or enclosure.
Melting Point	The temperature at which a solid substance changes to a liquid state. For mixtures, the melting "range" may be given.
Message Center	The message center is part of the communications center and is co-located with it or adjacent to it. The center receives, records and routes information about resources, administration and tactical communications traffic.

mg	Milligram. A metric unit of weight. 1000 milligram = 1 gram (g).
mg/m^3	Milligrams per cubic meter. Unit for measuring concentrations of gases, vapors or particulates in air.
mg/kg	Milligrams per kilogram. An expression of toxicological dose.
Miscibility	A liquid's ability to mix with water.
Mist	A liquid condensation particle.
ml	Milliliter. A metric unit of volume equal to one cubic centimeter or about 1/16 of a cubic inch. 1000 ml = one liter.
mm Hg	Millimeters of Mercury. A unit of measurement for low pressures or partial vacuums.
Mobilization Center	An off-incident location at which emergency service personnel and equipment are temporarily located pending assignment, release or re-assignment.
Monitoring equipment	Instruments and devices used to identify and quantify contaminants.
mppcf	Million particles per cubic foot. A unit for measurement of particles of a substance suspended in air. Exposure limits for mineral dusts (silica, graphite, Portland Cement, nuisance dusts and others) are now expressed in mg/ml. ***mppcf is no longer the accepted measurement unit for exposure limits.***
MSHA	The Mining Safety and Health Administration of the US Department of the Interior. The federal agency with authority over safety and health regulation for the mining industry.
Multi-Agency Coordination System (MACS)	The combination of facilities, equipment, personnel, procedures and communications integrated into a common system with responsibility for coordination of resources and support when more than one agency is involved in an emergency operation.
Mutagen	A substance or agent capable of altering the genetic material in a living cell.
Mutagenisis	Alteration of the inherited material.
N_2	Nitrogen. A colorless, odorless and tasteless gas that will not burn and will not support combustion. The earth's atmosphere is about 78 percent nitrogen. At higher concentrations, Nitrogen can displace Oxygen and become a lethal asphyxiant.
NaOH	Sodium Hydroxide, or Caustic Soda.
National Interagency Incident Management	Consists of five major subsystems which collectively provide a total systems approach to all risk incident management. The subsystems are: the incident

System (NIIMS)	command system; training; qualifications and certification; supporting technologies; and publications management.
NFPA	National Fire Protection Association. An international, voluntary organization dedicated to promoting and improving fire-protection and fire-prevention, and to establish safeguards against loss of life and property by fire. Best known on the industrial scene for the National Fire Codes – 16 volumes of codes, standards, recommended practices and manuals developed and periodically updated by NFPA technical committees.
NIOSH	National Institute for Occupational Safety and Health – part of the Public Health Service of the US Department of Health and Human Services. A federal agency which tests and certifies respiratory protective devices and air sampling detector tubes; recommends occupational exposure limits for various substances; and assists the Occupational Safety and Health Administration (OSHA) in occupational safety and health investigations and research.
NOAA Weather Station	A mobile weather data collection and forecasting facility provided by the National Oceanic and Atmospheric Administration, for utilization within the incident area.
Non-Flammable gas	A compressed gas not classified as flammable.
Non-Liquefied Gas	A gas that is entirely gaseous at a temperature of 70ºF.
NOS	"Not Otherwise Stated" or "Not Otherwise Specified."
NO_x	Oxides of nitrogen. Undesirable air pollutants, NO_x emissions are regulated by EPA under the Clean Air Act.
NRC	National Response Center. A notification center in the Coast Guard Building in Washington, DC, with a toll-free number (**800-424-8802**) which must be called when significant oil or chemical spills or other environmentally related accidents occur.
Olfactory	Relating to the sense of smell. The olfactory organ in the nasal cavity is the sensing element that detects odors and transmits information to the brain through the olfactory nerves.
Operational Period	The period of time scheduled for execution of a given set of operational actions as specified in the Incident Action Plan.
Operations Coordination Center (OCC)	The primary facility of the Multi-agency Coordination System. It houses the staff and equipment necessary to perform the MACS functions.
Oral Toxicity	Adverse effects resulting from taking a substance into the body by ingestion.
Oral	Used in or taken into the body through the mouth.
Organic Peroxide	An organic derivative of the inorganic compound hydrogen peroxide.

Orinasal Respirator A respirator that covers the nose and mouth and generally consists of a quarter- or half-facepiece.

