Unit I
Hazardous Materials: An Overview of the Problem

At the end of this unit, the student will be able to:

- Define hazardous materials and the Department of Transportation categories and classifications.
- Describe five ways hazardous materials are present in the community, and five modes of hazardous materials transportation.
- Describe three situations where hazardous materials created harm when released from their containers.
- Define a hazardous material incident/emergency.
- Define "outcome" as it relates to an emergency.

UNIT I—HAZARDOUS MATERIALS: AN OVERVIEW OF THE PROBLEM

TIME REQUIRED FOR THIS UNIT: *90 minutes*

METHODOLOGY OUTLINE:

Step 1.	Introductions	40 minutes
Step 2.	Interactive Discussion Definition of Hazardous Materials Introduce Unit Content	10 minutes
Step 3.	Slide Tape Presentation HM Categories and Classifications HM Locations HM Incidents	15 minutes
Step 4.	Interactive Lecture The Hazardous Material Emergency Outcomes of Hazardous Materials Emergencies	20 minutes
Step 5.	Summary	5 minutes

INSTRUCTIONAL MATERIALS

1. Slides 1–5 (Step 2)
2. Slide Tape 1, "Hazardous Materials—An Overview of the Problem" (Step 3)
3. Slides 124–130 (Step 4)

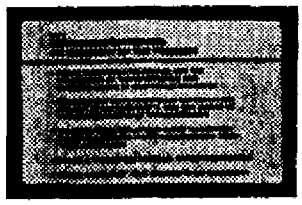
TIME	CONTENT/METHODOLOGY	MATERIALS

40 min.	**STEP 1**—Introductions
	• Welcome participants.
	• Introduce Instructor(s).
	• Give locations of restrooms, snack/lunch areas, etc.
	• Complete any necessary paperwork, course logistics, etc.
	• Briefly describe the purpose of this course.
	  • To teach you how to predict what is likely to happen with hazardous materials—*before* you act.
	  • This course emphasizes how to analyze the emergency in order to *define the emergency problem*—not how to solve the problem.
	• Ask participants to stand up and introduce themselves, and briefly describe their reasons for taking this course.	

10 min.	**STEP 2**—Interactive Discussion— Definition of hazardous materials • *Discuss the definition of hazardous materials.* Ask students to turn to the question on hazardous materials on page I-3 of the Student Manual. Read the question to the students: **What does the concept of hazardous materials mean to you?** In other words, if someone asked you to define hazardous materials, how would you do it? Let the students respond by writing their thoughts in the appropriate space on the question sheet. Allow 2 minutes. After the students have had a chance to jot down their	Slide 1 Slide 2 SM I-3 Slide 3

Slide 1

Slide 2



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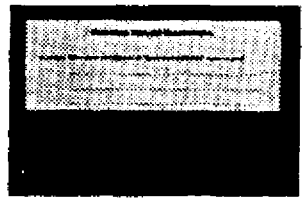
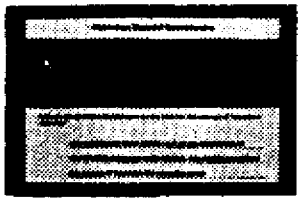


TIME	CONTENT/METHODOLOGY	MATERIALS
	answers, ask for an answer from the group. In order to prepare the students for the course definition to be presented, point out the following elements as the students bring them up. These elements include:	
	• **Any substance.** • **Once out of the container.** • **Gets out of the container when something goes wrong.** • **Can hurt or harm the things it touches or impinges upon (people, systems, including the environment and property).** • *Present course definition.*	
	While several definitions are valid, make the point that, for the purpose of this course, the preferred definition is:	Slide 4
	Any substance that jumps out of its container at you when something goes wrong and hurts or harms the things it touches or impinges upon. Have the students write this definition in the appropriate space on page I-3 of the Student Manual.	Slide 5 (Blank)
	STEP 3—Slide Tape Presentation— Hazardous Materials—An Overview of the Problem	
15 min.	• *Introduce the Slide Tape Presentation.*	
	This slide tape presents a general overview of hazardous materials and the problems these materials present. It is introductory in tone, and describes the various categories, classifications and uses of hazardous materials. It introduces some of the dangers hazardous materials pose in emergencies. It also indicates where hazardous materials might be found in the community.	
	Ask the students to note the chart on page I-4 of the Student Manual as a reference for the categories, classifications, examples, and general characteristics of hazardous materials. Definitions are listed on Student Manual pages I-6 to I-8.	SM I-5 SM I-6–I-8

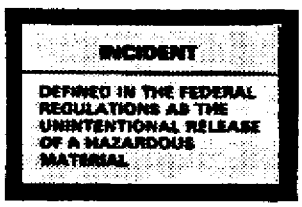
Slide 4



Slide 5

TIME	CONTENT/METHODOLOGY	MATERIALS
	• **Present the Slide Tape.**	
	Be sure that slide #6 is showing, and that the cassette is properly rewound before starting the slide tape.	Slides 6–123
	NOTE: If this slide/tape is in two carousel trays, slides 6–75 should be in the first tray, and slides 76–123 should be in the second tray. Instructor should manually stop the tape when slide 75 (blank) is showing.	
	— Change carousel tray to show the second half of the slide. DO NOT MOVE OR ADJUST THE TAPE IN ANY WAY. Any adjustments will affect sychronization. — Be sure Slide 76 is showing, and that the tape has not been moved. — Ask the students if they have any questions. — Introduce next segment of slide tape. — Start tape.	
	STEP 4—Interactive Lecture with Slides— The Hazardous Material Emergency	
20 min.	• *Define "incident" and "emergency."*	SM I-3
	Incident—Defined in the federal regulations as the unintentional release of a hazardous material.	Slide 124
	Emergency—A sudden, generally unexpected occurrence demanding immediate action.	Slide 125
	• *Introduce Hazardous Material Behavior Model.*	Slide 126
	From past experiences, it is noted that an emergency (specifically a hazardous material emergency) may go through **several steps in a basic sequence of events.**	SM & IG A-1
	These events are:	
	• **Stress (for an emergency to begin, the containment system must be stressed in some way)**	
	• **Breach (if the containment system is stressed beyond its capacity, a breach will occur)**	

Slide 124



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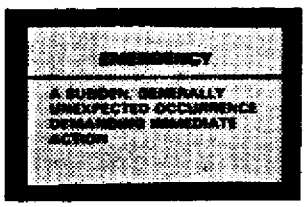
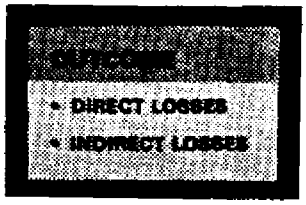


Slide 126

TIME	CONTENT/METHODOLOGY	MATERIALS
	• **Release (when the containment systems breaches, the contents may be released)**	
	• **Engulf (released matter and energy disperse from the point of release and engulf the surrounding areas)**	
	• **Impinge (as the hazardous material and/or container disperse from the point of release, they may touch or impinge upon vulnerable exposures)**	
	• **Harm (the impinged exposures may be harmed)**	
	• *Introduce the concept of outcomes in a hazardous material emergency.*	
	For the purpose of this course, this potential harm at the end of a hazardous material emergency will be called the "**outcome**" of that emergency.	
	The outcome of an emergency (any emergency) is the state or condition (impact) at the end of that emergency.	Slide 127
	Outcome includes both direct losses and indirect losses.	
	Direct losses include fatalities, injuries, property and environmental losses.	Slide 128
	Indirect losses refer to system disruption, damaged reputations and residual fear of hazardous materials.	Slide 129
	Unfavorable outcomes or the potential of **unfavorable outcomes** stir us to become involved with these emergencies.	

