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Hazmat Team Planning Guidance

Office of Emergency and Remedial Response
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TABLE OF CONTENTS

1.0 INTRODUCTION **1**

2.0 DO YOU NEED A HAZMAT TEAM? **3**

2.1 Conducting a Hazards Analysis 3

2.1.1 Hazards Identification 3
2.1.2 Vulnerability Analysis 6
2.1.3 Risk Analysis 6

2.2 Do You Need a Hazmat Team? 6

3.0 TRAINING AND EQUIPPING YOUR HAZMAT TEAM **7**

3.1 Training 7
3.2 Medical Monitoring 9
3.3 Equipment 10

3.3.1 Monitoring Equipment 10
3.3.2 Personal Protective Equipment 11
3.3.3 Containment Equipment 13

3.4 Summary of Costs 14

4.0 PREPARING RESPONSE PLANS AND STANDARD OPERATING PROCEDURES **15**

4.1 Conclusion 16

APPENDIX A Beginning the Hazards Analysis Process **17**

APPENDIX B Medical Program **29**

APPENDIX C Hazardous Materials Incident: First-On-Scene Checklist **53**

APPENDIX D U.S. EPA Regional Superfund Training Contacts **55**

APPENDIX E Selected References **57**

APPENDIX F Informed Sources **59**

LIST OF TABLES

No.	Title	page
1	Personal Protective Equipment, Approximate Costs	12
2	Containment Equipment and Tools, Approximate Costs	13
B-1	Recommended Medical Program	31
B-2	Common Chemical Toxicants Found at Hazardous Waste Sites, Their Health Effects and Medical Monitoring	34
B-3	Tests Frequently Performed by Occupational Physicians	43
B-4	Signs and Symptoms of Chemical Exposure and Heat Stress that Indicate Potential Medical Emergencies	48

LIST OF FIGURES

No.	Title	Page
A-1	Hypothetical Dose-Response Curve of Two Chemicals, A and B	27

1.0 INTRODUCTION

This manual will assist local fire departments in identifying, acquiring, and maintaining the hazardous materials response equipment and trained personnel appropriate for their locale. This manual offers guidance in the following areas:

- Determining actual hazmat response requirements;
- Establishing the goals and levels of expertise needed to meet those requirements;
- Estimating the costs and developing a budget to meet your goals; and
- Preparing response plans and standard operating procedures (SOP S) to include the entire local response community.

This manual will not provide specific answers to all your questions. Each locale must plan according to its own needs as well as its available resources.

Appendix A, Beginning the Hazard Analysis Process, includes an overview of the extent of today's hazmat problem. Appendix C contains a Hazardous Materials Incident First-On-Scene checklist similar to one you should develop for your response community. Appendix E contains a selected list of established regulations, standards, and guidance and reference documents available to assist you in making informed decisions for your situation. Appendix F includes the names of some individuals actively involved in the hazmat response business. These people can help you plan goals, identify sources of help, and advise you on pitfalls to avoid. Keep in mind that the most successful response programs are often the most creative in meeting local needs and constraints.

Still interested? Then let's get started!

2.0 DO YOU NEED A HAZMAT TEAM?

Do you really need a Hazmat Team? What do you expect it to be capable of doing? How much is it going to cost to establish and maintain a team? These are some of the questions that we will try to help you answer.

2.1 CONDUCTING A HAZARDS ANALYSIS

First you need to develop a realistic picture of the potential for a hazardous materials incident to occur in your community by conducting a hazards analysis. A hazards analysis will help you to:

- Identify the facilities that manufacture, store, and/or use hazardous substances;
- Determine the specific properties of the materials, including their health effects;
- Determine how the materials are stored and/or used, as well as what quantity is present;
- Determine what controls and countermeasures exist at facilities where hazardous materials are present (e.g., containment, neutralization, facility fire brigades, hazmat teams, and automatic alarms);
- Identify transportation corridors (e.g., highways, waterways, air, and pipelines) through which hazardous materials are carried;
- Estimate the human population, public buildings and systems, and environmental features that would be affected (and the extent of the effect) in the event of a release;
- Identify the frequency and scope of past incidents;
- Estimate the likelihood of an incident and the severity of any consequences to human beings and the environment; and
- Understand what your organization would be expected to do or provide in case of an incident.

The U.S. Environmental Protection Agency (EPA), the Federal Emergency Management Agency FEMA), and the U.S. Department of Transportation (DOT) have published the *Technical Guidance for Hazards Analysis*. This publication describes in detail how to conduct a community-based hazards analysis, with particular focus on lethal toxic chemicals. The same federal agencies have also published the *Handbook of Chemical Hazard Analysis Procedures*. It provides an easy to understand overview of chemical hazards, and guidance on conducting a hazards analysis for toxic, flammable, and explosive hazards. You can obtain copies of these guidance documents and other helpful publications by contacting the agencies listed in Appendix E, Selected References.

There are three steps in a hazards analysis:

1. Hazards identification;
2. Vulnerability analysis; and
3. Risk analysis.

We will now describe each of these steps in more detail.

2.1.1 Hazards Identification

A hazards identification will provide you with information on the hazardous materials in your area. It provides you with information on each material's:

- Identity;
- Quantity;
- Location;
- Physical and chemical properties;

- Storage conditions;
- Transportation routes; and
- Potential hazards.

You can look for this information in a variety of places, for example:

- SARA Title III reports;
- Fire department records;
- Fire inspection reports;
- Transportation data; and
- Government agencies and local businesses.

This section describes how each of these information sources can help you.

SARA Title III Reports

Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA) requires facilities to report information about hazardous materials they have on site. (Title III is also called the Emergency Planning and Community Right-to-Know Act of 1986.)

Section 302 of SARA requires facilities that produce, use, or store certain quantities of one or more extremely hazardous substance on EPA's section 302 list to notify the State Emergency Response Commission (SERC). The SERC then notifies the Local Emergency Planning Committee (LEPC). Facilities must cooperate with LEPCs in preparing a comprehensive emergency plan for the district.

Section 311 of SARA requires facilities that must prepare or have available Material Safety Data Sheets (MSDSs) under the Occupational Safety and Health Administration (OSHA) hazards communication regulations to submit either copies of their MSDSs, or a list of MSDS chemicals to the LEPC, the SERC, and the local fire department.

MSDSs provide the following information:

- The chemical name;
- Its basic characteristics, for example:

  -- toxicity, corrosivity, reactivity;
  -- known health effects;
  -- basic precautions in handling, storage, and use;
  -- basic countermeasures to take in the event of fire, explosion, or leak; and
  -- basic protective equipment to minimize exposure to a release.

More detailed information on MSDSs and sample information provided by MSDSs is contained in Appendix A, Beginning the Hazards Analysis Process.

Section 312 of SARA requires that some facilities submit Tier 1 and/or Tier 2 reports. Tier 1 reports contain aggregate information on the quantity and general location of chemicals (listed by categories) stored on site. Tier 2 reports provide substance-specific information on the quantity of the hazardous materials present on site, how they are stored, and their location.

Title III requires that your LEPC make information contained in these various reports available to you, unless the information has been protected by trade secret provisions.

Fire Department Records

Some of the information you need may already be in your fire department files. Review the recent history of your responses to hazardous materials incidents. Focus on the past five years. Go through your files carefully! Unless you have maintained very precise files, the information you need can be buried under such classifications as "Washdown," "Stand-by," "Odor Investigations," or the infamous "Other." Look at the information in these reports for clues to the presence of a hazardous material. Even though you may not be able immediately to identity the specific materials, any situation where something unusual occurred during normal fire fighting operations (e.g., a turnout coat developing holes) can indicate that a hazardous material was present. Try to assemble the following information:

- What material was present?
- How much material was present?
- How much material was released or involved in the problem?
- What injuries and/or deaths happened?
- What environmental effects, if any, were there?
- What was the potential for additional injury or damage in each case?
- What was the actual cost incurred as a result of the incident (e.g., costs related to response, cleanup, and system disruptions)?
- How may incidents have occurred?

Fire Inspection Reports

Fire department pre-plans are developed around special problems in your jurisdiction and may contain information about hazardous materials.

Local fire inspection reports typically list substances found in buildings that could present special or unusual problems concerning public safety, as well as provide an assessment of the ability of emergency responders to handle incidents at that building. These inspections are normally conducted on an annual basis, with more frequent inspections for more hazardous buildings. These inspections focus on substances that are not on official lists of hazardous materials or are not present in reportable quantities, but are considered hazardous to the responders.

Finally, fire inspection reports may help you develop a picture of the rate of growth of hazardous materials in your community.

Transportation Data

Police and fire department personnel may have a good idea of what hazardous materials pass through a community, the routes most frequently used, and the frequency of transport. If you have a truck weigh station in or around your jurisdiction, you may be able to obtain information regarding the number of placarded loads moving through your area. Further information regarding the load contents may be available through the carrier or shipper's office.

Specific guidance on gathering information about hazmat transportation in your community is included in the *Handbook of Chemical Hazard Analysis Procedures* mentioned earlier and listed in Appendix E, Selected References.

Government Agencies and Local Businesses

Now that you have reviewed your own files, it may be useful to contact the local health department. Another useful contact may be the waste treatment facility in your jurisdiction, if you have such a facility. Although they may not have dealt with large quantities of hazardous materials, these people may have investigated hazmat problems in the past.

Try to document the types and quantities of hazardous materials involved, the potential for harm associated with each incident, and the total number of past incidents in the community. In addition, try to contact any other agency or business in your jurisdiction that may have dealt with these materials.

Other sources of historical data for your jurisdiction include your state department of natural resources, your state emergency management agency, and EPA These sources frequently maintain a record of all incidents that occurred within the past ten years, recorded by the counties in which they occurred.

When you complete the hazards identification step, you should have a list of the facilities with hazardous materials on site, the location and quantity of the chemicals, the health hazards posed by the chemicals, and the routes used to transport the hazardous materials through your community, The next step is to determine who might be affected by an incident.

2.1.2 Vulnerability Analysis

The vulnerability analysis identifies the geographic zone of your community that, may be affected by a spill or release of a hazardous material; the populations within the zone that may be subject to harm; specific environmental dangers; and critical buildings in the zone (e.g., hospitals, schools) that are at risk.

You can obtain more detailed information on how to conduct a vulnerability analysis from the *Technical Guidance for Hazards Analysis* mentioned previously and listed in Appendix E, Selected References.

2.1.3 Risk Analysis

The risk analysis provides you with a basis to judge the likelihood of a release, as well as the severity of consequences to humans and the environment if an incident occurs. The risk analysis gives you a basis for comparing sites to establish major areas of emphasis for emergency planning.

You can obtain more detailed information on how to conduct a risk analysis from the *Technical Guidance for Hazards Analysis.*

2.2 DO YOU NEED A HAZMAT TEAM ?

You should now be developing a reasonably accurate picture of the hazardous materials in your community and the potential threat these chemicals pose. Your data should be helping you answer two very important questions:

- Do you need a Hazmat Team?
- If so, what level of expertise do they need?

If you determine that the hazardous materials in your area pose a threat to your community, there are a number of ways to address the problem.

For example, you could ignore the existence of the hazardous materials, you could rely on the industrial sector to prepare for the occurrence of a hazardous release, or you could develop your public response capabilities,

Some communities will need to start from “ground zero” and develop a coordinated “hazmat response community” that includes fire fighters, the police, hospitals and medical personnel, the media, public works personnel, volunteers, contractors, and others. *The Hazardous Materials Emergency Planning Guide (NRT-I),* published by the National Response Team, includes extensive guidance to help you set up a comprehensive local emergency plan. Only when your response “community” is fully planned, trained, and operational, will you develop a more accurate picture of whether you need a Hazmat Team and what its role would be.

Let’s presume that you have decided that your community needs a Hazmat Team. The next chapter will provide you with some practical advice on what you should do next.

3.0 TRAINING AND EQUIPPING YOUR HAZMAT TEAM

If you think that you need a Hazmat Team, you should consider the following three areas before announcing the formation of a team:

- Training;
- Medical monitoring; and
- Equipment (monitoring, personal protective, and containment).

In this chapter we describe basic needs and requirements related to training, medical monitoring, and equipment, and provide some cost estimates for each area. Remember: your actual costs will depend upon your local hazmat situation.

Reference will be made to the following regulations and standards:

- 29 CFR 1910.120, OSHA Final Rule, Hazardous Waste Operations and Emergency Response; and
- National Fire Protection Association (NFPA), *Standard 472, Professional Competence of Responders to Hazardous Material Incidents.*

Refer to Appendix E, Selected References, for information on how to obtain copies of these publications. We suggest that you obtain copies of all publications listed in Appendix E whether you have decided to start a Hazmat Team or not. Even if you decide not to have a formal Hazmat Team, you still have training and operational obligations to meet!