ORM Other Regulated Materials. Materials that do not meet the definitions of hazardous materials, but pose enough hazardous characteristics that they require regulation.

Orthophoto Maps Aerial photographs corrected to the scale such that geographic measurements may be taken directly from prints. They may contain graphically emphasized geographic features and may be provided with overlays of such features as water systems, important facility locations, etc.

OSHA Occupational Safety and Health Administration of the US Department of Labor, the federal agency with safety and health regulatory and enforcement authority for most US business and industry.

Out-Of-Service Resources Resources assigned to an incident, unavailable for various reasons.

Overhead Personnel Personnel assigned to supervisory positions including Incident Commander, command staff, general staff, directors, supervisors and unit leaders.

Oxidation In a literal sense, oxidation is a reaction in which a substance combines with oxygen, provided by an oxidizer or oxidizing agent. *(See definitions below.)* In a broader sense, based on modern atomic theory, science today defines oxidation as a reaction – brought about by an oxidizing agent – in which atoms, molecules or ions lose electrons. In this broader sense, an oxidation reaction may occur even when oxygen is not present.

Oxidizer DOT defines an oxidizer or oxidizing material as a substance which yields oxygen readily to stimulate the combustion (oxidation) of organic matter. Chlorate (ClO_3), permanganate (MnO_4) and nitrate (NO_3) compounds are examples of oxidizers; note that all contain oxygen (O).

Oxidizing Ability The ability to yield oxygen readily to stimulate combustion.

Package Markings The descriptive name, instructions, cautions, weight or specification marks required to be placed on the outside containers of hazardous materials.

Packaging Any container that holds a material (hazardous or non-hazardous). Packaging included non-bulk and bulk packaging.

PEL Permissible Exposure Limit. An exposure limit established by OSHA. May be a time-weighted average (TWA) limit, or a maximum concentration exposure limit. *See also Skin.*

Penetration The movement of a material through a suit's closures, such as zippers, buttonholes, seams, flaps or other design features of chemical protective clothing, and through punctures, cuts and tears.

Percent Volatile	Percent Volatile by volume; the percentage of a liquid or solid (by volume) that will evaporate at an ambient temperature of 70ºF (unless some other temperature is stated). Examples: butane, gasoline and paint thinner (mineral spirits) are 100 percent volatile; their evaporation rates vary, but over a period of time, each will evaporate completely.
Permeation	A chemical action involving the movement of chemicals on a molecular level, through intact material.
Permissible Exposure Limit	See "PEL"
Personal Protective Equipment	The equipment provided to shield or isolate a person from the chemical, physical and thermal hazards that may be encountered at a hazardous materials incident. Adequate personal protective equipment should protect the respiratory system, skin, eyes, face, hands, feet, hand, body and hearing. Personal protective equipment includes both personal protective clothing and respiratory protection.
pH	Indication of the acidity or alkalinity of a substance. A pH from 1 to 7 is acidic and from 7 to 14, alkaline. A pH of 7 is neutral. Technically, pH is the logarithm of the reciprocal of the concentration of hydrogen ions in solution.
Piggyback Transport	A type of shipping in which bulk containers from one mode such as highways transportation are placed on flat cars or container-ships for transportation by another mode such as rail or marine.
Placards	10 – ¾" square diamond makers required on hazmat transporting vehicles – trucks, tank cars, freight containers 640 cu. ft or larger, etc.
Planned or unplanned entry into an IDLH environment, an environment of unknown concentration of hazardous contaminant or an environment of unknown composition	A situation in which respiratory devices are recommended to provide adequate protection to workers entering an area where the contaminant concentration is above the IDLH or is unknown.
Planning Meeting	A meeting, held as needed throughout the duration of an incident, to select specific strategies and tactics for incident control operations and for service and support planning.
PMCC	Pensky-Mertens Closed Cup – a flash point test method.
Poison, Class A	A gas or liquid so toxic that an extremely small amount of the gas or the vapor formed by the liquid is dangerous to life.
Poison, Class B	Less toxic liquids and solids that are hazardous either by contact with the body (skin absorption) or by ingestion.