Slide 127



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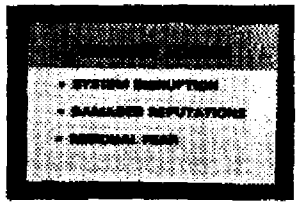


TIME	CONTENT/METHODOLOGY	MATERIALS
5 min.	**STEP 5**— Summary	
	• *Review the unit.*	
	Hazardous materials are substances that **jump out of the container** at you when something goes wrong.	
	Hazardous materials take many forms and represent a **wide variety of products**.	
	Hazardous materials are found just about **everywhere.**	
	Hazardous materials have the **potential for creating a great deal of harm** when released from their container.	
	The results of the hazardous material release is known as **outcome**.	Slide 130
	Any questions?	(Blank)

Slide 130

HAZARDOUS MATERIALS: AN OVERVIEW OF THE PROBLEM
Slide/Tape Script

Slide 6

While it may not be apparent, materials classed as hazardous play a vital role in our lives—helping to make them better in various ways:

Slide 7

The food we eat, the clothes we wear, and the furniture in our homes are all produced with the help of hazardous materials.

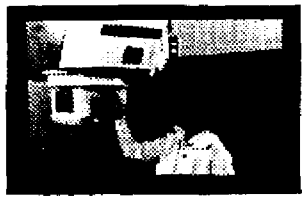
Slide 8

Fuels power our cars and trucks and heat our homes.

Slide 9

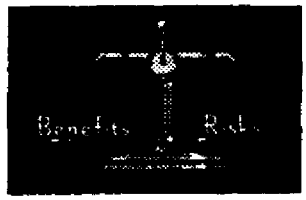
Pesticides fight pests and improve crop yields.

Slide 10



Certain hazardous materials control disease, while some are used in medical treatment programs.

Slide 11



Unfortunately, these benefits aren't free, there is risk associated with them. This risk comes from the likely harm associated with the release of hazardous materials.

Slide 12

With some materials, we don't even fully understand their long-term health and environmental effects (chronic effects).

Slide 13

Let's look at the realm of hazardous materials to get a feel for this risk. We will define hazardous materials and discuss where hazardous materials are found in your community and review past emergencies involving these materials.

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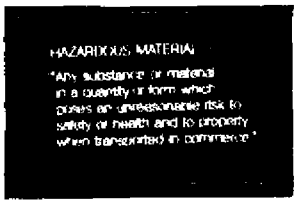
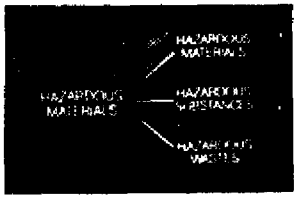


The actual number of hazardous materials varies with each reference used. Congress identifies 2,400 hazardous materials under their defintion. This definition reads, "any substance or material in a quantity or form which poses an unreasonable risk to safety or health and to property when transported in commerce."

Slide 15



The recent additions of hazardous wastes and hazardous substances has increased the list of hazardous materials considerably.

Slide 16

When hazardous wastes and substances are spilled, they present both acute and chronic environmental concerns—concerns for water, atmosphere, and ground contamination.

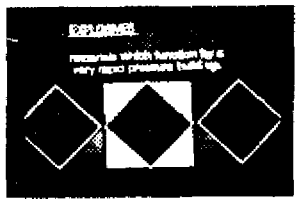
Slide 17

Hazardous materials can be classified in any number of ways. Let's look at some of the dangers and characteristics of hazardous materials as highlighted by the Department of Transportation (DOT) classification system.

Slide 18

While many hazardous materials exhibit multiple dangers in the DOT classification system, they are generally classified by their primary hazard.

Slide 19

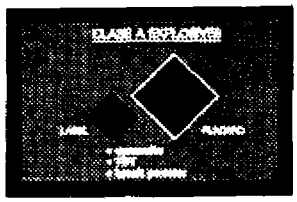


Explosives are defined as "compounds, mixtures, or devices designed to function with substantially instantaneous releases of gas and heat."

Slide 20

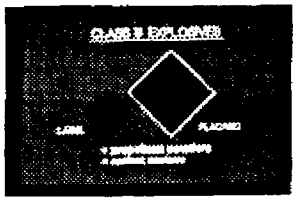
Explosives are often sensitive to heat or shock. They may also be activated by reaction with corrosive materials.

Slide 21



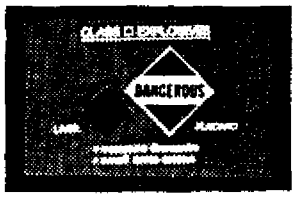
Class A explosives are of detonating or otherwise maximum danger. These detonations are characterized by the instantaneous release of pressure buildup and projecting of shrapnel. Dynamite and nitroglycerine are examples.

Slide 22



Class B explosives function by rapid burning, called deflagration, rather than detonation. A solid fuel rocket motor is an example.

Slide 23



Class C explosives are manufactured articles that contain small quantities of a *Class A* or *Class B* explosive. The principal hazard is fire. Small arms ammunition is an example.

Slide 24

Blasting agent is a material intended to function by detonation, but is so insensitive that there is very little probability of accidental explosion. Examples of blasting agents include ammonium nitrate-fuel oil mixtures and nitro carbonitrates.

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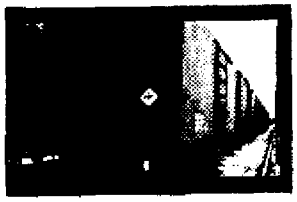


Rail shipments and explosives are generally military ordnance and are often in wooden boxes shipped in box cars.

Slide 26

For commercial products, fiberboard boxes are used.

Slide 27

"Compressed gases" are materials in the container under a pressure exceeding 40 psia at 70°F or a pressure exceeding 104 psia at 130°F. For liquid flammable materials, the test for vapor pressure exceeding 40 psia is made at 100°F.

Slide 28

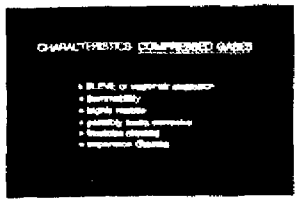
Compressed gases can be in a liquified or a nonliquified form.

Tank cars carry compressed gases in the liquid form. Gases are liquified by either pressure or extreme cooling—as in cryogenics.