3.1 TRAINING: Do the job safely and intelligently!

If you are going to send someone to evaluate or control an emergency involving hazardous materials, that person must receive training to do the job safely and intelligently. In Standard 472, the National Fire Protection Association recommends that hazmat responders receive the appropriate training for each of the following four levels:

- First Responder Awareness Level
- First Responder Operations Level
- Hazardous Materials Technician
- Hazardous Materials Specialist

A Hazmat Team should be trained to the "Hazardous Materials Technician" level defined by NFPA Standard 472.

In addition to the NFPA standard, OSHA's Worker Protection Standards, found in 29 CFR 1910.120, require levels of training, medical surveillance, personal protective equipment, and emergency response plans (including the use of a site-specific incident command system).

According to 29 CFR 1910.120(q)(6): *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....*

EPA has issued regulations with the same requirements for hazardous materials responses in states not covered by OSHA regulations. These standards are now required for everyone responding to hazardous materials incidents.

The following is a brief description of each of the five responder levels in the OSHA Worker Protection Standards.

First Responder Awareness Level. This level of training applies to individuals: (1) who are likely to witness or discover a hazardous materials release;

and (2) who have received prior training in initiating an emergency response sequence by notifying the proper authorities. Individuals at this level can take no further action beyond notifying the authorities of a hazardous materials release.

This is the first step in hazardous materials training. If you have not yet accomplished this goal, then this is the place to start the training for all of your emergency response personnel. This would also be a good level of training for local elected officials, industry managers, and any employees involved in your budgetary development or approval process. This level of training will help these individuals to develop an accurate picture of the hazardous materials problem and the programs needed to address that problem.

First Responder Operations Level. Individuals at this level function as part of the initial response group at the site of an actual or potential hazardous materials release. They protect nearby persons, property, and/or the environment from the effects of the release. They are trained to respond in a purely defensive manner. They are not responsible for stopping the release. Rather, they contain the release, if possible, from a safe distance, while preventing additional exposures.

This may be the current level of training for your local fire and police departments, emergency medical service (EMS) agency, and similar organizations. If these potential first responders are not yet at this level, training them should be your primary goal. A minimum of eight hours of initial training is required to satisfy this level of expertise. You must accomplish this before proceeding with the development of your Hazmat Team.

Hazardous Materials Technician. Technicians are responsible for stopping hazardous materials releases. A technician's goal is to plug, patch, or in any other way, stop the release to which he has responded. This is a more aggressive role than that of a first responder at the operations level. The OSHA regulations require a minimum of 24 hours of training at the first responder operations level for hazmat technicians. Technicians must also demonstrate in the field a certain competency in these training areas.

If this response level is not compatible with your understanding of a Hazmat Team, you may have been envisioning the development of a well-trained operations level response rather than a formal Hazmat Team. This is just one reason why you must determine the actual response needs of your jurisdiction before proceeding with Hazmat Team development. If your goals can be met within the definition of the first responder operations level, then you probably do not need to incur the additional costs required for technician training. However, if you do wish to proceed, you will need to establish a training program that meets your needs as well as all OSHA requirements.

Hazardous Materials Specialist. Hazardous materials specialists respond with and provide support to hazardous materials technicians. Their duties parallel those of the hazardous materials technician. In addition, however, their duties require a more directed or specific knowledge of the various substances involved in the response. Hazardous materials specialists must have training equal to the technician level and demonstrate competency in specified areas. Among other things, they must be familiar with and know how to implement the relevant local emergency response plan and must have knowledge of the state emergency response plan.

On-Scene Incident Commander. The On-Scene Incident Commander (OIC) assumes overall control of the emergency response incident scene and coordinates the activities of the emergency responders and the communications among them. The OIC must receive training equivalent to the first responder operations level and must demonstrate competency in certain specified areas. For example, the OIC must know how to implement the local emergency response plan and know of state and federal response capabilities; know and understand the hazards and risks associated with employees working in chemical protective clothing; and know and understand the importance of decontamination procedures.

If you have decided that your community needs responders trained at least to the level of a hazardous materials technician, then you have crossed into the realm of a Hazmat Team.

Cost of Training

Training costs money, whether it is conducted in service or on an overtime basis. Indeed, training costs can make the biggest dent in your Hazmat Team budget. First, decide on the size of team you would like to have. Then you can more accurately estimate the dollars needed to train personnel to the response level you require. For example, consider the following:

- What degree of coverage do you want (e.g., 24 hours per day, 7 days a week; 8 hours per day, 5 days a week)?

- Who will cover vacations, sick leave, or other absences?

- Will your team always be on duty, or sometimes off duty subject to call?

In many communities, the total size of a Hazmat Team is larger than just the number of members on duty at a given time. Only you can accurately estimate the personnel required. We recommend, however, a minimum of four persons on duty per shift. Typical initial training costs associated with an "average" four person Hazmat Team are approximately $4,500, with additional funds required for supplemental financing for each year of operations.

29 CFR 1910.120(q)(7) outlines the requirements for "trainers" or instructors of emergency response personnel. Instructors within the hazmat sector must be competent in the subjects they teach. State and federal agencies offer numerous training programs. By taking advantage of these programs and programs offered by the International Hazardous Materials Association and similar organizations, you can minimize costs while maximizing training opportunities. Be sure to establish the credibility of instructors and training materials when investigating training sources. Current information regarding available training programs can be obtained by contacting your state department of natural resources and/or your regional EPA training contact. Refer to Appendix D for a list of EPA training contacts.

At this point, you may wish to explore alternatives to a Hazmat Team, particularly if your department cannot bear alone the costs of personnel, training, and equipment.

One alternative available to you is to modify the fire department mutual aid contract. Upon written commitment, the participating mutual aid organizations would agree to train a certain number of employees to a specified level of expertise. Each organization would agree to have at least one of these trained employees on duty at all times.

Costs would be shared by these organizations according to a predetermined formula. As long as the total response team can be assembled at a scene within a reasonable time (i.e., less than one hour), this may be an effective alternative to a formal Hazmat Team.

If you represent a fire department dealing with mostly fixed facility problems, you may want to approach industry representatives in your locale. After all, these people are part of your response community! Because industry personnel routinely work with the very substances that you are preparing to handle, they already have a working knowledge of the substances. They also may have a facility response team equipped with personal protective equipment and monitoring equipment. Check to see if they will either supply equipment for you to use or replace any equipment you expend at these sites. Also, consider using these industry resources in your training program.

Also, consider calling on volunteer organizations in your community who may have special knowledge or talents to support your response capability. Would it be possible to recruit these people for your planning operations and/or as technical advisors in the event of a release? Fire departments have volunteers and the police have reserve forces; you might develop a similar program for your Hazmat Team:

3.2 MEDICAL MONITORING: Keep your team healthy!

The OSHA regulations in 29 CFR 1910.120(q)(9) require you to provide a medical monitoring program for your Hazmat Team. The medical monitoring program requires a complete examination of your Hazmat Team members at the following times:

- Prior to assignment to the Hazmat Team;
- At regular intervals not greater than bi-annually;
- At termination of employment or upon reassignment to another job description;
- After any exposure to a hazardous material; and
- At such times as the physician deems necessary.

The scope of this program will depend upon: (1) the physician you choose to oversee your program; and (2) the information you provide to this physician as a result of your hazards analysis program. You can help the physician develop a program to effectively protect your responders while minimizing the costs involved.

Based upon the list of substances that your team may be exposed to during responses, the physician will provide, with your assistance, a written medical monitoring procedure. Refer to Appendix B, Medical Program, for general guidance in designing a medical program for personnel at hazardous waste sites. Appendix B is reproduced from chapter 5 of the *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*. (See Appendix E, Selected References, for more information.)

Cost of Medical Monitoring

The cost of this required medical monitoring program will range from $450 to $1000 per person each year. (Keep in mind, this is only an estimate.) If you choose a team of four persons per shift for three shifts, then the costs can run from $5,400 to $12,000 annually. **Before you panic, discuss this program with a physician who can supply you with an accurate figure for your proposed operation!** Remember a medical monitoring program is a requirement, not an option.

3.3 EQUIPMENT: Respond Effectively!

You will need specialized equipment for air monitoring, personal protection, and containment. Unless you plan to buy a new response vehicle dedicated solely to hazmat response, then equipment costs will usually be less than the costs associated with training and medical monitoring. You probably cannot train and equip a team to deal with every possible situation that may happen, but you can look at your list of likely problems and gear your program to those ends. As you identify what equipment you need, check with other members of your response community before purchasing it. If the equipment is available to you through the response community, then you may not need to purchase it.

3.3.1 Monitoring Equipment

If you expect your Hazmat Team to enter potentially hazardous atmospheres of unknown content, your team will need the equipment to detect dangerous airborne chemical concentrations. The equipment listed below is the minimum any entry team should have when responding to an incident:

a. Combustible gas indicator detects the presence of flammable gases and indicates the approximate concentration of the gas/vapor in "%" concentrations of the lowest explosive limit.

b. Oxygen level indicator measures the level of available oxygen in the atmosphere. Even though your team is entering with positive pressure self contained breathing apparatus (SCBA), the oxygen meter will warn them if excessive oxygen is present or if something is using or displacing the available oxygen.

c. Calorimetric tubes measure the concentration of a specific chemical or chemical family. Through your hazards analysis you have an idea of what tubes your team will need. These tubes are calibrated to indicate "parts per million" (ppm) or "%" concentrations.

d. pH paper indicates whether a substance is acidic or basic. This represents a small investment to keep the team out of corrosive situations.

e. Flame ionization and photoionization detectors detect the presence of organic vapors in concentrations as low as 0.5 ppm and are valuable additions to your equipment supplies. These detectors may be available to you through local, state, and federal agencies.

An investment of about $1,700 will provide your team with this basic monitoring equipment.

Before you make any decisions about monitoring equipment, review 29 CFR 1910.120(h) and the *Standard Operating Safety Guides, Part 5* listed in Appendix E, Selected References, for additional information. Both will give you a better picture of how monitoring equipment may be used to characterize sites and to assure personnel safety.

3.3.2 Personal Protective Equipment

Before your team can enter areas with actual or suspected hazardous materials concentrations, they must be outfitted with equipment that provides respiratory and dermal protection. This is particularly important when your team is responding to a situation that has yet to be fully evaluated.

You probably already own the most expensive piece of necessary personal protective equipment: the SCBA. The cost of this item will not be included here in the equipment estimates for your Hazmat Team because it is commonly found within the response community and at fixed facilities with potential airborne toxins. If you do not already have SCBAs, however, then you can count on spending $1,200 per unit (for a 30-minute tank) and $400 per spare cylinder.

Protection Levels

There are four levels of protection to be considered for hazmat work. Since a response team usually works in an uncharacterized atmosphere, two levels can be eliminated from immediate consideration. These are:

Level D: Normal work uniform with no respiratory protection.

Level C: Respiratory protection using an air purifying respirator (filter type mask), with some dermal protection including a lightweight chemical coverall, gloves, and boots.

Your goal is maximum respiratory protection when: (1) entering atmospheres containing unknown substances; or (2) entering atmospheres containing known substances in unknown concentrations. This leaves two remaining levels to discuss:

Level B: Maximum respiratory protection utilizing SCBA and a lesser degree of dermal protection than provided by Level A.

Level A: Maximum respiratory protection by utilizing SCBA and maximum dermal protection from a totally encapsulating chemical suit.

Review your hazards analysis data to determine whether your team will be expected to work in direct contact with concentrated chemicals. If so, then you should investigate attaining a Level A capability. Otherwise, a Level B approach may be your best bet. Keep in mind that even if you need Level A capability, the majority of your responses will require only a Level B operation.

When researching protective suits, remember that these suits are not armor. These suits resist particular chemicals. They do not protect against every chemical, nor does one size fit all. Select your equipment carefully, based on your team's potential exposure, and size this equipment to your team members on an individual basis.

Should you decide on a Level B approach for your team, you may wish to consider a fifth protective level: Level B encapsulated. Level B equipment, regardless of taping, leaves some skin, and all of the SCBA gear, exposed. Since several common chemicals are corrosive or become so upon contact with the moisture in the air (see Appendix A), ordinary Level B protection may not be adequate. Level B encapsulated suits are slightly more expensive, but they afford a higher degree of protection, reducing the possibility of dermal contact with harmful vapors and completely enclosing the wearer's air supply.

Costs of Chemical Protection Equipment

Approximate costs of chemical protection equipment are contained in Table 1. You can estimate that the initial cost for a Level B encapsulated program with Nomex ® coveralls (for flash protection) would be about $2,410 - 3,060.

The costs for your team are completely dependent on your type of program and the number of people involved. Don't forget that any personal protective equipment you choose and any decontamination procedures you use must be consistent with the SOPs defining their use and the provisions in 29 CFR 1910.120(q)(10).