Poison, Class C	Liquids or solids that evolve toxic or strongly irritating fumes when heated or when exposed to air (excluding Class A poisons).
Poisons, Class D	Radioactive materials.
Polar Solvents	Any flammable liquid that is miscible and destroys regular foam by mixing with the water in the foam.
Polymerization	A chemical reaction in which one or more small compounds combine to form larger compounds. A hazardous polymerization is such a reaction which takes place at a rate which releases large amounts of energy (usually heat). If hazardous polymerization can occur with a given material, the MSDS usually will list conditions that could start the reaction, and – since the material usually contains a polymerization inhibitor – the expected time period before the inhibitor is used up.
Potential Occupational Carcinogen	Any substance, combination or mixture of substances which causes an increased incidence of benign and/or malignant neoplasms, or a decrease in the latency period between exposure and onset of neoplasms in humans or in one or more experimental mammalian species as a result of oral respiratory or dermal exposure. This definition includes any substance that is metabolized into one or more potential occupational carcinogens by mammals (29CFR 1990.103, OSHA Cancer Policy).
ppb	Parts per billion. Unit for measurement of the concentration of a gas or vapor in air.
ppm	Parts per million. Unit for the measurement of the concentration of gases, vapors and solids.
Pressure Vessel	A storage tank or vessel which has been designed to operate at pressures above 15 psi.
Preventive Actions	Actions taken by the incident commander at an emergency to prevent the problem from increasing.
Protection Factors	
Assigned protection factor (APF)	The minimum anticipated protection provided by a properly functioning respiratory or class of respirators to a given percentage of properly fitted and trained users.
Simulated Workplace Protection Factor (SWPF)	A surrogate measure of the workplace protection provided by a respirator.
Workplace Protection Factor (WPF)	A measure of the protection in the workplace by a properly functioning respirator when correctly worn and used.
Protective Clothing	Equipment designed to protect the wearer from heat and/or hazardous materials. Protective clothing is divided into three types: structural fire fighting protective clothing, chemical protective clothing, and high-temperature protective clothing.

psi	Pounds per square inch. For MSDS purposes, a unit for measuring the pressure a material exerts on the walls of a confining vessel or enclosure. For technical accuracy, pressure must be expressed as *psig* (pounds per square inch gauge) or *psia* (pounds per square inch absolute – or gauge pressure plus sea-level atmospheric pressure, or psig plus about 14.7 psi). *See also, "mm Hg"*
Pyrophoric Liquid	Any liquid capable of igniting spontaneously when exposed to dry or moist air.
Radio Cache	A cache may consist of a number of portable radios, a base station, and – in some cases – a repeater, stored in a predetermined location for dispatch to incidents.
Radioactive Material (RAM)	Any material that spontaneously emits ionizing radiation.
RCRA	Resource Conservation and Recovery Act. Federal environmental legislation administered by the EPA, aimed at controlling the generation, treatment, storage, transportation and disposal of hazardous waste.
Reaction	A chemical transformation or change. The interaction of two or more substances to form new substances.
Reactivity	A description of the tendency of a substance to undergo chemical reaction (usually with the release of energy). Undesirable effects such as pressure buildup, temperature increase, and formation of noxious toxic or corrosive products may occur because of the reactivity of a substance by heating, burning, direct contact with other materials or other conditions of use or storage. A solid waste which exhibits a "characteristic of reactivity" as defined by RCRA may be regulated by the EPA as a hazardous waste.
Recommended Exposure Limit	See "REL"
Reducing Agent	In a reduction reaction (which always occurs simultaneously with an oxidation reaction) the reducing agent is the chemical or substance which combines with oxygen, or which loses electrons in the reaction. *See, also, "oxidation."*
Refinery	A place where crude materials are purified.
Reinforced Attack	Those resources requested in addition to an initial attack.
REL	Recommended exposure limit. An 8- or 10-hour, time weighted average (TWA) or ceiling (C) exposure concentration recommended by NIOSH, that is based on an evaluation of health effects data.
Reporting Locations	Any of six facilities or locations where incident assigned resources may check in. The locations are: *Incident Command Post Resources Unit (RESTAT); base; camp; staging area; helibase;* and *division supervisor* – for direct line assignments. (Check-in is at one location only.)

Rescue Medical Any manned ground vehicle capable of providing emergency medical services.

Resources All of the immediate or supportive assistance available to help control an incident, including personnel equipment, control agents, agencies and printed emergency guides.

Respiratory Protection Equipment designed to protect the wearer from the inhalation of contaminants. Respiratory protection is divided into three types: *positive pressure self-contained breathing apparatus; positive pressure supplied-air respirators;* and *air purifying respirators.*

Respiratory System The body's breathing system, including the lungs, trachea, mouth and nose, and the associated nervous and circulatory supply systems.