Slide 29

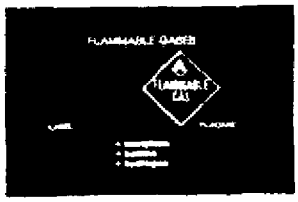
Cylinders generally contain nonliquified gases at high pressures.

Slide 30



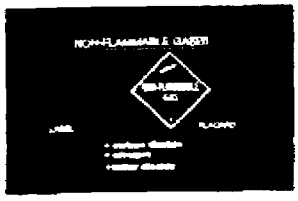
Compressed gases may pose the danger of a violent rupture in an accident. Vapor can travel great distances. Vapors ignite. Vapors may be toxic and or corrosive. Liquids released from compressed gas tanks may be very cold and could cause frostbite. Liquified gases can expand many hundreds of times beyond the size of their containers.

Slide 31



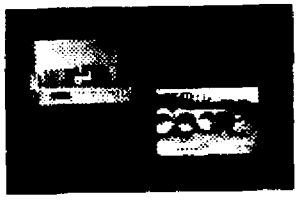
Flammable compressed gases can ignite and burn readily.

Slide 32



Nonflammable gases often are toxic and generally will not burn, but, like oxygen (a nonflammable gas), may support the combustion of other materials.

Slide 33



Common packages for compressed gases include the:

Slide 34

Cylinder or ton container, and
Pressurized tank truck or pressurized rail tank car.

Slide 35

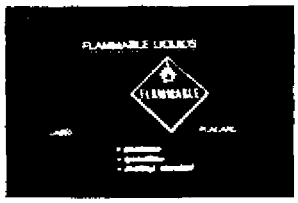
Large stationary spheres are found as storage containers for compressed gases.

Slide 36

FLAMMABLE AND COMBUSTIBLE LIQUIDS

This category includes liquids that give off ignitable vapors at temperatures of 200°F or less It is divided into two groups

Slide 37



Flammable liquids have a closed cup flash point below 100°F. They are capable of producing flammable vapors at normal ambient temperatures. Examples are acetone, gasoline, and methyl alcohol.

Slide 38

Pyrophoric liquids can spontaneously ignite in the air at or below 130°F. An example is aluminum alkyls.

Slide 39

Combustible liquids have flash points between 100 and 200°F. Examples are fuel oil and kerosene

Slide 40

Flammable and combustible liquids are generally found in nonpressurized containers, including metal cans, 55-gallon metal drums,

Slide 41

Tank trucks and rail tank cars

Slide 42

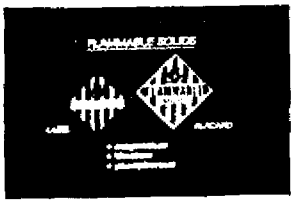
Note the oval tank profile and the more squared ends of this tank truck in contrast with the rounded ends of pressure *tanks*

Slide 43

FLAMMABLE SOLIDS

Flammable solids are solid materials, other than explosives, that are likely to cause fires by self-ignition, retained heat from manufacturing or processing, or through spontaneous chemical changes When ignited, these materials burn so vigorously and persistently that they create a serious transportation hazard

Slide 44



Examples are magnesium, titanium, and phosphorus.

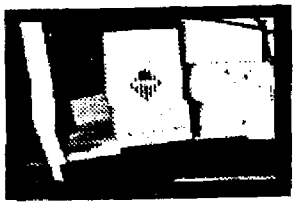
Slide 45

Water-reactive, flammable solids are those that will become spontaneously combustible or will generate flammable gas or toxic gas in dangerous quantities—if they come into contact with water. An example is calcium carbide.

Slide 46

Spontaneously combustible material—can heat or self-ignite under conditions normally found in transportation. Wet charcoal is a good example, as are phosphorus, potassium, and sodium.

Slide 47



Containers for flammable solids include fiberboard boxes or metal drums,

Slide 48

Water-tight, sift-proof containers like these containers of calcium carbide—a flammable solid which is water reactive;

Slide 49

and rail tank cars and box cars.

Slide 50

OXIDIZERS

Oxidizers yield oxygen readily to stimulate combustion.

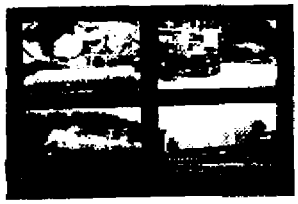
Slide 51

Some are highly sensitive to heat, shock, or friction; some react to organic materials; some release heat readily; and some are toxic. Ammonium nitrate fertilizer and lithium peroxide are examples.

Slide 52

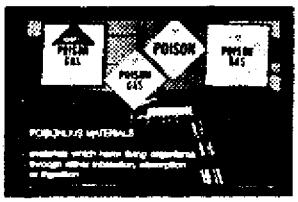
Organic peroxides are unstable and highly sensitive to heat. They can also be sensitive to friction or shock. They can detonate if heated beyond normal transportation temperatures. Examples include benzoyl peroxide and peracetic acid.

Slide 53



Containers for the oxidizer category include bags, fiberboard or metal drums, highway vehicles, tank cars, and hopper cars.

Slide 54



POISONS

Poisons are materials that can harm living organisms—specifically people, but also animals and plants—through inhalation (breathing), absorption through the skin, or by ingestion (eating). There are several classes of poisons.

Slide 55

Poisons A—Are poisonous gases or liquids of such a nature that a very small amount of the gas or vapor of the liquid, mixed with air, is dangerous to life. An example is hydrocyanic acid or phosgene.

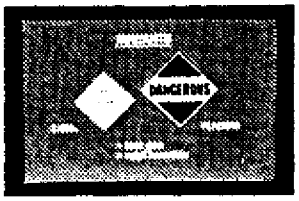
Slide 56

Poisons B—Are substances, liquids, or solids known to be so toxic to humans as to afford a threat to health during transportation. Examples include aniline, arsenic, and methyl bromide.

Slide 57

Etiologic agents are germs or toxins that may cause disease in humans. Examples would be anthrax, botulism, polio, rabies, and tetanus.

Slide 58



Irritants will cause discomfort, but usually not death. Tear gas and xylyl bromide are examples.

Slide 59

Packages for poisons include a wide range of small,

Slide 60

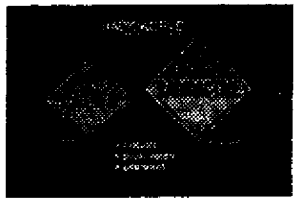
and bulk packages, like tank cars.

Slide 61

RADIOACTIVE MATERIALS

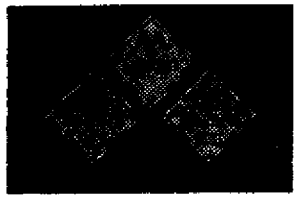
Radioactive materials continuously give off ionizing radiation.

Slide 62



Radioactive materials, such as uranium hexafloride, uranium metal, and plutonium nitrate solution, give off alpha and beta particles and/or gamma radiation. Some radioactive materials are also corrosive; some are oxidizers.

Slide 63



Radioactive materials are further classified and labeled based on the amount of radiation in a package.