TABLE 1

PERSONAL PROTECTIVE EQUIPMENT
APPROXIMATE COSTS (CATALOG PRICES)
TEAM SIZE: 4

LEVEL B ENCAPSULATED CAPABILITY

QTY	ITEM	PRICE	COST
6 - 8	"B" encapsulated Saranex® suits	$ 125.00 - 175.00	$ 750.00 - 1,400.00
4	Nomex® coveralls	150.00	600.00
8	Chemical boots	50.00	400.00
8	Latex boot covers	5.00	40.00
8	Nitrile gloves (sized over & under)	2.00	16.00
4	Viton® gloves	35.00	140.00
8	Butyl gloves	17.00	136.00
8	Thermal glove liners	2.00	16.00
1	Box latex gloves	20.00	20.00
4	Hard hats	6.00	24.00
8	Hooded Saranex® suits	18.00	144.00
4	Acid splash protection	25.00	100.00
4	Duct tape	6.00	24.00
	TOTAL		$ 2,410.00 - 3,060.00

LEVEL A CAPABILITY: SUIT OPTIONS

QTY	ITEM	PRICE	COST
4	Teflon® encapsulated suits	5,800.00	23,200.00
4	Viton® encapsulated suits	2,800.00	11,200.00
4	Butyl encapsulated suits	1,300.00	5,200.00
4	PVC encapsulated suits	1,100.00	4,400.00

3.3.3 Containment Equipment

Once your team is suited up and ready to enter the hot zone, they will need materials to contain the released chemicals, tools and materials to stop the release, as well as containers in which to secure volatile released products.

Table 2 below is a list of containment equipment and non-sparking tools that should be included in a beginning inventory of most Hazmat Teams. The tools and equipment needed by your Hazmat Team will be dictated by the hazards you might face. Refer to your hazards analysis data and add any specialized equipment you may need.

Many of the supplies you will need can be purchased at local hardware stores. For more information, check the yellow pages of your telephone book under "Fire Equipment," "Safety Equipment," or other appropriate headings for the particular equipment you may need.

If you require special equipment (such as pagers) to summon assistance, then you should include these items in your budget. Do you have intrinsically safe radios and lights? If not, then you will have to purchase them. Using the information obtained in your hazards analysis process, identify your specific needs and include them in your budget proposal.

TABLE 2

CONTAINMENT EQUIPMENT AND TOOLS
APPROXIMATE COSTS (CATALOG PRICES)

QTY	ITEM	PRICE	COST
2	Non-sparking bung wrench	$ 16.00	$ 32.00
2	Non-sparking drum box wrench	73.00	146.00
1	Non-sparking tool kit	898.00	898.00
2	"Safe" shovels	29.00	58.00
2	Rolls of banner guard	15.00	30.00
2	Pushbrooms	12.50	25.00
12	Traffic cones		150.00
2	85-gallon Epoxy lined drums	120.00	240.00
2	30-gallon Epoxy lined drums	60.00	120.00
2	8-gallon drums	50.00	100.00
2	25-gallon poly pails	6.00	12.00
1	Haz Mat "A" Kit	660.00	660.00
100	Feet of 8" oil sorbent boom		425.00
2	Bundles (200 each) sorbent pads	75.00	150.00
6	Bags of inert sorbent material	7.00	42.00
2	Boxes (75 each) 55-gallon PE bags	84.50	169.00
	TOTAL		$ 3,257.00

3.4 **SUMMARY OF COSTS**

We have given you an overview of the costs related to training, medical monitoring, and equipment for a Hazmat Team. The total estimates for each area are as follows:

Training	$4,500
Medical monitoring	5,400 - 12,000
Monitoring equipment	1,700
Protective equipment	2,410 - 3,060
Containment equipment	3,257
TOTAL COST	$ 17,267 - 24,517

Personnel costs are ongoing and will probably increase with time. The cost of equipment maintenance and replacement will be affected by inflationary increases unless alternate means of funding and replacement can be found.

Under the Superfund program, EPA has issued regulations that may permit you to recover some of the costs your Hazmat Team incurs in the course of its response work. These regulations permit reimbursement to local governments (up to $25,000 per incident) for "temporary emergency measures" taken in the course of responding to a spill or release of a CERCLA hazardous substance or pollutant or contaminant. This reimbursement covers immediate response measures required at the local level. These measures can include activities such as securing the area, controlling the release source, containing the substance released, or similar activities your team must perform within minutes or hours of the release to prevent or mitigate injury to human health or the environment. This reimbursement does not include expenditures associated with traditionally local services and responsibilities, such as routine emergency fire fighting. For details on the six steps that comprise the reimbursement process, see Part 310 of Title 40 of the Code of Federal Regulations (40 CFR Part 310).

Some jurisdictions have adopted an ordinance allowing them to bill the party responsible for a release for equipment expended; others bill for personnel hours and equipment. Some organizations have existing agreements to reimburse any assisting group or agency for costs resulting from an incident at their facility. With these types of arrangements, the agency supplying the assistance will not have to full. fund every item expended.

Does this mean maintenance costs of the hazmat program can be reduced? Possibly! Remember though, you may not be able to recover any costs from some spillers, and reimbursement may be delayed from others. You will still need to maintain a budget reserve for equipment replacement in a timely manner.

4.0 PREPARING RESPONSE PLANS AND STANDARD OPERATING PROCEDURES

During an incident, your Hazmat Team must depend upon and work closely with other persons or groups that have particular hazmat expertise, including:

- Fire personnel;
- Police;
- EMS personnel;
- Public works personnel;
- Local health department personnel;
- Specialists in the hazardous material(s) with which you are dealing (e.g., from private industry, the local high school, or the local community college or university);
- State agencies; and
- Federal agencies and the Regional Response Team.

As you define the roles needed for your response community, start to develop a mental picture of the people in your area that will meet these needs, and what training and involvement will be required to make them part of your response program. You will need this assistance for everything from early recognition of the presence of hazardous materials to the final critique of your operations.

Before your team can respond to a hazardous materials incident, however, you need to develop your response plans and Standard Operating Procedures (SOPS) as required by 29 CFR 1910.120(q).

Develop your Hazmat Team and your outside resources concurrently. Listing persons and groups as resources without including them in the planning and training phases of your development process reduces their effectiveness as resources. These people must know what is expected of them and be familiar with your response SOPs and Incident Command System. A contractor responding to your request for heavy equipment will not be of help to you if his people do not meet OSHA training requirements.

As you proceed to develop your response capabilities, identify the resources available to you, what you expect them to do, what level of training they need, as well as what level of training they currently have, and make sure to include them in your planning, training, and in developing your response SOPs.

A response will be more effective if you train and drill your response community. If you familiarize the individuals and agencies in your response community with each other and develop compatible procedures through real scale simulations, uniting your response community at the scene of an emergency will be easier.

For detailed guidance on response plans, consult the *Hazardous Materials Emergency Planning Guide* published by the National Response Team and commonly referred to as *NRT-1*. See Appendix E, Selected References, for directions on obtaining a copy of the guide. Computer packages are available (e.g., SAFER®, CAMEO II) to aid in the management of emergency operations or to simulate emergency scenarios to assist with training and preparedness.

For further information on available computer packages, consult EPA's Chemical Emergency Preparedness and Prevention Technical Assistance Bulletin #5, *Computer Systems for Chemical Emergency Planning.* This bulletin will provide you with a checklist for evaluating computer packages and information on available systems identified as applicable to local planning. To obtain a copy of this bulletin, refer to Appendix E, Selected References.

4.1 CONCLUSION

Every facility or jurisdiction will have some unique hazard or response capability that will deserve special consideration in the planning process. This manual asks a lot of questions for which you will have to supply the answers. We have supplied you with a realistic picture of the challenges to be overcome and the magnitude of the effort involved.

The key message we intend to convey in this manual is to research your problem by conducting a hazards analysis, and then plan accordingly with your entire response community.

APPENDIX A
BEGINNING THE HAZARDS ANALYSIS PROCESS

This appendix provides a summary of the sources of information about hazardous materials in a community. Detailed information is provided about Material Safety Data Sheets (MSDSs) and their use in the hazards analysis process.

Several recent federal studies show that there are currently between 5 and 6 million chemicals. This number grows at a rate of about 6,000 chemicals per month. Furthermore, a recent computer review of the complete list of known chemicals by the Chemical Abstract Service indicates that a first responder can expect to encounter any of 1.5 million of these chemicals in an emergency, with 33,000 to 63,000 of them considered hazardous. To complicate matters, these hazardous chemicals are known by 183,000 different names.

The U.S. Department of Transportation (DOT) and the U.S. Environmental Protection Agency (EPA) have used several measures of toxicity and volume of production to develop a shortened list of chemicals that they consider hazardous when transported in commerce. This list is comprised of about 2,700 chemicals, listed in 40 CFR 172.101. The *1987 Emergency Response Guidebook* also lists these chemicals. The Occupational Safety and Health Administration (OSHA) regulates about 400 hazardous chemicals on the basis of occupational exposures. The National Institute of Occupational Safety and Health (NIOSH) *Pocket Guide to Chemical Hazards* contains a list of these chemicals. As required by Title III of the Superfund Amendments and Reauthorization Act of 1986, EPA has prepared a list of extremely hazardous substances that currently includes about 360 lethal air toxins.

Even these relatively short lists of chemicals can be intimidating to local response personnel hoping to develop a comprehensive hazards analysis for their community. Further complicating their job is the fact that, according to a recent study by the National Academy of Sciences, National Research Council (NRC), there is so little known about seven-eights of the 63,000 hazardous chemicals that not even a partial assessment can be made of their health hazards. Some conclusions drawn from the NRC study are as follows:

- Of the 3,350 pesticides classified as important chemicals, information sufficient to make a partial assessment of the associated health hazards is available on only about 1,100 to 1,200 (34%) of them.

- Of the 1,815 drugs or drug ingredients noted, about 36% have enough information for a partial assessment.

- For the 8,627 food additives listed, there is partial information on 19%.

- For the remaining 48,500 industrial chemicals, there is enough information on just 10% to develop even a partial assessment.

The lack of generally accepted names for chemicals considered hazardous and the lack of data available to assess risks together create a stumbling block for emergency response personnel and community officials responsible for developing a viable, effective local hazardous materials management system. Without a contingency plan based on effective and accurate hazards analysis prior to an emergency, it would be difficult and time-consuming to develop the necessary information in the midst of an emergency.

Hazards Analysis Data Sources

The first step of a hazards analysis is to gather data on the location, quantities, and health hazards of chemicals in a community before a release occurs. This task may seem monumental from two aspects: (1) the sheer numbers of chemicals out there, and (2) the lack of information in useable form available on these chemicals. This section suggests various methods you can use to gather useful data about chemical hazards in your community.

1. Consult historical records. These records contain information, on a national level, concerning the most frequently released chemicals. For example, studies have shown that the most commonly released hazardous chemical is commercial vehicle fuel (gasoline). In 1985, EPA commissioned a national study of 6,928 incidents involving chemicals other than fuel to look at hazardous chemicals and the source of their releases. [1] The study indicated that 74.8% of the releases were fixed facility incidents and 25.2% were in-transit incidents.

   The fixed facility incidents were distributed as follows:

   20.7% storage,
   19.4% valves and pipes,
   14.1% process,
   17.9% unknown, and
   27.8% other. [2]

   The in-transit incidents were distributed as follows:

   54.5% truck,
   36.1% rail,
   3.8% barge,
   3.1% pipeline, and
   2.5% other.

   Perhaps the most useful information from this national study is the identity of the chemicals most commonly involved in these 6,928 incidents. Approximately 48.5% of the incidents involved only the following 10 chemicals:

   23.0% polychlorinated biphenyls (PCBs),
   6.5% sulfuric acid,
   3.7% anhydrous ammonia,
   3.5% chlorine,
   3.1% hydrochloric acid,
   2.6% sodium hydroxide,
   1.7% methanol/methyl alcohol,
   1.7% nitric acid,

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[1] *Acute Hazardous Events Data Base,* Industrial Economics, Inc., Cambridge, MA, December 1985. EPA is in the process of updating this report. Although the newer statistics vary slightly from those presented in this report, the general distribution of release incidents has not significantly changed.

[2] The types of incidents contained in this category include disposal, heating and cooling systems, and vehicles not in-transit.

1.4% toluene, and
1.4% methyl chloride.

Human injury or death resulted from 468 of the 6,928 incidents. Events involving injuries and deaths have occurred throughout all industrial sectors, with about one-third occurring at chemical and petroleum refining facilities, one-third occurring at a wide variety of other industrial facilities, and one-third occurring in-transit. The 10 chemicals listed above accounted for 35.8% of the death and injury events, as follows:

9.6% chlorine,
6.8% anhydrous ammonia,
5.6% hydrochloric acid,
4.7% sulfuric acid,
2.8% PCBs,
2.4% toluene,
1.9% sodium hydroxide,
1.5% nitric acid,
0.4% methyl alcohol, and
0.1% methyl chloride.

Notice that the release and injury data are different. For example, although PCBs were involved in more incidents, chlorine posed a greater threat to humans. Determining this potential for causing injury to humans is the area of hazards analysis that takes the most effort on the part of the local response community. Gathering the information in a systematic manner cannot be done while responding to an incident.

2. Consult summaries of previous incidents available from emergency management and environmental response organizations at the local, state, regional, and federal levels. For example, EPA Region VII and states in that region have comprehensive computerized records of all reported incidents by county since 1977. Any jurisdiction can request these records.