Response That portion of an incident management in which personnel are involved in controlling a hazardous materials incident.

RESTAT An acronym for resource unit – a unit within the planning section.

Rupture Disk A safety relief device in the form of a metal disk that closes the relief channel under normal conditions. The disk bursts at a set pressure to permit the escape of gas.

Safety Relief Valve A device found on pressure cargo tanks containing an operating part that is held in place by spring force. Valves open and close at set pressures.

Section That organization level having functional responsibility for primary segments of incident operations such as operations, planning, logistics, finance. The section-level is organizationally between branch- and incident-commander.

Sensitizer A substance which, on first exposure, causes little or no reaction in humans but which, on repeat exposure, may cause a marked response not necessarily limited to the contact site. Skin sensitization is the most common form of sensitization in the industrial setting, although respiratory sensitization to a few chemicals is also known to occur.

SETA Setaflash Closed Tester – a flash point test method.

Service Life The length of time for an air-purifying element to reach a specific effluent concentration. Service life is determined by the type of substance being removed, the concentration of the substance, the ambient temperature, the specific element being tested (cartridge or canister), the flow rate resistance and the selected breakthrough value. The service life for a self-contained breathing apparatus (SCBA) is the period of time, as determined by the NIOSH certification tests, in which adequate breathing gas is supplied.

Sheer Section A safety feature incorporated into cargo tank piping and fittings designed to fail or break completely to prevent damage to shut-off valves or the tank itself.

Shipping Papers A shipping order, bill of lading, manifest, or other shipping documents issued by the carrier.

Single-Use Dust Respirators approved for use against dust or mists that may cause pneumoconiosis and fibrosis.

Skin A notation, sometimes used with PEL or TLV exposure limit information, indicating that the stated substances may be absorbed by the skin, mucous membrane and eyes when they are either airborne or by direct contact with them, and that an additional exposure route must be considered in evaluating the exposure of an individual.

Skin Sensitizer See *Sensitizer*.

Skin Toxicity See *Dermal Toxicity*.

Slopover An expulsion of oil and froth on the surface of a tank, produced when water or foam is applied to a burning liquid surface.

Solubility A measure of the amount of a substance that will dissolve in another substance.

Solubility In Water A term expressing the percentage of a material – by weight – that will dissolve in water at ambient temperature. Solubility information can be useful in determining spill cleanup methods and fire extinguishing methods for a material. Terms used to express solubility are: *negligible* (less than 0.1 percent), *slight* (0.1 to 1.0 percent), *moderate* (1 to 10 percent), *appreciable (more than 10 percent)*, and *soluble in all proportions.*

SO_x Oxides of sulfur. SO_x pollutant emissions are regulated by EPA under the Clean Air Act.

Span-Of-Control The supervisory ratio of from three to seven individuals with five being established as a general rule of thumb.

Species A biological type. On MSDAs, "species" refers to the test animals – usually rats, mice or rabbits – which were used to obtain the results of toxicity test data.

Specific Gravity The ratio of the density of a substance to the density of a reference substance; it is an abstract number that is unrelated to any units. For solids or liquids, specific gravity is numerically equal to density, but for gases it is not, because of the difference between the density of the reference substances, which are usually water (1g/cc) for solids and liquids, and air (0.00129 g/cc, or 1.29 g/L and 0ºC and 760 mm Hg) for gases.

Spontaneous Combustion Ignition in a thermally isolated substance, as in oily rags or hay, caused by a localized heat-increasing reaction between the oxidant and the fuel.