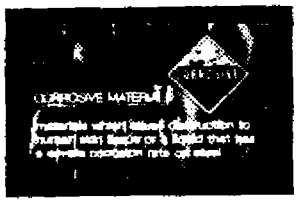
Slide 64

Radioactive materials are most commonly small packages of radiopharmaceuticals.

Slide 65

Rail shipments include lead-shielded casks on special rail cars and small shipments in piggy-back trailers.

Slide 66



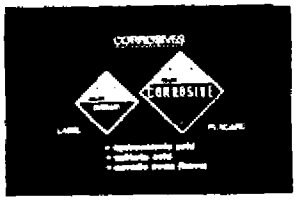
CORROSIVES

Corrosive materials cause destruction to human skin tissue.

Slide 67

Some corrosives fume. That is, they emit toxic or irritating vapors when released from their package. If a fuming corrosive is spilled, you must find out how it reacts with water. Some fuming products may be diluted with water to stop fuming, but other fuming corrosives will react violently with water and release even greater quantities of vapor.

Slide 68



Examples are hydrochloric acid, sulfuric acid, and caustic soda.

Slide 69

Packages for corrosives include plastic carboys, metal kegs,

Slide 70

tank trucks,

Slide 71

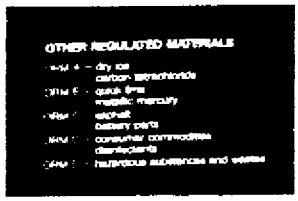
and tank cars.

Slide 72

OTHER REGULATED MATERIALS

Other Regulated Materials, also known as ORMs, require appropriate packaging and handling under certain conditions.

Slide 73



ORM A materials have anesthetic, irritating, noxious, toxic, or other properties that provide extreme annoyance or discomfort to passengers or crew in the event of leakage.

ORM B materials are capable of causing significant damage to an airplane from leakage during transportation. They are corrosive to aluminum only.

ORM C materials have characteristics that make it unsuitable for shipment unless properly identified.

ORM D are consumer commodities that present a limited hazard during transportation.

ORM E are certain hazardous substances and wastes.

Slide 74

Packages include bags, metal cans, and glass jars.

Slide 75

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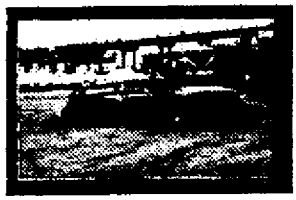
Slide 76

Since hazardous materials are found just about everywhere, the possibility of an accident is always with us;

Slide 77

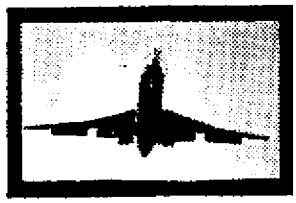


and with these materials, a single accident can have serious consequences.

Slide 78

In Laurel, Mississippi, a train derailment caused the loss of LP gas from 14 tank cars. The fires and explosions that occurred killed two people, injured hundreds, destroyed 60 homes, and caused the evacuation of more than 1,000 persons in the area.

Slide 79



An air transportation incident at National Airport in Washington, D.C., involved a leaking container of viral hepatitis, an etiologic agent. Release of the contents could have had a major impact on the people in the metropolitan Washington area.

Slide 80

In La Grange, Missouri, a flaming vessel carrying 840,000 gallons of gasoline ripped from its moorings after a series of explosions at an oil terminal and drifted into a railway bridge down river at Quincy, Illinois, killing six.

Slide 81

In Ruff Creek, Pennsylvania, a pipeline rupture released 75,000 gallons of propane, killing two people.

Slide 82

A truck driver in Marshalls Creek, Pennsylvania, noticed a tire fire on his vehicle, removed the placards, and then notified the fire department. Upon their arrival, firefighters could not find the driver or see any indication of the vehicle's contents. While attempting to extinguish the fire, the contents—thirteen tons of blasting agent—exploded, killing six firefighters and destroying their apparatus.

Slide 83

A crossing accident in California injured four railroad personnel when the train hit the rear of a double-bottom trailer containing methyl bromide, a poisonous liquid, which was released.

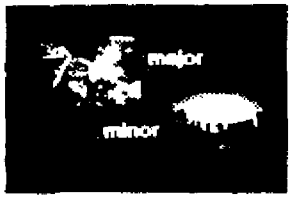
Slide 84

This incident involved a 1,900-gallon tank truck of LP gas that was ignited. The emergency personnel responding applied water to the tank for 45 minutes until their tanker operation was interrupted causing them to pull back.

Slide 85

The tank never exploded. The action of the emergency response personnel in securing the area and pulling back the emergency personnel was correct, as it would have averted a major catastrophe and loss of life had the tank exploded.

Slide 86



Not all hazardous materials emergencies become major incidents. The leakage of liquified petroleum gas (a flammable gas) through a nipple connected to the unloading valve on this rail car at an unloading rack was considered minor.

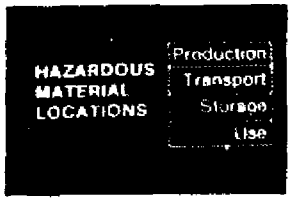
Slide 87

In a rail yard, a splash of sulphuric acid, a corrosive material, from a failed rupture disk on the safety vent of this tank car injured a railroad employee.

Slide 88

Hazardous materials incidents can occur in the home too. The occupant of this apartment was laying kitchen tile using a flammable mastic. The vapors of the mastic were ignited by a cigarette, causing the entire apartment to burst into flames.

Slide 89



As we previously mentioned, hazardous materials play a vital part in the lives of nearly all Americans. Few of us can go through a day without coming into contact in some way; with these materials.

Slide 90

Manufacturing plants throughout the country produce large quantities of hazardous materials.

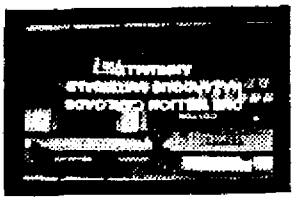
Slide 91

Both raw materials and finished products may be hazardous and are often stored at production sites.

Slide 92

Hazardous materials are transported throughout the country by rail, highway, air, water, and pipeline.

Slide 93



Because of their ability to safely transport large quantities at a time, railroads are major carriers of hazardous materials.

Slide 94

Railroads are located in cities, towns, and

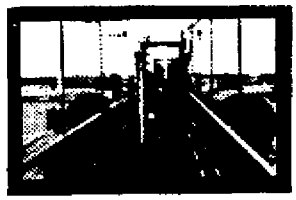
Slide 95

rural areas. The three types of facilities:
railroad rights-of-way,

Slide 96

classification yards, and

Slide 97



loading and unloading areas, present different types of risk.

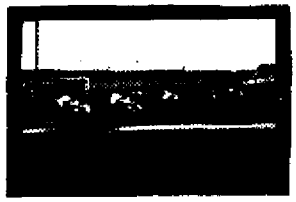
Slide 98

More than a billion tons of hazardous materials are transported annually by highway, including a million tons of explosives, 300,000 tons of poisons, and 100,000 shipments of radioactive isotopes.