3. Local fire and police department records may list incidents involving hazardous materials.

4. The yellow pages of the telephone book and the state industrial directory will list most local fixed facilities that manufacture, store, or use chemicals. EPA has recently prepared summaries for 14 types of facilities that show what types of hazardous chemicals may be encountered at the facilities. Copies of the summaries may be obtained from EPA by calling the national RCRA/Superfund Industrial Assistance Hotline toll-free at (800) 424-9346.

Once the chemicals in a community have been identified as to name and quantity, there are several national data bases that can evaluate the hazards and risks presented by those chemicals. You might consult any of the following:

A. Poison Control Centers. If the chemical is a consumer product, a regional Poison Control Center can quickly provide comprehensive hazard information.

B. Manufacturer’s technical medical staff. If the chemical is an industrial bulk chemical, CHEMTREC (Chemicals in Transportation Emergency Center) can provide quick assistance. Call (800) CMA-8200 for non-emergency situations, and (800) 424-9300 during emergencies. You can also contact the technical medical staff of the company that manufacturers the chemical.

C. Agency for Toxic Substances and Disease Registry. If the chemical is a mixture or a waste, if a second opinion is required, or if the chemical is unknown, a good source of information is the Agency for Toxic Substances and Disease Registry at the Centers for Disease Control. It can be reached by dialing (404) 639-0615 day or night.

Remember that health assessment information is incomplete for many chemicals. Information from any of the sources listed above may be qualified, and each local planning group should locate a competent medical authority to work with them to obtain and interpret health effects data.

Material Safety Data Sheets (MSDSs)

Recent state and federal legislation regarding hazard communication, right-to-know, and mandatory local notification for certain hazardous chemicals will assist local response groups in developing pre-emergency and on-scene hazard assessments of chemicals in the community. This legislation makes the MSDS a primary information source on chemical hazards.

Local response groups and planners are being provided with MSDSs by local industry as required by SARA Title III. However, MSDSs will not be useful to local response groups unless they are familiar with the information presented on the MSDS and how that information will assist them in making a hazard assessment, whether for pre-emergency planning or responding to an emergency.

The minimum content of an MSDS is mandated by OSHA Each sheet must contain the following sections:

1. The chemical name, chemical formula, common synonyms, chemical family, and the manufacturer's name and emergency telephone number;
2. Hazardous ingredients and regulatory exposure limits, if any;
3. Physical properties;
4. Fire and explosion hazard data;
5. Health hazard data;
6. Reactivity data;
7. Spill or leak procedures;
8. Special protection information; and
9. Special precautions.

Although there are several sources of generic MSDSs, including some where the information is computerized, response and/or planning personnel should obtain current MSDSs from companies in their community to establish and maintain good working relationships with them.

In reviewing the MSDS, note the different ways information is presented and the lack of uniform presentation. From the varying formats, you will gain some insights into the use of MSDSs and factors to be considered in interpreting them. The depth of information furnished in MSDSs depends on knowledge of the chemical and the management attitude of the company providing the information.

MSDS Section 1 - Materials Identification. This section identifies the chemical by name, synonyms, and/or family name. The manufacturer's name and emergency telephone number should be used to obtain additional data and assistance. Several preparers have chosen to emphasize the health hazards, precautionary measures, and emergency contacts at the top of the sheets.

MSDS Section 2 - Ingredients and Hazards. This section describes all ingredients contained in the material or chemical, and hazards associated with it. Absolute clarity in describing all ingredients of a material and its hazardous components is essential; however, experience indicates that clarity is not always achieved. When discussing chlorine and its hazards, one MSDS preparer assumed chlorine to be the pure chemical in the gaseous form, whereas fire fighters are more likely to encounter chlorine as a solid (HTH - commonly used in swimming pool chemical control) or as commercial bleaches (a liquid that is fairly dilute).

If you review the ingredients and hazards of anhydrous ammonia and ammonia hydroxide, you will see that anhydrous ammonia is a colorless gas with an extremely pungent odor and that ammonium hydroxide is a clear, colorless liquid. Although their forms are different and their ability to reach human beings when released is different, the hazard is the same. Ammonia is intensely corrosive to human tissue, whether it is inhaled, contacts the skin, or is ingested. OSHA regulates work place exposures of ammonia at 50 ppm (permissible exposure limit, PEL) while the American Conference of Governmental Industrial Hygienists (ACGIH) recommends a level of 25 ppm (threshold limit value, TLV). Additionally, OSHA regulations state that at concentrations of 500 ppm in air, the material becomes immediately dangerous to life and health (IDLH).

The OSHA system is designed to provide safe working conditions for reasonably healthy adult humans for 8-hour exposures for 40 hours per week for 40 years. This approach is not directly applicable to general populations. Obviously, anyone with pre-existing respiratory ailments would be expected to be more affected by irritants and by those chemicals that affect the-central nervous system. The IDLH limits are likewise not applicable to children, especially those in the first year of life, since their metabolism and nervous system responses are significantly different than those of adults or older children.

The following information was found in MSDSs for the listed chemicals:

Name	Form	Exposure Limit (PEL)	IDLH
Ammonium hydroxide	Liquid	50 ppm	500 ppm
Anhydrous ammonia	Gas	50 ppm	500 ppm
Chlorine	Gas	1 ppm (ceiling)	25 ppm
Gasoline (unleaded)	Liquid	300 ppm (ACGIH)	
petroleum distillate		500 ppm (OSHA)	
benzene		10 ppm	
Hydrochloric acid	Liquid	5 ppm	100 ppm
Methyl alcohol	Liquid	200 ppm	25,000 ppm
Nitric acid	Liquid	2 ppm	100 ppm
Polychlorinated biphenyls	Liquid	0.5 mg/m^3 (ACGIH)	
Sodium hydroxide	Solid	2 mg/m^3	200 mg/m^3
Sulfuric acid	Liquid	1 mg/m^3	80 mg/m^3
Toluene	Liquid	200 ppm	2,000 ppm

All of the OSHA limits are for airborne concentrations and vary widely among the substances listed. It is important to note that the ratio of exposure limit to IDLH concentration also varies widely. The greater the range between these two numbers, the greater the chance an exposed person will avoid permanent harm or death.

It is important to know how these materials become airborne and the rate at which they do so. For this information, we will have to look elsewhere on the sheets.

MSDS Section 3 - Physical Data. When assessing hazards, the ability to evaluate the physical data combined with the health hazard data is essential. The common physical properties provided on a typical MSDS include boiling point, freezing point, specific gravity, vapor pressure, vapor density, solubility, and appearance. Other parameters may be provided at the discretion of the company completing the sheets.

Let's look briefly at characteristics of the 11 chemicals and discuss the implications of each for the first responder:

a. *Boiling point* - the temperature at which a liquid turns to a vapor.

Chemical	Boiling Point
Ammonium hydroxide	36°C
Anhydrous ammonia	-33°C
Chlorine	-34°C
Gasoline (unleaded)	38° - 204°C
Hydrochloric acid (37%)	53°C
Hydrochloric acid (munatic) (35%)	65.6° - 110°C
Methyl alcohol	64.5°C
Nitric acid (6068%)	122°C (67%)
Polychlorinated biphenyls	360° - 390°C
Sodium hydroxide	1390°C
Sodium hydroxide solution (50%)	145°C
Sulfuric acid	310°C
Toluene	231° - 232°C

Since ambient temperatures range from around -2O°C to 50°C (-10°F to 120°F), any chemical with a boiling point below the ambient temperature will rapidly become a gas when released from its container. This is certainly the case for chlorine and anhydrous ammonia. Other materials with boiling points only slightly above normal ambient temperature will rapidly expand and pressurize containers and explode if heated only slightly. Other materials, such as polychlorinated biphenyls (PCBs) and sodium hydroxide pellets, will be unaffected by the heat of normal structural fires, but could be affected by the application of water to that fire. Sodium hydroxide pellets, for example, will dissolve in water to form a corrosive liquid.

b. *Freezing point* - temperature at which the liquid form of a chemical will turn into the solid form.

c. *Melting point* - temperature at which the solid form of a chemical will turn into the liquid form.

The two physical parameters above may be of limited use to response personnel for most chemicals. There are several chemicals for which control measures such as freezing are effective and where dry ice, for example, may be used to mitigate a release. Similarly, some chemicals undergo a form change when exposed to structural fire temperatures. This can significantly increase the hazard to response personnel. Low-melting-point solids and most liquids exposed to fire temperatures may emit toxic materials in the smoke plume.

d. *Specific gravity* - density of a chemical compared to the density of water. If the specific gravity is less than one, the chemical will float on water. If the specific gravity is greater than one, the chemical will sink. In either case, it is important for response personnel to consider the property of solubility concurrently with specific gravity. Properties for the 11 chemicals are listed below:

Chemical	Exposure Limit	Specific Gravity	Solubilitv
Ammonium hydroxide	50 ppm	0.9	Infinite
Anhydrous ammonia	50 ppm	0.68	Soluble
Chlorine	1 ppm	2.4	0.7%
Gasoline (unleaded)	300 ppm	0.7-0.8	Insoluble
Hydrochloric acid	5 ppm	1.18	Infinite
Methyl alcohol	200 ppm	0.8	Miscible
Nitric acid		1.41	Complete
Polychlorinated biphenyls	0.5 mg/m^3	1.5	0.01 ppm
Sodium hydroxide	2 mg/m^3	2.13	111 gm/100 gm
Sulfuric acid	1 mg/m^3	1.84	Infinite
Toluene	200 ppm	0.86	0.05 gm/100 gm

Toluene, gasoline, and methyl alcohol are all flammable or combustible liquids with similar TLV levels. A glance at their solubilities shows, however, that mitigation techniques would have to be substantially different due to their solubility (i.e., methyl alcohol is completely miscible in water whereas the others are relatively insoluble). Not only would fire fighting methods differ, but additional attention would have to be paid to solubility when environmental damage is possible. Many chemicals that are listed as only slightly soluble can still cause significant environmental toxicity to plants or aquatic life. Toxicity of methyl alcohol is 250 ppm and toluene 1,180 ppm; therefore, each of them presents a serious environmental hazard if significant runoff is allowed to occur.

Most MSDSs do not provide environmental risk information; therefore, this data will have to be sought from other sources. One excellent source for environmental risk information about many common chemicals is the EPA OHM-TADS (Oil & Hazardous Materials - Technical Assistance Data System). Access to this system can be gained by contacting any EPA Regional Office.

e. *Vapor density* - density of a gas compared to the density of air. If the vapor density is less than one, the material will rise in still air and dissipate. If the vapor density is greater than one, the vapor will attempt to sink in still air and potentially collect in low spots and valleys.

f. *Vapor pressure* - pressure exerted by vapors against the sides of the container. Vapor pressure is temperature dependent. The lower the boiling point of the liquid, the greater the vapor pressure it will exert at a given temperature. In more common terms, the higher the vapor pressure, the more rapidly the material will change from liquid form to a vapor when released into the environment, and the higher the equilibrium concentration with air will be.

Boiling point, vapor pressure, and vapor density as found in MSDSs for the compounds of interest are listed below:

Chemical	Boiling Point	Vapor Pressure	Vapor Density
Ammonium hydroxide	36°C	15 mm Hg @ 20°C	1.2
Anhydrous ammonia	-33°C	23 atm @ 20°C 4800 mm Hg @ 20°C	0.6
Chlorine	-34°C	-800 mm Hg @ 20°C	2.49
Gasoline (unleaded)	38 - 204°C	N/A	N/A
Hydrochloric acid (37%)	53°C	190 mm Hg @ 20_{o}C	1.27
Methyl alcohol	64.5°C	97 mm Hg @ 20_{o}C	1.1
Nitric acid (60-68%)	122°C (67%)	62 mm Hg @ 20_{o}C	2 to 3
Polychlorinated biphenyls	360 - 390°C	<1 mm Hg @ 20_{o}C	N/A
Sodium hydroxide	1390°C	Negligible	
Sodium hydroxide solution (50%)	145°C	6.3 mm Hg @ 104°F	
Sulfuric acid (96%)	310°C	22 mm Hg @ 145°C	<0.3 @ 25°C
Sulfuric acid (93.2%)		<0.3 mm Hg @ 25°C	3.4
Toluene	231 - 232°C	22 mm Hg @ 20°C	3.14

The detail of the information furnished on an MSDS varies from rough estimates or general statements for some materials to multiple listings for others. If you can picture the room in which a release occurs from its container, and then look at the range of vapor pressures for the most commonly released substances, it will be apparent that both chlorine and anhydrous ammonia will present an almost instantaneous vapor (inhalation) hazard. Since both of these chemicals are soluble to some extent, a fog line may be helpful in volatilization suppression or in concentration reduction, even when the release is continuous. However, when the intent is to reduce vapor production, the water from the hose lines should not enter pooled materials like ammonia or chlorine. For materials like sodium hydroxide and PCBs, a vapor hazard is not likely to exist under real-world conditions.