Stability	An expression of the ability of a material to remain unchanged. For MSDS purposes, a material is stable if it remains in the same form under expected and reasonable conditions of storage or use.
Stabilization	The state of an incident when the immediate problem or emergency has been controlled, contained or extinguished.
Stage of Incident	One of five definite and identifiable phrases through when an emergency passes from onset (interruption of normal conditions) to stabilization.
Staging Area	That location where incident personnel and equipment are assigned. It is expected that personnel and equipment at the staging area must be available within three minutes to enter the incident area.
Standard Transportation Commodity Code (STCC number)	A listing of code numbers for categories of articles being shipped, in general use by carriers.
STEL	Short-term Exposure Limit
Stress	A state of tension put on a shipping container by internal chemical action, external mechanical damage or external flames or heat.
Strike Team	Specified combinations of the same kind and type of resources, with common communications and a common leader.
Structural Firefighters Protective Clothing	Clothing that will prevent gases, vapors, liquids and solids from coming in contact with the skin. This equipment includes helmet, scba, coat and pants, rubber boots, gloves, bands around the legs, arms, waist and face mask, and covering for neck, ears, and all parts of the head not covered by the helmet or the scba or the face mask.
Subsurface Injection	Discharge of foam or water into a storage tank from an outlet at the tank.
Teratogenisis	Alteration in the formation of cells, tissues, and organs, resulting from physiologic and biochemical changes in a fetus during growth.
TLV-C	The ceiling exposure limit – the concentration that should not be exceeded even instantaneously.
TOC	TAG Open Cup, a flash point test method.
Toxic Materials	Substances that can be poisonous if inhaled, swallowed or absorbed into the body through cuts or breaks in the skin.
Toxicity	The sum of adverse effects resulting from exposure to a material, generally by ingestion, absorption through the skin or inhalation.
Tractor Plow	Any tracked vehicle with a plow for exposing mineral soil, with transportation and operating personnel.
Trade Name	The trademark name or commercial name for a material.

TSCA	Toxic Substances Control Act. Federal environmental legislation administered by the EPA, which regulates the manufacture, handling and use of materials classified as *toxic substances.*
TWA	Time Weighted Average. With reference to exposure, TWA is the airborne concentration of a material to which a person is exposed, averaged over the total exposure time (generally the total work day of 8 to 12 hours).
UEL	Upper Explosive Limit. (Also known as *UFL* or *Upper Flammable Limit.*) The highest concentration of a vapor or gas that will produce a flash of fire when an ignition source is present. At higher concentrations than the UEL, the mixture is too rich to burn.
UFL	See *UEL*
Unified Command	A method for all agencies or individuals who have jurisdictional responsibility, and in some cases who have functional responsibility at an incident, to contribute to determining overall objectives for the incident and the selection of strategy to achieve those objectives.
Unit	That organizational element with functional responsibility for a specific incident planning, logistic or finance activity.
Unstable	Tending toward decomposition or other unwanted chemical change during normal handling and/or storage.
Unstable Materials	Substances capable of rapidly undergoing chemical changes or decomposition
USDA	US Department of Agriculture
Vapor	Gas given off, with or without the aid of heat, by substances that under normal circumstances are either solid or liquid.
Vapor Density	The weight of a vapor or gas compared to the weight of an equal volume of air, or an expression of the density of the vapor or gas. Materials lighter than air have a vapor density of less than 1.0 (e.g., acetylene, methane, hydrogen). Materials heavier than air have a vapor density of more than 1.0 (e.g., carbon dioxide, propane, hydrogen sulfide, ethane, butane, chlorine, sulfur dioxide).

Vapor Pressure The pressure exerted by the vaporization of a liquid in a closed container. When pressure vapor tests are performed on products, the test temperature is usually 68ºF to 100ºF and the vapor pressure is expressed as pounds per square inches (*psig* or *psid*). Vapor pressures reported on MSDSs are calculated in millimeters of mercury (mm Hg) at 68ºF (20ºC) unless otherwise stated.

- The vapor pressure of a substance at 100ºF will always be higher than the vapor pressure of a substance at 68ºF.
- Vapor pressures reported on MSDS in mm Hg are usually very low pressures. 760 mm Hg is equivalent to 14.7 psi.
- The lower the boiling point of a substance, the higher its vapor pressure.

Vapor Space Space left empty inside a tank containing liquefied gas to allow for expansion of the gas due to normal changes in temperature.

Vaporization The process of changing from liquid to vapor.

Ventilation See *general exhaust, local exhaust,* and *mechanical ventilation.*

Viscosity The flow resistance of a liquid. This characteristic increases and decreases with the temperature of the liquid. Low-viscosity liquids have little adhesive qualities and hence flow freely.

Warm Zone Area where personnel and equipment decontamination and hot-zone support takes place. It includes control points for the access corridor and thus assists in reducing the spread of contamination. This is also referred to as the decontamination-, contamination reduction-, or limited access-zone/corridor.

Water Solubility The ability of a liquid or solid to mix with or dissolve in water.

Water-Reactive Substances, generally flammable solids, which will react in varying degrees when mixed with water or when they come in contact with humid air.

Waybill The shipping paper prepared by the railroad from a bill of lading. Waybills generally accompany a shipment and are carried by the conductor in the caboose of a train.

Weak Seam In oil tanks, a special roof-to-shell seam attachment that is designed to give under overpressure and release vapor from the vapor space.

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