Slide 99

Because highways are everywhere, the possibility of a hazardous materials accident is everywhere. In addition to the highways, also consider the

Slide 100



truck terminal facilities and bulk loading and unloading points.

Slide 101

In air transportation, hazardous materials are found aboard cargo aircraft and passenger planes. Hazardous materials are

Slide 102

found at airport freight terminals and on highways to and from airports.

Slide 103

In water transportation, many shipments of hazardous materials are found at major seaports and

Slide 104

along the major rivers of the nation. For potential hazardous materials locations, you must consider the actual transportation routes

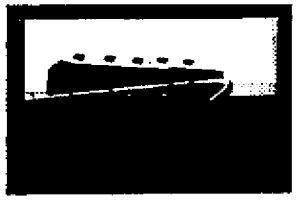
Slide 105

and the bulk terminals and warehousing facilities.

Slide 106

Pipelines crisscross the country carrying gases and liquids.

Slide 107



The potential locations include the pipeline, the pumping stations, and other facilities found along the pipeline, as well as underground lines leading into offices and homes.

Slide 108

Storage of the hazardous materials occurs before and after they are transported to the general area of use.

Slide 109

Storage facilities for hazardous materials are scattered throughout the community. For example, LP gas storage is prominent where the gas is being used for heat and industrial processes.

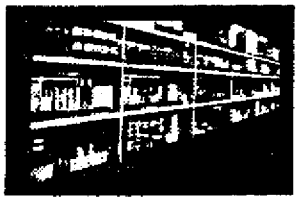
Slide 110

Local service stations store petroleum products in large quantities.

Slide 111

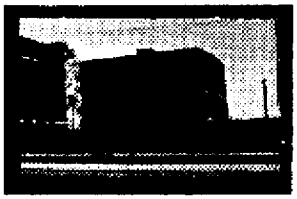
Hospitals store radioactive materials, compressed gases, and cryogenics.

Slide 112



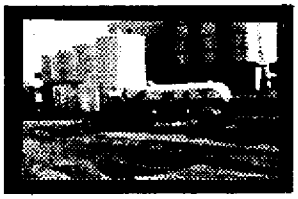
Local chemical distributors store corrosives, oxidizers, poisons, flammable liquids, and flammable gases.

Slide 113



Bonded warehouses and retail stores contain alcohol for human consumption.

Slide 114

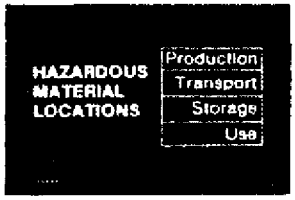


Agricultural chemical dealers store anhydrous ammonia and a variety of pesticides, oxidizers, corrosives, and poisons.

Slide 115

Petroleum tanks are found in many communities.

Slide 116



Hazardous materials may be found in places not normally associated with their special dangers.

Your home is no exception.

Slide 117

Look at your garage, kitchen, or cleaning closet when you get home. That one-gallon can of gasoline is flammable and has the potential to do quite a bit of damage if not handled properly.

Slide 118

Local emergency response personnel should be able to add to this list of hazardous materials locations because of their knowledge of them in the community. Pre-emergency planning and inspections are important.

Slide 119

Emergency response personnel must take the initiative. They must go out into the community.

Slide 120

Identify production, storage, and use sites for hazardous materials.

Slide 121

Identify transportation routes and the commodities moving over these routes. Then determine the resources required to handle reasonably likely problems.

Slide 122

Participation in the contingency planning process and inspections can reduce property damage and save lives.

Slide 123

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Unit II
Why This Course?

At the end of this unit, the student will be able to:

- Name at least five potentially dangerous assumptions about hazardous materials.
- Specify ways hazardous materials emergencies are different.
- Give reasons why it is important to "define your hazardous material problem" before getting directly involved in an emergency.
- Explain course goals, objectives, scope and limitations.
- Explain the purpose of an emergency response effort.

UNIT II—WHY THIS COURSE?

TOTAL TIME REQUIRED FOR THIS UNIT: *90 minutes*

METHODOLOGY OUTLINE:

Step 1.	Individualized Activity Pretest	10 minutes
Step 2.	Interactive Slide Tape Presentation Incident 1 Comparison Matrix	30 minutes
Step 3.	Interactive Discussion Mission and Purpose Discussion	25 minutes
Step 4.	Lecture Course Goals, Objectives, Scope, and Limitations	25 minutes

INSTRUCTIONAL MATERIALS

1. Slides 131 & 132 (Step 1)
2. Slides 133–154 (Step 2 slide tape presentation, Incident 1)
3. Slide 155 (Step 2—Comparison Matrix)
4. Slides 156–160 (Step 3)

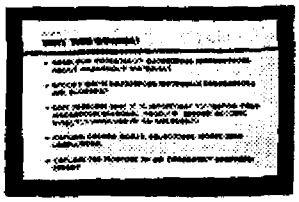
REFERENCES

Pretest: King, James B., "How To Face A Hazardous Material Emergency," *Firehouse*, September 1978.

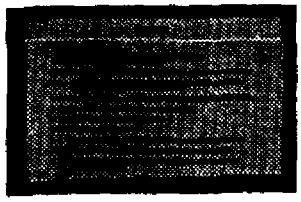
Incident I: National Transportation Safety Board Special Investigation Report—Phosphorus Trichloride release in Boston and Maine Yard 8 during switching operations—Somerville, Massachusetts, April 3, 1980, NTSB-HZM-81-1.

TIME	CONTENT/METHODOLOGY	MATERIALS
10 min.	**STEP 1**—Individualized Activity—Pretest	Slide 131
	• *Introduce Pretest.*	Student Manual p. II-3
	Instructions to students:	
	Turn to page II-3 in your Student Manual. You will find the Pretest form. To complete this pretest, listen as I read the statements printed on the form.	Slide 132
	If you agree, circle the "A" (for agree) to the left of the statement. **If you disagree, circle the "D"** (for disagree) to the left of the statement.	
	• *Read Pretest statements one time each.*	
	Read each statement once, pausing after each statement briefly (1–2 seconds) so that students can record their response.	
	1. **A plan will get me ready for any hazarodus material emergency.**	
	2. **As an emergency responder, I must do something about a hazardous material emergency.**	
	3. **I know when to call for help in a hazardous material emergency.**	
	4. **All I have to do to get help is to call CHEMTREC.**	
	5. **I can count on railroads for help.**	
	6. **I must extinguish any fires.**	
	7. **If I can get water on the container, it will control the hazard.**	
	8. **I know what hazardous materials will do in an emergency.**	
	9. **Department of Transportation placards will give me all the information I need.**	

Slide 131



Slide 132



TIME	CONTENT/METHODOLOGY	MATERIALS

CAUTION: **You will be setting the tone of the course during any discussion of the pretest.** The nature of this course requires the students to have an open mind on the subject of hazardous materials. These statements and the answers to them are someone's opinion and others may differ. Therefore, avoid arguing, threatening, or embarassing anyone during any discussion of the pretest, otherwise you might undermine your effectiveness.