MSDS Section 4 - Fire and Explosion Data. Most of the MSDSs contain specific information for fire fighters on the physical characteristics of the chemicals when involved in a fire. These characteristics, summarized below, should be familiar to fire personnel.

Chemical	**Flash Point**	**Autoignition Temperature**	**Flammability Limits**	**Extinguishing Media**
Ammonium hydroxide	---	---	---	---
Anhydrous ammonia	1208°C	651°C	16 - 27%	Shut off gas
Chlorine	N/A	N/A	N/A	N/A
Gasoline (unleaded)	-45°F	536 - 853°F	1.5 - 7.6%	Dry chemical Water spray
Hydrochloric acid	N/A	N/A	N/A	N/A
Methyl alcohol	52°F	385°F	6 - 36.5%	Water spray
Nitric acid	None	None	N/A	N/A
PCBs	N/A	N/A	N/A	N/A
Sodium hydroxide	None	None	N/A	N/A
Sulfuric acid	None	None	N/A	N/A
Toluene	40°F	480°F	1.3 - 7.1%	Dry chemical

In addition to these normal fire characteristics, the chemicals present other fire-related hazards, some of which are reported in the fire and explosion section. Examples of these are the following:

- Chlorine and anhydrous ammonia are usually stored in pressure containers. The violent rupture of these containers represents a significant hazard.

- Many of these chemicals generate toxic vapors or mists when involved in a fire.

- Hydrochloric acid, nitric acid, sodium hydroxide, and sulfuric acid are such vigorous oxidizers or reducers that, although they are not flammable hazards themselves, they react with many metals to produce extremely flammable hydrogen gas.

MSDS Section 5 - Health Hazard Information. This section presents information on routes of exposure (inhalation, ingestion, dermal) and, in some cases, the severity of risk (low, moderate, high). This information is essential for selecting appropriate personal protective equipment and safety procedures for response actions. Some MSDSs highlighted the major hazards in section one, while others give a more detailed hazard listing in this section. Some sheets list the NFPA 704 rating for the specific chemical. This should be encouraged, as it provides emergency response personnel a basis for quick judgments about the severity of personal exposure. A brief hazard summary for each chemical is listed below:

Chemical		**Hazards**
Ammonium hydroxide	Corrosive -	severe eye and skin irritant
Anhydrous ammonia	Corrosive -	severe eye and skin irritant
Chlorine	Corrosive -	life threatening toxic effects may occur at concentrations of 25 ppm on short exposures
Gasoline	Flammable -	irritant - CNS effects - some evidence of carcinogenicity - also numerous chronic effects
Hydrochloric acid	Corrosive -	may be fatal if ingested
Methyl alcohol	Flammable -	may be fatal if ingested
Nitric acid	Corrosive -	strong oxidizer at higher concentrations
PCBs	Very long-	lasting material - some evidence of liver damage - carcinogenic risk and adverse reproductive effects.
Sodium hydroxide	Corrosive -	may be fatal if swallowed causing severe burns
Sulfuric acid	Corrosive -	causes severe burns - may be fatal if swallowed - harmful if inhaled
Toluene	Flammable -	chronic skin irritant - various systemic effects on the central nervous system, liver, and kidneys

These chemicals are corrosive to nearly every part of the human body. The effects of chlorine and sulfuric acid are very similar. What makes chlorine a greater risk is its volatility when released. Sulfuric acid is already a liquid at ambient temperatures and volatilizes very slowly.

MSDS Section 6 - Reactivity Data. Generally, four areas of information are presented in this section. All are potentially useful to those responding to a hazardous chemical emergency.

a. *Stability.* Is the material stable at ambient temperatures and pressure, or at normal storage conditions? Most of the chemicals reviewed are stable and not liable to undergo spontaneous changes.

b. *Polymerization.* Will the chemical change through polymerization at normal storage and temperature conditions? For chemicals that spontaneously polymerize, this frequently leads to the heat generation and potential container failure.

C. *Decomposition.* What new chemicals and what hazards will be created by the thermal decomposition of the chemical? Important information is included in this section for officials concerned about the exposures of response personnel and the general population if the chemical is exposed to fire. For example, formaldehyde may be formed from fire involving methyl alcohol; oxides of nitrogen from anhydrous ammonia; and oxides of carbon from most of the other chemicals. This may increase the hazards from simple asphyxiation.

d. *Incompatibles.* What materials may cause violent reactions with the chemical? Note especially the MSDS for gasoline.

Most chemicals will have a large number of potentially violent combinations. It is important to have some idea of the likelihood of incompatibles contacting each other. Many chemicals are potent acids or bases, and will certainly be incompatible with chemicals of widely differing pH. For example, the sheet for sulfuric acid lists water as being incompatible. The mixing of sulfuric acid (96%) with water (at pH of 7) releases enough heat to cause a violent reaction.

MSDS Section 7 - Spill or Leak Procedures. This section contains suggested steps for handling releases of the chemical in question. The information provided is usually similar to the 1987 DOT *Emergency Response Guidebook.* It is important to note the order in which the material is presented. If the material is extremely flammable, but not particularly toxic, initial advice will usually be to control ignition sources. If the material is extremely toxic, initial advice will generally be to evacuate or shelter in place.

MSDS Section 8 - Special Protection Information. For many MSDSs now in use, this section is not very specific. Hopefully, improvements will be made that include specific respiratory and clothing information. It is important to know that no impervious clothing is suitable for every chemical. For example, polyethylene protective clothing is not recommended for concentrated sulfuric acid, but is suitable for more dilute solutions.

Special problems may be created for first responders by those materials that destroy normal fire fighter protective clothing. These materials (e.g., chlorobenzene, methyl iodide), for which breakthrough times are less than one tank of air, may not offer any useful protection to the responder. Once a hazards analysis is completed and response organizations are at the point where they are selecting response equipment, it is suggested that they obtain a copy of *Guidelines for the Selection* of *Chemical Protective Clothing,* Cambridge, MA: A.D. Little Co., 1987, and check out the protective clothing recommendations for the chemicals in their community.

MSDS Section 9 - Special Precautions. Many MSDSs do not contain any information in this area. For extremely flammable materials, there is an additional warning about sparks and radiant heat. For chlorine, there is a warning about igniting other combustible materials on contact. For many other chemicals, standard storage and handling procedures are repeated.

One important area that may be covered on some MSDSs is the chemical hazard to animal or aquatic life. This information is frequently based on controlled laboratory settings. The information from this testing is presented in terminology different than the regulatory TLV and PEL information, and it will take an additional effort on the responder's part to evaluate.

These tests evaluate the substance's physical/chemical properties, determine routes of entry into the organisms being tested, and document exposure variables. The tests also evaluate the biological fate of the chemicals and develop a dose/response curve for the specific effects being evaluated. A hypothetical dose/response curve is shown in Figure 1. The most common expression of these test results is the dose or concentration at which 50% are affected, known as the TD_{50}. Toxicologists exhibit their skills by the accuracy with which they can extrapolate animal data to predict effects on man. In general, TD_{50} data are commonly given for pesticides and other chemicals developed for pest and weed control. An example of interpreting these data for responders is shown below:

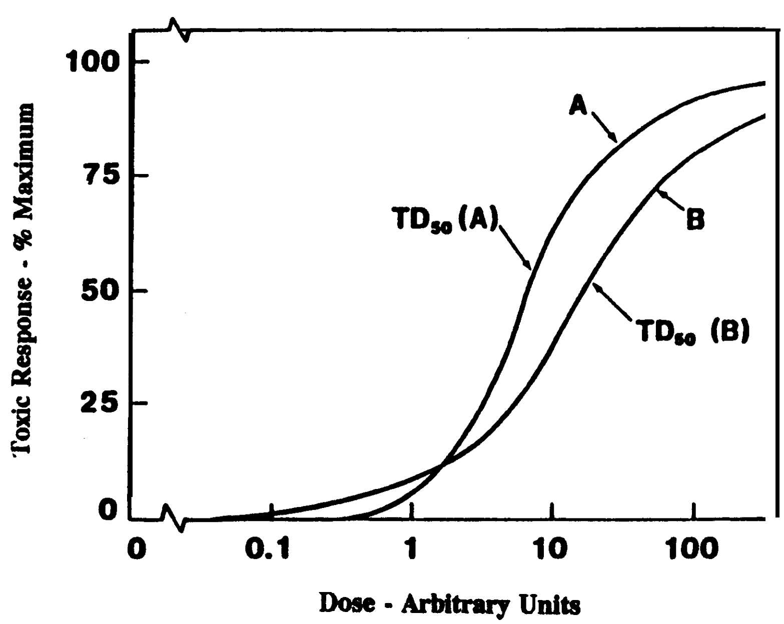
RELATIVE INDEX OF TOXICOLOGY

Toxicity Rating	Probable Oral Dose	Lethal Dose for Humans (Average Adult)
Practically non-toxic	>15 g/kg	More than a quart
Slightly toxic	5 - 150 g/kg	Between pint and quart
Moderately toxic	0.5 - 5 g/kg	Between ounce and quart
Very toxic	50 - 500 mg/kg	Between teaspoonful and ounce
Extremely toxic	5 - 50 mg/kg	7 drops to teaspoonful
Super toxic	<5 mg/kg	A taste (less than 7 drops)

Dose/response curves deal with acute exposures, but it is important to consider also the potential for repetitive exposures at lower doses, which may accumulate in the body. This situation is called chronic exposure and is diagramed in Figure A- 1.

FIGURE A-l

Hypothetical Dose-Response Curve
of Two Chemicals, A and B



APPENDIX B
MEDICAL PROGRAM

CONTENTS

INTRODUCTION 30

DEVELOPING A PROGRAM 30

PRE-EMPLOYMENT SCREENING 42

Determination of Fitness for Duty 42
Baseline Data for Future Exposures 43
Sample Pre-Employment Examination 44

PERIODIC MEDICAL EXAMINATION 45

Periodic Screening 45
Sample Periodic Medical Examination 46

TERMINATION EXAMINATION 46

EMERGENCY TREATMENT 47

NON-EMERGENCY TREATMENT 49

MEDICAL RECORDS 49

PROGRAM REVIEW 50

REFERENCES 51

NOTES: For additional guidance, see U.S. EPA Environmental Response Team's *Occupational Medical Monitoring Program Guidelines for SARA Hazardous Waste Field Activity Personnel*, January 1990, EPA OSWER Directive: 9285.3-04.

This appendix is reproduced from Chapter 5 of the *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*. See Appendix E, Selected References, for information about this document.

INTRODUCTION

Workers handling hazardous wastes can experience high levels of stress. Their daily tasks may expose them to toxic chemicals, safety hazards, biologic hazards, and radiation. They may develop heat stress while wearing protective equipment or working under temperature extremes, or face life-threatening emergencies such as explosions and fires. Therefore, a medical program is essential to assess and monitor workers' health and fitness both prior to employment or treatment; and to keep accurate records for future reference. In addition, OSHA recommends a medical evaluation for employees required to wear a respirator (29 CFR Part 1910.134(b)(10)), and certain OSHA standards include specific medical requirements (e.g., 29 CFR Part 1910.95 and 29 CFR Parts 1910.1001 through 1910.1045). Information from a site medical program may also be used to conduct future epidemiological studies; to adjudicate claims; to provide evidence in litigation; and to report workers' medical conditions to federal, state, and local agencies, as required by law.

This chapter presents general guidelines for designing a medical program for personnel at hazardous waste sites. It includes information and sample protocols for pre-employment screening and periodic medical examinations, guidelines for emergency and non-emergency treatment, and recommendations for program recordkeeping and review. In addition, it supplies a table of some common chemical toxicants found at hazardous waste sites with recommended medical monitoring procedures.

The recommendations in this chapter assume that workers will have adequate protection from exposures through administrative and engineering controls, and appropriate personal protective equipment and decontamination procedures, as described elsewhere in this manual. Medical surveillance should be used to complement other controls.

DEVELOPING A PROGRAM

A medical program should be developed for each site based on the specific needs, location, and potential exposures of employees at the site. The program should be designed by an experienced occupational health physician or other qualified occupational health consultant in conjunction with the Site Safety Officer. The director of a site medical program should be a physician who is board-certified in occupational medicine or a medical doctor who has had extensive experience managing occupational health services. A director and/or examining physician with such qualifications may be difficult to find, due to the shortage of doctors trained in occupational medicine in remote geographic areas where many hazardous waste sites are located. If an occupational health physician is not available, the site medical program may be managed, and relevant examinations performed, by a local physician with assistance from an occupational medicine consultant. These functions may also be performed by a qualified Registered Nurse, preferably an Occupational Health Nurse, under the direction of a suitably qualified physician who has responsibility for the program.[1]

All medical test analyses should be performed by a laboratory that has demonstrated satisfactory performance in an established interlaboratory testing program [l]. The clinical or diagnostic laboratory to which samples are sent should meet either (1) minimum requirements under the Clinical Laboratories Improvement Act of 1967 (42 CFR Part 74 Subpart M Section 263(a)), or (2) the conditions for coverage under Medicare. These programs are administered by the Health Care Financing Administration (HCFA), U.S. Department of Health and Human Services (DHHS).

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[1] Certified, state-licensed (where required) Physician's Assistants may also perform these examinations if a physician is available on the premises.

A site medical program should provide the following components:

- Surveillance:
  - Pre-employment screening.
  - Periodic medical examinations (and follow-up examinations when appropriate).
  - Termination examination.
- Treatment:
  - Emergency.
  - Non-emergency (on a case-by-case basis).
- Recordkeeping.
- Program review.

Table B-l outlines a recommended medical program; screening and examination protocols are described in the following sections. These recommendations are based on known health risks for hazardous waste workers, a review of available data on their exposures, and an assessment of several established medical programs. Because conditions and hazards vary considerably at each site, only general guidelines are given.

Table B-l. Recommended Medical Program

COMPONENT	RECOMMENDED	OPTIONAL
Pre-Employment Screening	• Medical history. • Occupational history. • Physical examination. • Determination of fitness to work wearing protective equipment. • Baseline monitoring for specific exposure.	• Freezing pre-employment serum specimen for later testing (limited to specific situations, see *Baseline Data for Future Exposures* in this chapter).
Periodic Medical Examinations	• Yearly update of medical and occupational history; yearly physical examination; testing based on (1) examination results, (2) exposures, and (3) job class and task. • More frequent testing based on specific exposures.	• Yearly testing with routine medical tests.
Emergency Treatment	• Provide emergency first aid on site. • Develop liaison with local hospital and medical specialists. • Arrange for decontamination of victims.	

Table B-1. Recommended Medical Program (continued)

COMPONENT	RECOMMENDED	OPTIONAL
	• Arrange in advance for transport of victims. • Transfer medical records; give details of incident and medical history to next care provider.	
Non-Emergency Treatment	• Develop mechanism for non-emergency health care.	
Recordkeeping and Review	• Maintain and provide access to medical records in accordance with OSHA and state regulations. • Report and record occupational injuries and illnesses. • Review Site Safety Plan regularly to determine if additional testing is needed. • Review program periodically. Focus on current site hazards, exposures, and industrial hygiene standards.	

The medical program's effectiveness depends on active worker involvement. In addition, management should have a firm commitment to worker health and safety, and is encouraged to express this commitment not only by medical surveillance and treatment, but also through management directives and informal encouragement of employees to maintain good health through exercise, proper diet, and avoidance of tobacco, alcohol abuse, and drug abuse. In particular, management should:

- Urge prospective employees to provide a complete and detailed occupational and medical history.
- Assure employees of confidentiality.
- Require workers to report any suspected exposures regardless of degree.
- Require workers to bring any unusual physical or psychological conditions to the physician's attention. Employee training should emphasize that vague disturbances or apparently minor complaints (such as skin irritation or headaches) may be important.

When developing an individual program, site conditions must be considered and the monitoring needs of each worker should be determined based on the worker's medical and occupational history, as well as current and potential exposures on site. The routine job tasks of each worker should be considered. For instance, a heavy equipment operator exposed to significant noise levels would require a different monitoring protocol from a field sample collector with minimal noise exposure. Likewise, an administrator may only need a pre-employment screening for ability to wear personal protective equipment - if this is an occasional requirement - rather than a more comprehensive program.

The potential exposures that may occur at a site must also be considered. While it is often impossible to identify every toxic substance that exists at each hazardous waste site, certain types of hazardous substances or chemicals are more likely to be present than others. Some of these are:

- Aromatic hydrocarbons.
- Asbestos (or asbestiform particles).
- Dioxin.
- Halogenated aliphatic hydrocarbons.
- Heavy metals.
- Herbicides.
- Organochlorine insecticides.
- Organophosphate and carbamate insecticides.
- Polychlorinated biphenyls (PCBs).

Table B-2 lists these groups, with representative compounds, uses, health effects, and available medical monitoring procedures.

In compiling a testing protocol, bear in mind that standard occupational medical tests weredeveloped in factories and other enclosed industrial environments, and were based on the presence of specific identifiable toxic chemicals and the possibility of a significant degree of exposure. Some of these tests may not be totally appropriate for hazardous waste sites, since available data suggest that site workers have low-level exposures to many chemicals [2]. In addition, most testing recommendations, even those for specific toxic substances, have not been critically evaluated for efficacy.

Another important factor to consider is that risk can vary, not only with the type, amount, and duration of exposure, but also with individual factors such as age, sex, weight, stress, diet, susceptibility to allergic-type reactions, medications taken, and off-site exposures (e.g., in hobbies such as furniture refinishing and automotive body work).

Table B-2. Common Chemical Toxicants Found at Hazardous Waste Sites, Their Health Effects and Medical Monitoring

HAZARDOUS SUBSTANCE OR CHEMICAL GROUP	COMPOUNDS	USES	TARGET ORGANS	POTENTIAL HEALTH EFFECTS	MEDICAL MONITORING
Aromatic Hydrocarbons	Benzene Ethyl benzene Toluene Xylene	Commercial solvents and intermediates for synthesis in the chemical and pharmaceutical industries.	Blood Bone marrow CNS [a] Eyes Respiratory system Skin Liver Kidney	All cause: CNS [a] depression: decreased alertness, headache, sleepiness, loss of consciousness. Defatting dermatitis. Benzene suppresses bone-marrow function, causing blood changes. Chronic exposure can cause leukemia. Note: Because other aromatic hydrocarbons may be contaminated with benzene during distillation, benzene-related health effects should be considered when exposure to any of these agents is suspected.	Occupational/general medical history emphasizing prior exposure to these or other toxic agents. Medical examination with focus on liver, kidney, nervous system, and skin. Laboratory testing: CBC [b] Platelet count Measurement of kidney and liver function.

Table B-2. Common Chemical Toxicants Found at Hazardous Waste Sites, Their Health Effects and Medical Monitoring (continued)

HAZARDOUS SUBSTANCE OR CHEMICAL GROUP	COMPOUNDS	USES	TARGET ORGANS	POTENTIAL HEALTH EFFECTS	MEDICAL MONITORING
Asbestos (or asbestiform particles)		A variety of industrial uses, including: Building Construction Cement work Insulation Fireproofing Pipes and ducts for water, air, and chemicals Automobile brake pads and linings	Lungs Gastrointestinal system	Chronic effects: Lung cancer Mesothelioma Asbestosis Gastrointestinal malignancies Asbestos exposure coupled with cigarette smoking has been shown to have a synergistic effect in the development of lung cancer.	History and physical examination should focus on the lungs and gastrointestinal system. Laboratory tests should include a stool test for occult blood evaluation as a check for possible hidden gastrointestinal malignancy. A high quality chest X-ray and pulmonary function test may help to identify long-term changes associated with asbestos diseases, however, early identification of low-dose exposure is unlikely.
Dioxin (see Herbicides)					

Table B-2. Common Chemical Toxicants Found at Hazardous Waste Sites, Their Health Effects and Medical Monitoring (continued)

HAZARDOUS SUBSTANCE OR CHEMICAL GROUP	COMPOUNDS	USES	TARGET ORGANS	POTENTIAL HEALTH EFFECTS	MEDICAL MONITORING
Halogenated Aliphatic Hydrocarbons	Carbon tetrachloride Chloroform Ethyl bromide Ethyl chloride Ethylene dibromide Ethylene dichloride Methyl chloride Methyl chloroform Methylene chloride Tetrachloroethane Tetrachloroethylene (perchloroethylene) Trichloroethylene Vinyl chloride	Commercial solvents and intermediates in organic synthesis.	CNS[a] Kidney Liver Skin	All cause: CNS[a] depression; decreased alertness, headaches, sleepiness, loss of consciousness. Kidney changes: decreased urine flow, swelling (especially around eyes), anemia. Liver changes: fatigue, malaise, dark urine, liver enlargement, jaundice. Vinyl chloride is a known carcinogen; several others in this group are potential carcinogens,	Occupational/general medical history emphasizing prior exposure to these or other toxic agents. Medical examination with focus on liver, kidney, nervous system, and skin. Laboratory testing for liver and kidney function; carboxyhemoglobin where relevant.

Table B-2. Common Chemical Toxicants Found at Hazardous Waste Sites, Their Health Effects and Medical Monitoring (continued)

HAZARDOUS SUBSTANCE OR CHEMICAL GROUP	COMPOUNDS	USES	TARGET ORGANS	POTENTIAL HEALTH EFFECTS	MEDICAL MONITORING
Heavy Metals	Arsenic Beryllium Cadmium Chromium Lead Mercury	Wide variety of industrial and commercial uses.	Multiple organs and systems including: Blood Cardiopulmonary Gastrointestinal Kidney Liver Lung CNS [a] Skin	All are toxic to the kidneys. Each heavy metal has its own characteristic symptom cluster. For example, lead causes decreased mental ability, weakness (especially hands), headache, abdominal cramps, diarrhea, and anemia. Lead can also affect the blood-forming mechanism, kidneys, and the peripheral nervous system. Long-term effects [c] also vary. Lead toxicity can cause permanent kidney and brain damage; cadmium can cause kidney or lung disease. Chromium, beryllium, arsenic, and cadmium have	History-taking and physical exam; search for symptom clusters associated with specific metal exposure, e.g., for lead look for neurological deficit, anemia, and gastrointestinal symptoms. Laboratory testing: Measurements of metallic content in blood, urine, and tissues (e.g., blood lead level; urine screen for arsenic, mercury, chromium, and cadmium). CBC [b] Measurement of kidney function, and liver function where relevant.

Table B-2. Common Chemical Toxicants Found at Hazardous Waste Sites, Their Health Effects and Medical Monitoring (continued)

HAZARDOUS SUBSTANCE OR CHEMICAL GROUP	COMPOUNDS	USES	TARGET ORGANS	POTENTIAL HEALTH EFFECTS	MEDICAL MONITORING
				been implicated as human carcinogens.	Chest X-ray or pulmonary function testing where relevant.
Herbicides	Chlorophenoxy compounds: 2,4-dichloro-phenoxyacetic acid (2,4-D) 2,4,5-trichloro-phenoxyacetic acid (2,4,5-T) Dioxin (tetrachloro-dibenzo-p-dioxin, TCDD), which occurs as a trace contaminant in these compounds, poses the most serious health risk.	Vegetation control.	Kidney Liver CNS [a] Skin	Chlorophenoxy compounds can cause chloracne, weakness or numbness of the arms and legs, and may result in long-term nerve damage. Dioxin causes chloracne and may aggravate pre-existing liver and kidney diseases.	History and physical exam should focus on the skin and nervous system. Laboratory tests include: Measurement of liver and kidney function, where relevant. Urinalysis.

Table B-2. Common Chemical Toxicants Found at Hazardous Waste Sites, Their Health Effects and Medical Monitoring (continued)

HAZARDOUS SUBSTANCE OR CHEMICAL GROUP	COMPOUNDS	USES	TARGET ORGANS	POTENTIAL HEALTH EFFECTS	MEDICAL MONITORING
Organochlorine Insecticides	Chlorinated ethanes: DDT Cyclodienes: Aldrin Chlordane Dieldrin Endrin Chlorocyclohexanes: Lindane	Pest control.	Kidney Liver CNS [a]	All cause acute symptoms of apprehension, irritability, dizziness, disturbed equilibrium, tremor, and convulsions. Cyclodienes may cause convulsions without any other initial symptoms. Chlorocyclohexanes can cause anemia. cyclodienes and chlorocyclohexanes cause liver toxicity and can cause permanent kidney damage.	History and physical exam should focus on the nervous system. Laboratory tests include: Measurement of kidney and liver function. CBC [b] for exposure to chlorocyclohexanes.

Table B-2. Common Chemical Toxicants Found at Hazardous Waste Sites, Their Health Effects and Medical Monitoring (continued)

HAZARDOUS SUBSTANCE OR CHEMICAL GROUP	COMPOUNDS	USES	TARGET ORGANS	POTENTIAL HEALTH EFFECTS	MEDICAL MONITORING
Organophosphate and Carbamate Insecticides	Organophosphate: Diazinon Dichlorovos Dimethoate Trichlorfon Malathion Methyl parathion Parathion Carbamate: Aldicarb Baygon Zectran	Pest control.	CNS [a] Liver Kidney	All cause a chain of internal reactions leading to neuro-muscular blockage. Depending on the extent of poisoning, acute symptoms range from headaches, fatigue, dizziness, increased salivation and crying, profuse sweating, nausea, vomiting, cramps, and diarrhea to tightness in the chest, muscle twitching, and slowing of the heartbeat. Severe cases may result in rapid onset of unconsciousness and seizures. A delayed effect may be weakness and numbness in the feet and hands. Long-term, permanent nerve damage is possible.	Physical exam should focus on the nervous system. Laboratory tests should include: RBC [d] cholinesterase levels for recent exposure (plasma cholinesterase for acute exposures). Measurement of delayed neurotoxicity and other effects.