Keep in mind that we are not looking for right or wrong answers—we want the student to think about his/her values and make a response. *We are trying to get the student to start thinking!*

Ask the students to raise their hands in answer to the following questions:

How many of you agreed with any of the statements?

Pause for students to raise their hands. Indicate relative numbers to the class.

How many of you agreed with all of the statements?

Pause for students to raise their hands. Indicate relative numbers to the class.

How many of you disagreed with all the statements?

Pause for students to raise their hands. Indicate relative numbers to the class.

Generally the answers should have been disagree.

Explain the background and origin of the pretest.

PRETEST BACKGROUND

MISCONCEPTIONS FOUND IN THE ANALYSIS OF HAZARDOUS MATERIAL EMERGENCIES (MISCONCEPTIONS OF THE PERSONS HANDLING THE EMERGENCY).

ARTICLE WRITTEN BY JAMES B. KING, PAST CHAIRMAN OF THE NATIONAL TRANSPORTATION SAFETY BOARD FOR FIREHOUSE MAGAZINE; BASED ON INVESTIGATIONS OF ACCIDENTS IN WHICH EMERGENCY RESPONSE PERSONNEL WERE HARMED (written in 1978).

- *Discussion points for pretest—use only if questions arise:*

1. **A plan will get me ready for any hazardous material emergency.**

   Comments: Hazardous material emergencies are so varied that it is impossible to plan for every specific contingency. Does the plan consider the magnitude of the problems created by hazardous materials? How do you know the plan is based on the right approaches, analysis, and information?

2. **As an emergency response person, I must do something about a hazardous material emergency.**

   Comments: There are many hazardous material emergencies in which it is best to do nothing but let the emergency run its natural cycle. Must you do something about the hazardous material even if you can't get the fire out or if all the harm has been done by the time you get there?

3. **I know when to call for help in a hazardous material emergency.**

   Comments: Hazardous material emergencies are difficult to read, and it is often difficult to know when help will be needed. With more than 2,400 materials just classified by DOT, and sizes of shipments or storage ranging from ounces to tons, how can you expect to know the risks posed by all of them?

4. **All I have to do to get help is call CHEMTREC.**

   Comments: CHEMTREC can only give limited assistance and information. Emergency response personnel on the scene have the responsibility to know and use all the resources available, which are much more than CHEMTREC. CHEMTREC answers the phone with communicators, not hazardous material experts, but they can get experts involved. Do you have time to wait for them to come, or wait if the expert isn't in or doesn't answer the phone when CHEMTREC calls?

5. **I can count on railroads for advice.**

   Comments: Obviously, you must not count solely on any single outside source for help. Can you always contact the needed railroad personnel when you need them? When does the Bureau of Explosives respond? (When the railroad calls them!)

TIME	CONTENT/METHODOLOGY	MATERIALS

6. **I must extinguish the fire.**

   Comments: In many kinds of hazardous material emergencies, extinguishing the fire is exactly the wrong choice of strategy. Where will unignited vapors or gases go after the fire is out and the release has not been controlled?

   With some products, water will increase the danger in the affected area.

7. **If I get water on the container, it will control the hazard.**

   Comments: Many hazardous materials are water reactive. Also, many emergencies are beyond the stage where cooling will help. Should water be used at all? How much water do you need to offset the BTU production from a large spill fire? Can you get water where it will cool the ENTIRE tank?

8. **I know what hazardous materials will do in a derailment.**

   Comments: Derailments are completely unpredictable, depending on the material involved, conditions of the container, fire impingement, etc. How many of us really understand hazardous material behavior? With more than 33,000 chemicals in commerce and up to 180,000 names, how do we know which ones are dangerous?

9. **Department of Transportation placards will give me all the information I need.**

   Comments: DOT placards only provide limited identification of class, or only partial hazard characteristics. Do you know that not only "explosives" but five other DOT classes have detonated in emergencies?

STEP 2—Interactive Slide Tape Presentation—

30 min. Incident 1

- *Introduce Incident 1.*

  Student Manual p. II-4

  At the conclusion of the pretest discussion, instruct the students to turn to page II-4 in their Student Manuals.

  Indicate that you are going to present an exercise. During this presentation, students will be asked to react to the information presented.

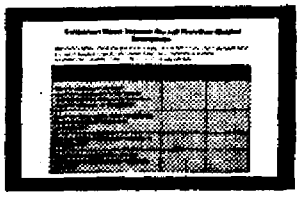
  For information, a copy of one of the DOT Emergency Action Guides is reprinted in the Student Manual page II-4 for your reference.

  At pauses in the presentation, students can discuss the points made or questions asked.

TIME	CONTENT/METHODOLOGY	MATERIALS
	• **Show Slide Tape 2: "Incident 1."** **Ensure that Slide 129 is showing and that the tape is fully rewound.**	Slides 133 to 154
	• *Discuss any questions which might arise concerning Incident 1.* Indicate that further information on the incident is available from the National Transportation Safety Board (Special Investigation Report—NTSB-HZM-81-1 and NTSB-HZM-MAP-81-1). Try to keep any discussion short and keep it in line with the decisionmaking aspects of handling hazardous material emergencies.	
	• *Discuss why the students' ability to predict fire behavior is different than their ability to predict hazardous materials behavior.* Ask the students the following question: **Is your ability to predict fire behavior different than your ability to predict hazardous material behavior? If so, why?** Allow a short discussion.	
	Use the **Comparison Matrix** to show the difference between an emergency involving a structural fire and one involving hazardous materials. Ask students to turn to page II-5 in their Student Manual. Have students answer the questions on the matrix by putting a "yes," "no," or "?" in the eight blocks, keeping in mind their experience with Incident 1 and their experience as firefighters. Their answers will probably be mostly "yes" in the first column under structural fire, and either "no" or "?" in the HM emergency column. All "no" answers in the second column (HM column) provide the Instructor with a basis for concluding that the course is needed. **In summary**, students probably don't understand the behavior of hazardous materials, they haven't been taught skills for applying this behavior, they don't reinforce these skills regularly, and they don't feel confident to define the problem in a hazardous material emergency.	Student Manual p. II-5 Slide 155

TIME	CONTENT/METHODOLOGY	MATERIALS
25 min.	**STEP 3**— Individualized Activity— Mission and Purpose	
	• *Discuss the mission of the students' organizations.*	
	Have the students turn to page II-6 of the Student Manual. Read the first question to the students.	Student Manual p. II-6
	What is the mission of your organization?	Slide 156
	Let the students answer by writing their thoughts in the space provided on the questionnaire. Discuss the answer and try to form a consensus, if you can. Let some of the students read their answers. Try to bring out the following points from the students' answers:	
	• **Protect life and property.** • **Do the above safely.**	
	• *Discuss how the student's organizations accomplish that mission.*	
	Read Question 2 to the students.	
	How does your organization accomplish that mission?	Slide 157
	Let the students answer by writing their thoughts in the space provided on the questionnaire sheet. Discuss the answer and try to form a consensus, if you can. Let some of the students read their answers. Try to bring out the following points from the students' answers:	
	Prevention activities—to stop emergency from happening.	
	Preparedness activities—to get ready for the eventual emergency.	
	Response activities—actual handling of the emergency.	
	Recovery activities—getting your act back together after the emergency.	