Table B-2. Common Chemical Toxicants Found at Hazardous Waste Sites, Their Health Effects and Medical Monitoring (continued)

HAZARDOUS SUBSTANCE OR CHEMICAL GROUP	COMPOUNDS	USES	TARGET ORGANS	POTENTIAL HEALTH EFFECTS	MEDICAL MONITORING
Polychlorinated Biphenyls (PCBs)		Wide variety of industrial uses.	Liver CNS[a] (speculative) Respiratory system (speculative) Skin	Various skin ailments, including chloracne; may cause liver toxicity; carcinogenic to animals.	Physical exam should focus on the skin and liver. Laboratory tests include: Serum PCB levels. Triglycerides and cholesterol. Measurement of liver function.

[a]CNS = Central nervous system,
[b]CBC = Complete blood count.
[c]Long-term effects generally manifest in 10 to 30 years.
[d]RBC = Red blood count.

PRE-EMPLOYMENT SCREENING

Pre-employment screening has two major functions: (1) determining an individual's fitness for duty, including the ability to work while wearing protective equipment, and (2) providing baseline data to compare with medical data. These functions are discussed below. In addition, a sample pre-employment examination is described.

Determination of Fitness for Duty

Workers at hazardous waste sites are often required to perform strenuous tasks (e.g., moving 55-gallon drums) while wearing personal protective equipment, such as respirators and protective clothing, that may cause heat stress and other problems. To ensure that prospective employees are able to meet work requirements, the pre-employment screening should focus on the following areas:

Occupational and Medical History

- Make sure the worker fills out an occupational and medical history questionnaire. Review the questionnaire before seeing the worker. In the examining room, discuss the questionnaire with the worker, paying special attention to prior occupational exposures to chemical and physical hazards.
- Review past illnesses and chronic diseases, particularly atopic diseases such as eczema and asthma, lung diseases, and cardiovascular disease.
- Review symptoms, especially shortness of breath or labored breathing on exertion, other chronic respiratory symptoms, chest pain, high blood pressure, and heat intolerance.
- Identify individuals who are vulnerable to particular substances (e.g., someone with a history of severe asthmatic reaction to a specific chemical).
- Record relevant lifestyle habits (e.g., cigarette smoking, alcohol, and drug use) and hobbies.

Physical Examination

- Conduct a comprehensive physical examination of all body organs, focusing on the pulmonary, cardiovascular, and musculoskeletal systems.
- Note conditions that could increase susceptibility to heat stroke, such as obesity and lack of physical exercise.
- Note conditions that could affect respirator use, such as missing or arthritic fingers, facial scars, dentures, poor eyesight, or perforated ear drums.

Ability to Work While Wearing Protective Equipment [3]

- Disqualify individuals who are clearly unable to perform based on the medical history and physical exam (e.g., those with severe lung disease, heart disease, or back or orthopedic problems).
- Note limitations concerning the worker's ability to use protective equipment (e.g., individuals who must wear contact lenses cannot wear full facepiece respirators).
- Provide additional testing (e.g., chest X-ray, pulmonary function testing, electrocardiogram) for ability to wear protective equipment where necessary.

Base the determination on the individual worker's profile (e.g., medical history and physical exams, age, previous exposures and testing).

Make a written assessment of the worker's capacity to perform while wearing a respirator, if wearing a respirator is a job requirement. Note that the Occupational Safety and Health Administration (OSHA) respirator standard (29 CFR Part 1910.134) states that no employee should be assigned to a task that requires the use of a respirator unless it has been determined that the person is physically able to perform under such conditions.

Baseline Data for Future Exposures

Pre-employment screening can be used to establish baseline data to subsequently verify the efficacy of protective measures and to later determine if exposures have adversely affected the worker. Baseline testing may include both medical screening tests and biologic monitoring tests. The latter (e.g., blood lead level) may be useful for ascertaining pre-exposure levels of specific substances to which the worker may be exposed and for which reliable tests are available. Given the problem in predicting significant exposures for these workers, there are not clear guidelines for prescribing specific tests. The following approach identifies the types of tests that may be indicated:

l A battery of tests based on the worker's past occupational and medical history and an assessment of significant potential exposures. Table B-3 presents examples of tests frequently performed by occupational physicians.

Table B-3. Tests Frequently Performed by Occupational Physicians

FUNCTION	TEST	EXAMPLE
Liver:		
General	Blood tests	Total protein, albumin, globulin, total bilirubin (direct bilirubin if total is elevated).
Obstruction	Enzyme test	Alkaline phosphatase.
Cell injury	Enzyme tests	Gamma glutamyl transpeptidase (GGTP), lactic dehydrogenase (LDH), serum glutamicoxaloacetic transaminase (SGOT), serum glutamic-pyruvic transaminase (SGPT).
Kidney:		
General	Blood tests	Blood urea nitrogen (BUN), creatinine, uric acid.
Multiple Systems and Organs	Urinalysis	Including color; appearance; specific gravity; pH; qualitative glucose, protein, bile, and acetone; occult blood; microscopic examination of centrifuged sediment.
Blood-Forming Function	Blood tests	Complete blood count (CBC) with differential and platelet evaluation, including white cell count (WBC), red blood count (RBC), hemoglobin (HGB), hematocrit or packed cell volume (HCT), and desired erythrocyte indices. Reticulocyte count may be appropriate if there is a likelihood of exposure to hemolytic chemicals.

- Standard established testing for specific toxicants in situations where workers may receive significant exposures to these agents. For example, long-term exposure during cleanup of a polychlorinated biphenyls (PCB) waste facility can be monitored with pre-employment and periodic serum PCB testing [4]. Standard procedures are available for determining levels of other substances, e.g., lead, cadmium, arsenic, and organophosphate pesticides.

- Where applicable, pre-employment blood specimens and serum frozen for later testing. (PCBs and some pesticides are examples of agents amenable to such monitoring.)

Sample Pre-Employment Examination

Occupational and Medical History

- Do a complete medical history emphasizing these systems: nervous, skin, lung, blood-forming, cardiovascular, gastrointestinal, genitourinary, reproductive, ear, nose, and throat.

Physical Examination

Include at least the following:

- Height, weight, temperature, pulse, respiration, and blood pressure.

- Head, nose, and throat.

- Eyes. Include vision tests that measure refraction, depth perception, and color vision. These tests should be administrated by a qualified technician or physician. Vision quality is essential to safety, the accurate reading of instruments and labels, the avoidance of physical hazards, and for appropriate response to color-coded labels and signals.

- Ears. Include audiometric tests, performed at 500, 1,000, 2,000, 3,000, 4,000, and 6,000 hertz (Hz) pure tone in an approved booth (see requirements listed in 29 CFR Part 1910.95, Appendix D). Tests should be administrated by a qualified technician, and results read by a certified audiologist or a physician familiar with audiometric evaluation. The integrity of the eardrum should be established since perforated eardrums can provide a route of entry for chemicals into the body. The physician evaluating employees with perforated eardrums should consider the environmental conditions of the job and discuss possible specific safety controls with the Site Safety Officer, industrial hygienist, and/or other health professionals before deciding whether such individuals can safely work on site.

- Chest (heart and lungs).

- Peripheral vascular system.

- Abdomen and rectum (include hernia exam).

- Spine and other components of the musculoskeletal system.

- Genitourinary system.

- Skin.

- Nervous system.

Tests

- Blood.

- Urine.

- A 14 x 17-inch posterior/anterior view chest X-ray with lateral or oblique views only if indicated or if mandated by state regulations. The X-ray should be taken by a certified radiology technician and interpreted by a board-certified or board-eligible radiologist. Chest X-rays taken in the last 12-month period, as well as the oldest chest X-ray available, should be obtained and used for comparison. Chest X-rays should not be repeated more than once a year, unless otherwise determined by the examining physician.

Ability to Perform While Wearing Protective Equipment

To determine a worker's capacity to perform while wearing protective equipment, additional tests may be necessary. For example:

- Pulmonary function testing. Measurement should include forced expiratory volume in 1 second (FEV), forced vital capacity (FVC), and FEV - to - FVC ratio, with interpretation and comparison to normal predicted values corrected for age, height, race, and sex. Other factors such as FEF, MEFR, MVV, FRC, RV, and TLC [2] may be included for additional information. A permanent record of flow curves should be conducted by a certified technician and the results should be interpreted by a physician.

- Electrocardiogram (EKG). At least one standard, 12-lead resting EKG should be performed at the discretion of the physician. A "stress test" (graded exercise) may be administered at the discretion of the examining physician, particularly where heat stress may occur.

Baseline Monitoring

If there is likelihood of potential onsite exposure to a particular toxicant, specific baseline monitoring should be performed to establish data relating to that toxicant.

PERIODIC MEDICAL EXAMINATIONS

Periodic Screening

Periodic medical examinations should be developed and used in conjunction with pre-employment screening examinations. Comparing sequential medical reports with baseline data is essential to determine biologic trends that may mark early signs of adverse health effects, and thereby indicate appropriate protective measures.

The frequency and content of examinations will vary, depending on the nature of the work and exposures. Generally, medical examinations have been recommended at least yearly. More frequent examinations may be necessary, depending on the extent of potential or actual exposure, the type of chemicals involved, the duration of the work assignment, and the individual worker's profile. For example, workers participating in the cleanup of a PCB-contaminated building were initially examined monthly for serum PCB levels.

[2] FEF = forced expiratory flow; MEFR = maximal expiratory flow rate; MVV = maximal voluntary ventilation; FRC = functional residual capacity; RV = residual volume; TLC = total lung capacity.

Reviewing data from the first few months revealed no appreciable evidence of PCB exposure. The frequency of PCB testing was then reduced [4]. Periodic screening exams can include:

- Interval medical history, focusing on changes in health status, illnesses, and possible work-related symptoms. The examining physician should have information about the worker's interval exposure history, including exposure monitoring at the job site, supplemented by worker reported exposure history and general information on possible exposures at other sites.

- Physical examination.

- Additional medical testing, depending on available exposure information, medical history, and examination results. Testing should be specific for the possible medical effects of the worker's exposure. Multiple testing for a large range of potential exposures is not always useful; it may involve invasive procedures (e.g., tissue biopsy), be expensive, and may produce false-positive results.

  Pulmonary function tests should be administered if the individual uses a respirator, has been or may be exposed to irritating or toxic substances, or if the individual has breathing difficulties, especially when wearing a respirator.

  Audiometric tests. Annual retests are required for personnel subject to high noise exposures (an 8-hour, time-weighted average of 85 dBA [3] or more), those required to wear hearing protection, or as otherwise indicated.

  Vision tests. Annual retests are recommended to check for vision degradation.

  Blood and urine tests when indicated.

Sample Periodic Medical Examination

The basic periodic medical examination is the same as the pre-employment screening (see previous section, *Sample Pre-Employment Examination)*, modified according to current conditions, such as changes in the worker's symptoms, site hazards, or exposures.

TERMINATION EXAMINATION

After finishing work at a hazardous waste site, all personnel should have a medical examination as described in the previous sections (see *Sample Pre-Employment Examination).* This examination may be limited to obtaining an interval medical history of the period since the last full examination (consisting of medical history, physical examination, and laboratory tests) if all three following conditions are met:

- The last full medical examination was within the last 6 months.

- No exposure occurred since the last examination.

- No symptoms associated with exposure occurred since the last examination.

If any of these criteria are not met, a full examination is medically necessary at the termination of employment.

[3] dBA = decibels on A-weighted scale (29 CFR Part 1910.95).

EMERGENCY TREATMENT

Provisions for emergency treatment and acute non-emergency treatment should be made at each site. Preplanning is vital.

When developing plans, procedures, and equipment lists, the range of actual and potential hazards specific to the site should be considered, including chemical, physical (such as heat and/or cold stress, falls, and trips), and biologic hazards (animal bites and plant poisoning as well as hazardous biological wastes). Not only site workers, but also contractors, visitors, and other personnel (particularly firefighters) may require emergency treatment.

Emergency medical treatment should be integrated with the overall site emergency response program (see Chapter 12). The following are recommended guidelines for establishing an emergency treatment program.

- Train a team of site personnel in emergency first aid. This should include a Red Cross or equivalent certified course in cardiopulmonary resuscitation (CPR), and first-aid training that emphasizes treatment for explosion and burn injuries, heat stress, and acute chemical toxicity. In addition, this team should include an emergency medical technician (EMT) if possible. Table B-4 lists signs and symptoms of exposure and heat stress that indicate potential medical emergencies.

- Train personnel in emergency decontamination procedures in coordination with the Emergency Response Plan.

- Predesignate roles and responsibilities to be assumed by personnel in an emergency.

- Establish an emergency/first-aid station on site, capable of providing (1) stabilization for patients requiring off-site treatment, and (2) general first aid (e.g., minor cuts, sprains, abrasions).

    Locate the station in the clean area adjacent to the decontamination area to facilitate emergency decontamination.

    Provide a standard first-aid kit or equivalent supplies, plus additional items such as emergency/deluge showers, stretchers, portable water, ice, emergency eyewash, decontamination solutions, and fire-extinguishing blankets.

    Restock supplies and equipment immediately after each use and check them regularly.

- Arrange for a physician who can be paged on a 24-hour basis.

- Set up an on-call team of medical specialists for emergency consultations, e.g., a toxicologist, dermatologist, hematologist, allergist, ophthalmologist, cardiologist, and neurologist.

- Establish a protocol for monitoring heat stress.

- **Make plans in advance for emergency transportation to a nearby medical facility; develop contamination control procedures for that facility.**

    Educate local emergency transport and hospital personnel about possible medical problems on site; types of hazards and their consequences; potential for exposure; and the scope and function of site medical program.

Table B-4. Signs and Symptoms of Chemical Exposure and Heat Stress that Indicate Potential Medical Emergencies

TYPE OF HAZARD	SIGNS AND SYMPTOMS
Chemical Hazard	Behavioral changes Breathing difficulties Changes in complexion or skin color Coordination difficulties Coughing Dizziness Drooling Diarrhea Fatigue and/or weakness Irritability Irritation of eyes, nose, respiratory tract, skin, or throat Headache Light-headedness Nausea Sneezing Sweating Tearing Tightness in the chest
Heat Exhaustion	Clammy skin Confusion Dizziness Fainting Fatigue Heat rash Light-headedness Nausea Profuse sweating Slurred speech Weak pulse
Heat Stroke (may be fatal)	Confusion Convulsions Hot skin, high temperature (yet may feel chilled) Incoherent speech Convulsions Staggering gait Sweating stops (yet residual sweat may be present) Unconsciousness

Assist the hospital in developing procedures for site-related emergencies. This will help to protect hospital personnel and patients, and to minimize delays due to concerns about hospital safety or contamination.

For specific illnesses or injuries, provide details of the incident and the worker's past medical history to the appropriate hospital staff. This is especially crucial when specific medical treatment is required (e.g., for exposure to cyanide or organophosphate pesticides).

Depending on the site's location and potential hazards, it may be important to identify additional medical facilities capable of sophisticated response to chemical or other exposures.

Post conspicuously (with duplicates near the telephones) the names, phone numbers, addresses, and procedures for contacting:

On-call physicians.

Medical specialists.

Ambulance services.

Medical facility(ies).

Emergency, fire, and police services.

Poison control hotline.

Provide maps and directions.

Make sure at least all managers and all individuals involved in medical response know the way to the nearest emergency medical facility.

Establish a radio communication system for emergency use.

Review emergency procedures daily with all site personnel at safety meetings before beginning the work shift.

NON-EMERGENCY TREATMENT

Arrangements should be made for non-emergency medical care for hazardous waste site workers who are experiencing health effects resulting from an exposure to hazardous substances. In conjunction with the medical surveillance program, offsite medical care should ensure that any potential job-related symptoms or illnesses are evaluated in the context of the worker's exposure. Offsite medical personnel should also investigate and treat non-job-related illnesses that may put the worker at risk because of task requirements (e.g., a bad cold or flu that might interfere with respirator use). A copy of the worker's medical records should be kept at the site (with provisions for security and confidentiality) and, when appropriate, at a nearby hospital. Treating physicians should have access to these records.

MEDICAL RECORDS

Proper recordkeeping is essential at hazardous waste sites because of the nature of the work and risks: employees may work at a large number of geographically disparate sites during their careers, and adverse effects on long-term exposure may not become apparent for many years. Records enable subsequent medical care providers to be informed about workers' previous and current exposures.

Occupationalsafety and Health Administration (OSHA) regulations mandate that, unless a specific occupational safety and health standard provides a different time period, the employer must:

- Maintain and preserve medical records on exposed workers for 30 years after they leave employment (29 CFR Part 1910.20).
- Make available to workers, their authorized representatives, and authorized OSHA representatives the results of medical testing and full medical records and analyses (29 CFR Part 1910.20).
- Maintain records of occupational injuries and illnesses and post a yearly summary report (29 CFR Part 1904).

PROGRAM REVIEW

Regular evaluation of the medical program is important to ensure its effectiveness. Maintenance and review of medical records and test results aid medical personnel, site officers, and the parent company and/or agency managers in assessing the effectiveness of the health and safety program. The Site Safety Officer, medical consultant, and/or management representative should, at least annually:

- Assure that each accident or illness was promptly investigated to determine the cause and make necessary changes in health and safety procedures.
- Evaluate the efficacy of specific medical testing in the context of potential site exposures.
- Add or delete medical tests as suggested by current industrial hygiene and environmental data.
- Review potential exposures and Site Safety Plans at all sites to determine if additional testing is required.
- Review emergency treatment procedures and update lists of emergency contacts.

REFERENCES

1. Proficiency Testing Programs

   Division of Technology Evaluation and Assistance
   Laboratory Program Office
   Center for Disease Control
   Atlanta, GA 30333

   College of American Pathologists
   7400 N. Skokie Blvd.
   Skokie, IL 60077
   American Association for Bioanalysts
   205 W. Levee Street
   Brownsville, TX 78520

2. Costello, R.J. 1983. U.S. Environmental Protection Agency Triangle Chemical Site, Bridge City, Texas. NIOSH Health Hazard Evaluations Determination Report, HETA 83-417-1357.

3. ANSI. 1984. American National Standard for Respiratory Protection. ANSI Z88.6-1984. American National Standards Institute, 1430 Broadway, New York, NY 10018.

4. Gleit, A; Cohen, A.G.; Chase, K.H.; and J. Toth 1985. Summary Report of the Medical Surveillance Program for the Binghamton State Office Building Decontamination Project. Prepared for Versar New York, Inc.

APPENDIX C
HAZARDOUS MATERIALS INCIDENT
FIRST-ON-SCENE CHECKLIST
(EXAMPLE)

1. Report the incident as a possible hazmat accident. Give the exact location and request assistance.

2. Stay upwind and upgrade.

3. Isolate the area of non-essential personnel.

4. Avoid contact with liquid or fumes.

5. Eliminate ignition sources (lighted cigarettes, flares, and combustible engines).

6. Rescue the injured only if prudent.

7. Identify materials and determine conditions (spill, fire, leak, solid, liquid, vapor, single or mixed loads, waybills, bills of lading, shipper, owner, manufacturer, and carrier).

REPORT TO DISPATCHER

8. Initiate evacuation, downwind first, if necessary.

REPORT TO DISPATCHER

9. Establish command post location - upwind at a safe distance. Report exact location and give the approach route to dispatcher.

REPORT TO THE NATIONAL RESPONSE CENTER

OIL AND HAZARDOUS MATERIALS SPILLS/RELEASES

l-800-424-8802 (Toll Free Day or Night)

FOR ASSISTANCE:

EPA Regional Authority (Day or Night)

State Department of Natural Resources

State Department of Health and Environment

State Department of Environmental Control

APPENDIX D
U.S. EPA REGIONAL SUPERFUND TRAINING CONTACTS

Sharon L. Molden
US EPA - Region I (PHD-2211)
JFK Federal Building
Boston, MA 02203
(617) 565-3390
(ITS) 835-3390

Peter Ucker
US EPA - Region II
26 Federal Plaza, Room 734
New York, NY 10278
(212) 264-6324
(FTS) 264-6324

Brenda J. Wingate
US EPA - Region III (3HW14)
841 Chestnut Building
Philadelphia, PA 19107
(215) 597-4858
(FTS) 597-4858

Ralph D. Armstrong
US EPA - Region IV (HRMB)
345 Courtland Street, N.E.
Atlanta, GA 30365
(404) 347-3486
(FTS) 257-3486

Steve Ostrodka
US EPA - Region V
230 S. Dearborn Street
Chicago, IL 60604
(312) 886-3011
(FTS) 886-3011

Rosemary Henderson
US EPA - Region VI
First Interstate Bank Tower - 10th Floor
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(214) 655-2277
(FTS) 255-2277

William Keffer
US EPA - Region VII
25 Funston Road
Kansas City, KS 66115
(913) 236-3888
(FTS) 757-3888

Tina Artemis
US EPA - Region VIII (8HWM-ER)
Denver Place, Suite 500
999 18th Street
Denver, CO 80202-2405
(303) 294-7142
(FTS) 564-7142

Carita Hall-Reynolds
US EPA - Region IX (H-8-3)
1235 Mission Street
San Francisco, CA 94103
(415) 744-1914
(FTS) 484-1914

Loretta Hrin
US EPA - Region X (MS-533)
1200 6th Avenue
Seattle, WA 98101
(206) 442-7154
(FTS) 399-7154

APPENDIX E
SELECTED REFERENCES

This appendix lists documents that may prove helpful to anyone planning to establish a Hazmat Team.

REGULATIONS

29 CFR 1910.120, OSHA Final Rule: Hazardous Waste Site Operations and Emergency Response, as printed in the *Federal Register*, March 6, 1989, pp. 9316 - 9330.

STANDARDS

NFPA Standard 471-1989, Recommended Practice for Responding to Hazardous Materials Incidents. Quincy, MA: National Fire Protection Association, 1989.

NFPA Standard 472-1989, Standard for Professional Competence of Responders to Hazardous Materials Incidents. Quincy, MA: National Fire Protection Association, 1989.

Copies of NFPA publications can be obtained by calling l-800-344-3555 or by writing to:

National Fire Protection Association
1 Batterymarch Park
P.O. Box 9101
Quincy, MA 02269

Standard 471 is available for $15.50, Standard 472 for $13.25, and the Handbook (listed under Technical References) for $49.50. Purchased together, the publications cost $66.50.

GUIDANCE

Computer Systems for Chemical Emergency Planning: Chemical Emergency Preparedness and Prevention Technical Assistance Bulletin #5. Washington, DC: EPA, September 1989 (OSWER-89-005).

Hazardous Materials Emergency Planning Guide (NRT-1). Washington, DC: National Response Team, 1987.

Technical Guidance for Hazardous Analysis. Washington, DC: EPA/FEMA/DOT, 1987.

Copies of NRT-1, the Technical Guidance, and Technical Assistance Bulletin #5 may be obtained free of charge by calling the Emergency Planning and Community Right-To-Know Hotline at 1-800-535-0202.

Handbook of Chemical Hazard Analysis Procedures. Washington, DC: FEMA/DOT/EPA.

Copies of this handbook may be obtained by writing to:

Federal Emergency Management Agency
Publications Office
500 C Street, S.W.
Washington, DC 20472

Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities. Washington, DC: NIOSH/OSHA/U.S. Coast Guard/EPA, 1985. (DHHS/NIOSH Pub. No. 85-115).

Standard Operating Safety Guides. EPA, Office of Emergency and Remedial Response, Emergency Response Division, Environmental Response Team, 1988.

TECHNICAL REFERENCES

Hazardous Materials Response Handbook. Quincy, MA: National Fire Protection Association, 1989.

Copies of this Handbook may be obtained by writing to NFPA; the address is listed above under NFPA Standards.

Guidelines for the Selection of Chemical Protective Clothing. Cambridge, MA: AD. Little, 1987.

APPENDIX F
INFORMED SOURCES

Chief Don Brunken
Omaha Fire Department
1516 Jackson Street
Omaha, NE 68102
(402) 444-5760

Capt. Jerry Grey
San Francisco Fire Department
Station #36
109 Oak Street
San Francisco, CA 94102
(415) 8618000, ext. 236

Lt. Bill Hand
Houston Fire Department
1205 Dart
Houston, TX 77007
(713) 923-1334

William Keffer
U.S. EPA, Region VII
25 Funston Road
Kansas City, KS 66115
(913) 236-3888

Larry Knoche
Kansas Department of Health and Environment
Forbes Field, Building 740
Topeka, KS 66620
(913) 296-1500

Ron Kozel
Iowa Department of Natural Resources
Wallace Building
900 East Grand Avenue
Des Moines, IA 50319
(515) 281-8883

Dean Martin
Missouri Department of Natural Resources
Jefferson State Office Building
2010 Missouri Boulevard
Jefferson City, MO 65102
(314) 751-7929

Asst. Chief Mary Beth Michos
Emergency Medical and Technical Services
Department of Fire and Rescue
101 Monroe Street
Rockville, MD 20850
(301) 217-2099

Bat. Chief Larry Mullekin
Wichita Fire Department
455 N. Main
Wichita, KS 67202
(316) 683-7216

Lt. Jeff Rylee
Salt Lake City Fire Department
159 E. 100 Street
Salt Lake City, UT 84111
(801) 799-4217

Vickie Santoro
U.S. EPA/ERT (MS-101)
2890 Woodbridge Avenue
Building 18
Edison, NJ 08837-3679
(201) 906-6917

Clark Smith
Nebraska Dept. of Environmental Control
Box 98922
301 Centennial Mall South
Lincoln, NE 68509
(402) 471-2186

Lt. Bill Stringfield
St. Petersburg Fire Department
1429 Arlington Avenue North
St. Petersburg, FL 33705
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