Slide 155



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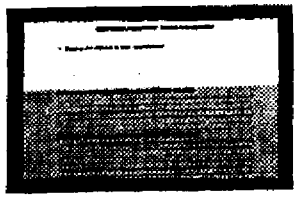
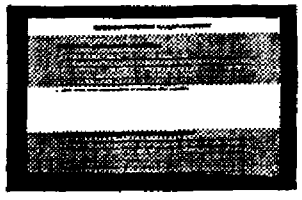
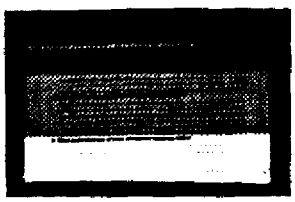


Slide 157

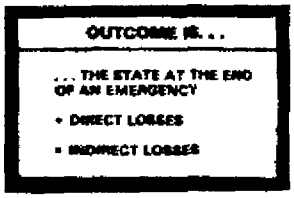


TIME	CONTENT/METHODOLOGY	MATERIALS
	• *Discuss the purpose of an emergency response effort.*	
	What is the purpose of your emergency response effort?	Slide 158
	Let the students answer by writing their thoughts in the space provided on the questionnaire sheet.	
	Discuss the answer and try to form a consensus, if you can. Let some of the students read their answers.	
	Try to bring out the following points from the students' answers:	
	Benner's answer: The purpose of an emergency response effort is to change the sequence of events in an emergency before that emergency has had a chance to run its course naturally, and to favorably change or influence the outcome.	
	Our objective: To come up with a more favorable outcome.	
	• *Discuss what is meant by outcome in an emergency:*	
	Definition (see OUTCOME in Glossary):	Slide 159
	An outcome is the state at the end of an emergency, including:	
	• **Direct losses**—fatalities, injuries, property, and environmental damage.	
	• **Indirect losses**—system disruption, damaged reputations, residual fear of hazardous materials.	
		Slide 160 (Blank)

Slide 158



Slide 159



Slide 160

TIME	CONTENT/METHODOLOGY	MATERIALS
25 min.	STEP 4— Interactive Lecture— Course Goals, Objectives, Scope, and Limitations	Sample Introductory Comments IG II-11

- *Explain the reasons why studying hazardous materials is important for emergency response personnel.*
  - **They are first on the scene of emergencies.**
  - **Everyone expects them to handle emergencies during the first critical minutes.**
  - **Emergencies can happen in any community at any time.**
  - **Their regular training is not always suitable for hazardous material emergencies.**
- *Comment briefly on the goals of the course.*

How do you know you are going to make a difference before you act in a hazardous material emergency?

As stated in the beginning, the **purpose of this course** is to teach you how to predict what is likely to happen with hazardous materials, before you act.

A problem properly defined is half solved. Emphasize that this is an EMERGENCY ANALYSIS course, teaching problem definition for emergencies involving hazardous materials. This course emphasizes how to analyze the emergency to *define the emergency problem*—not how to *solve* the problem. That is taught in another course.

An analytical method that will help you define the problem is called "Events Analysis."

Using events analysis, we will emphasize two key skill areas in this course.

1. *Detecting* hazardous material in emergencies. Before we react to a hazardous material emergency, we have to first know they are present in the emergency.
2. *Estimating* the likely harm that will occur if we do nothing. You have to know what the problem is before you decide what you are going to do about it. This course will deal with five important questions.
   These questions are:

TIME	CONTENT/METHODOLOGY	MATERIALS

A. Where will the hazardous material or container go if released during an emergency?
B. Why is the hazardous material or container likely to go there?
C. How will the hazardous material or container get there?
D. When will the hazardous material or container get there?
E. What harm will it do when it gets there?

SAMPLE INTRODUCTORY COMMENTS ABOUT THE COURSE—

Ask question: "What are *hazardous material* incidents and why bother studying *hazardous materials incident analysis*?"

Students can respond to the question on either an individual (written is preferred) or a group (discussion) basis. The instructor should function as the facilitator, guiding the discussion toward the "agreeable" (more functional) answer.

The desired answer, simply stated, is:

"A hazardous material incident is a set of sudden, unforeseen and urgent circumstances that demand action."

"We study hazardous materials incident analysis so we produce the best possible outcomes in future emergencies."

"We are the first on the scene of emergencies."

"Everyone expects us to handle emergencies during the first critical minutes."

"Emergencies can happen in any community at any time."

"Our regular training is not always suitable for hazardous materials emergencies."

When hazardous materials are involved in an incident, the possibility of the incident escalating into a disaster may be present. But what action is needed, for what purpose, by whom and when? All emergencies pose specific problems. Their solution requires decisions by whoever responds. But these decisions are dependent on how the decisionmaker defines the problem. How is the problem defined?

Defining the problem is the subject of this course.

Some hazardous material training courses teach response action, and others teach placards, guides, chemistry, cooling of tanks, safe distances, evacuation, patching leaks, and so forth. The general approach of these courses is "cookbook solutions." They offer action guides from which we pick the action (solution) that we think fits our specific emergency.

Or, they provide information that helps us identify the material and its chemical properties, which we are expected to interpret to define our problem. Often this results in solutions being applied before we adequately define what the problem is, or what outcome they will produce.

In hazardous materials incident analysis, on the other hand, you will be introduced to and practice an approach which uses events analysis methods to systematically define emergency

problems and shape response decisions. Through the use of principles, models and patterns, you will be shown methods that help you *reason* your way through the problem and its solution and its effects in most emergencies. This is different from learning "cookbook solutions" and then trying to figure out if the solution fits your problem.

Perhaps an example will show you the difference in approaches. Compare going to a doctor who treats patients using only "cookbook solutions" with one who systematically defines your problem before treating it.

You tell the doctor you have a headache; if a doctor is using the "cookbook solutions" approach, you get an aspirin. Say you have a sore toe, and epsom salt baths are prescribed. Would you feel comfortable with either treatment? Obviously not. If their treatment in either case cures the problem, it is more a result of luck than a reasoned diagnosis of your problem.

In reality, we can learn from good physicians. They have studied diseases, and do their diagnosis with a structured, systematic technique to search out and define a patient's problem, using their knowledge of the disease processes. They diagnose the problem before deciding upon treatment to prescribe. The objective of this course is to help you learn to do the same in hazardous materials incidents—to understand hazardous material behavior and define the problem you have to solve before you start treating it.

In this course, we will show you methods to analyze and define your hazardous materials incident "illnesses" (emergency problem). Just as you would not want a doctor to start treating you before systematically defining your problem, you do not want emergency response personnel handling hazardous materials incidents without adequately defining the problem. An analytical method that will help you do this is called *"events analysis."*

Using events analysis, we will emphasize two key skill areas in this course:

1. *Detecting* hazardous materials in emergencies. Before we react to a hazardous materials emergency, we have to first know they are present in the emergency.
2. *Estimating* the likely harm that will occur if we do nothing. You have to know what the problem is before you decide what you are going to do about it. This course will deal with five important questions. These questions are:
   A. Where will the hazardous material or container go if released during an emergency?
   B. Why is the hazardous material or container likely to go there?
   C How will the hazardous material or container get there?
   D. When will the hazardous material or container get there?
   E. What harm will it do when it gets there?

Because this is a problem-definition course, it must be stressed we will *not* discuss the resultant tactics, command post operations, repair procedures, emergency response teams or equipment, the regulatory scheme, or the chemistry of hazardous materials.

Each of you has a Student Manual for the course. The Student Manual in its entirety is for you to use and keep as a source document for ready reference. Feel free to put as many notes or highlights in it as you wish.

Now, let's get into the meat of the program.

INCIDENT ONE
Slide/Tape Script

Slide 133

Begin slide tape, "Incident I":

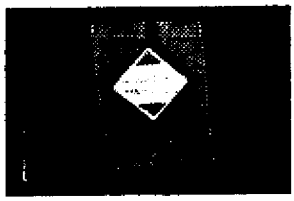
Slide 134

The time is 9:10 a.m. You are the dispatcher on duty. It is a nice, cool, clear, spring morning. You get a call from the trainmaster of a nearby railroad asking you to send help. There is a tank car leak in Yard 8.
What is the problem?
What do you do next?

Slide 135

The time is 9:13 now. Change roles. You are now the officer dispatched to the yard with two pumpers. Enroute to the site, you can see white fumes near the yard, drifting slowly several hundred feet downwind.
What are you going to do next?
What do you expect the hazardous material to do?

Slide 136



The time is 9:14. The trainmaster has just given you a Bureau of Explosives Guide for phosphorus trichloride)—the product leaking. You have with you the 1980 edition of the DOT's Emergency Response Guidebook.
What is the problem?
What are you going to do next?

Slide 137

The time is 9:15. The trainmaster tells you the location of the car, that the phosphorus trichloride hazard classification is "Corrosive," that the car contains 20,000 gallons, and that CHEMTREC's phone number is 800-424-9300.
What are you going to do next?
What do you expect the hazardous materials to do.)

Slide 138

The time is 9:20. You have established a command post. You see fuming phosphorus trichloride flowing down the gutter along the street curb about 100 feet where it enters a storm drain catch basin.
What do you expect the hazardous materials to do?
What are you going to do next?

Slide 139

The time is 9:21. The flow seems to be increasing. You are told the shipper is on the way from a plant a few miles away. You have your hoses charged.
What are you going to do next?
What do you expect the hazardous materials to do?

Slide 140

The time is 9:38. You are concerned about problems from the runoff into the sewer; you order a water hose stream to push the escaping phosphorus trichloride away from the sewer.
What do you expect the hazardous materials to do?
What are you going to do next?

Slide 141

The time is 9:40. The cloud is drifting toward nearby Cambridge. Police units order evacuating near the yard. Citizens are complaining about the acrid fumes and are fleeing plants and buildings. The shipper is still not there.
What do you expect the hazardous materials to do?
What are you going to do next?

Slide 142

The time is 9:48. The men you assigned to dike the spilled phosphorus trichloride are complaining about the vapors and withdrawing to *clear their masks*. The wind starts to shift, blowing fumes toward the rest area.
What do you expect the hazardous materials to do?
What are you going to do next?

Slide 143

The time is 10:00. You have ordered a 3,000-foot evacuation. You have also ordered the railroad to get bulldozers to dig a pit. The shipper's team arrives and tries to patch the car to stop it from leaking. They fail and the phosphorus trichloride contines to leak. The strong fuming continues. You think the pit will hold all the spilled phosphorus trichloride.
What do you expect the hazardous materials to do?
What are you going to do next?

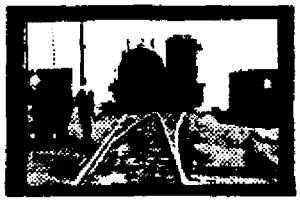
Slide 144

The time is 11:00. The wind shifts. Now the cloud is drifting toward Charlestown. The Environmental Protection Agency (EPA) is now on the scene. The shipper suggests flooding the pit with water to neutralize the phosphorus trichloride, but EPA's representative objects. The heavy fuming continues.
What do you expect the hazardous materials to do?
What are you going to do next?

Slide 145

The time is 11:30. One of your deputies tries to knock down the fuming vapors with a hose using water fog. The wind shifts, and some of the water runs into the pit. The fuming intensifies greatly.
What do you expect the hazardous materials to do?
What are you going to do next?

Slide 146

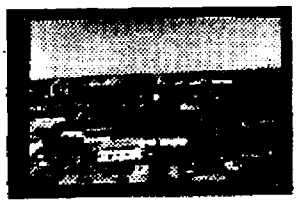


The time is 11:57. The wind begins to blow from the southeast and pick up to 15 mph.
What do you expect the hazardous materials to do?
What are you going to do next?

Slide 147

The time is 2:45 p.m. At your 2:00 meeting with more than 30 local, state, and federal representatives, you discuss the status of the recovery operation. The shipper suggests you wash down the area with water. EPA advises you to use a water curtain to knock down the fumes drifting into your community. You check the guidebook again. A truck is trying to pump out the pit. The fuming continues.
What do you expect the hazardous materials to do?
What are you going to do next?

Slide 148



The time is 3:05. The water spray curtain you ordered, as a result of the advice you got at the 2:00 meeting to knock down the fumes, is terminated immediately because the wind just shifted again, and more water is getting into the pit.
What do you expect the hazardous materials to do?
What are you going to do next?

Slide 149

The time is 3:06. The fumes intensified again. Now fumes are drifting into a previously unaffected residential area.
What do you expect the hazardous materials to do?
What are you going to do next?

Slide 150

The time is 4:30. The vacuum trucks have just finished emptying the pit. About 2" of phosphorus trichloride residue remains. The fuming continues.
What do you expect the hazardous materials to do?
What are you going to do next?

Slide 151

The time is 6:00. Another command post meeting. One advisor says backfill the pit with sand, another says drown and dilute the remaining phosphorus trichloride with water, and another says neutralize the pit with limestone or soda ash. The fuming continues, and some evacuation is still in effect.
What do you expect the hazardous materials to do for each?
What are you going to do next?

Slide 152

The pit was filled with sand, the spill area hosed down with water, and the emergency ended at 1:30 the next morning.

Slide 153

Epilogue

23,000 persons were evacuated at one time or another during the incident, and the Somerville Hospital reported 817 patient visits with complaints relating to the accident.
Nine patients were admitted on the first day of the accident. After 6 months, two of the firefighters who were involved in the ditch-digging operations were still undergoing treatment for pulmonary disfunction.

Slide 154

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