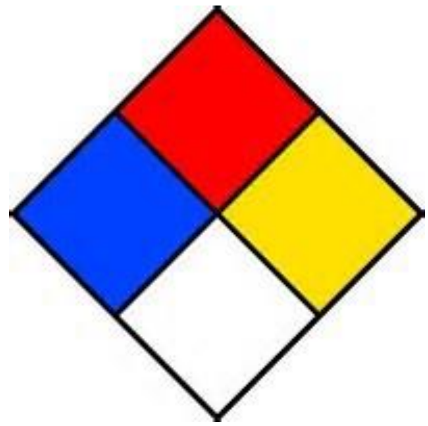
Operational Level



Responder Training

Department of Fire Services
Special Hazards Training Group
Hazmat Training Group

Revised 2016
Reference IFSTA
Hazardous Materials for First Responders
Fourth Edition

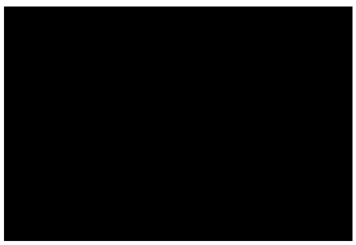
Slide 1

Hazardous Materials
Operational Level Responder

Introduction to HazMat

Analyze
Plan
Implement
Evaluate

Slide 2



Slide 3

Course Objectives

- To provide information to for emergency responders to take an ALL hazards approach to responses
- Provide information to emergency responders for their personal protection during a hazardous materials response
- Provide information to develop street smart hazardous materials incident problem solving skills
- Assist those preparing for the HazMat Operational Certification Exam

Slide 4

Slide 5

Hazmat / WMD Incidents

- Involve a substance that pose an unreasonable risk to people, the environment and / or property
- May involve a substance (product or chemical) that has been (or may be) released from a container or substance that is on fire
- May be the result of an accident, or a deliberate attack

Slide 6

What is a Hazardous Material?

- ANY material that poses an unreasonable risk of injury or damage to persons, property, and/or the environment as stated by the Department of Transportation (DOT)
- An estimated 2,000 new chemicals are introduced annually; mostly in 3 categories
  - Industrial chemicals
  - Household chemicals
  - Lawn care products

Slide 7

Hazardous Waste

What remains after a process has used some of the material and it is no longer pure

-Can be just as dangerous as the pure chemical
-Can be a mixture of several chemicals resulting in a hybrid substance

Slide 8

What is a WMD

- Any weapon or device that is intended or has the capability to cause death or serious injury to significant number of people through the release, dissemination, or impact of one of the following:

Toxic or poisonous chemicals or their precursors

A disease organism

Radiation and radioactivity

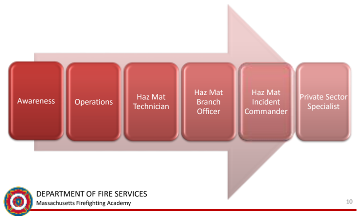
Slide 9

REVIEW QUESTION

How are hazardous materials incidents different from other types of emergencies?

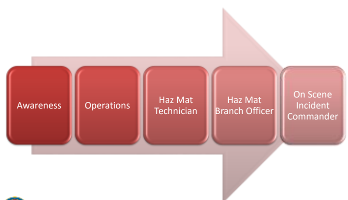
Slide 10

There are six levels of training according to NFPA® standards.



Slide 11

There are five levels of training according to OSHA standards.



Slide 12

Awareness Level

- Recognize presence or potential of hazardous materials
- Recognize type of container and identify material if possible
- Transmit info to proper authority and call for assistance
- Protect themselves and others from hazards
- Establish scene control

Slide 13

Operation Level

- Perform all Awareness Level responsibilities
- Identify the hazardous materials involved
- Determine nature and extent of the problem
- Protect selves, nearby person, environment, and property

Defensive

Slide 14

Operation Level

- Develop incident action plans
- Implement planned response
- Evaluate progress to make sure objectives are safely met

Defensive

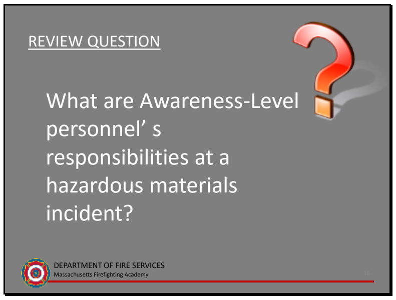
Slide 15

Technician Level

- Perform all awareness and operation level responsibilities
- Trained to operate in Level A protection
- Trained to operate advanced meter equipment
- Trained to work in the hot zone

Offensive

Slide 16



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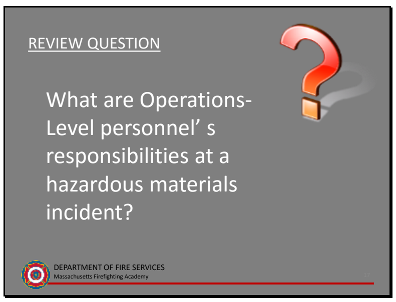

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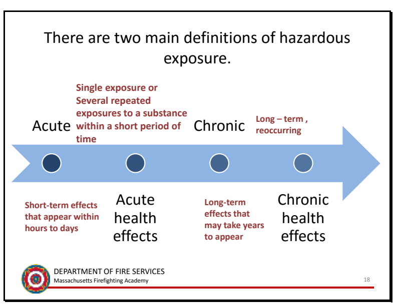

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Slide 19

Types of harm at hazardous materials incidents

TRACEM

- **T**hermal
- **R**adiological
- **A**sphyxiation
- **C**hemical
  - *Poisons/toxins, Corrosives, Irritants,*
  - *Convulsants, Carcinogens, Sensitizers/allergens*
- **E**tiological / biological
- **M**echanical

Slide 20

Thermal Hazards

- Hazardous materials can cause temperature extremes such as with elevated-temperature materials, exothermic reactions, fire, explosions, or cryogenic liquids
- Thermal hazards can also be caused by conditions on the scene such as extreme external air temperature or the use of PPE

Slide 21

Thermal Hazards
(Low Temperatures)

Liquefied gas → Instantly freeze materials ← Cryogen

Slide 22

WARNING!

- Any clothing saturated with a cryogenic material *must be removed immediately.*
- This action is particularly important if the vapors are flammable or oxidizers.
- *A first responder could not escape flames from clothing-trapped vapors if they were to ignite. (Structural Protective Clothing)*

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Slide 23

Thermal Hazards
(Elevated Temperature)

- Liquid phase at a temperature at or above 212° F
- Liquid phase with a flash point at or above 100° F that is intentionally heated and offered for transportation or transported at or below its flash point
- Solid phase at a temperature at or above 464°F
- These materials can ignite flammable and combustible materials

(U.S. Department of Transportation definition of elevated-temperature material)

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Slide 24

Thermal Burn Types and Symptoms

Thermal Burn Type	Symptoms
First Degree Burn – Involves the first (top) layer of skin	• Redness • Tenderness (painful to touch) • Mild swelling
Second degree Burn – Involves the first two layers of skin	• Deep reddening of the skin • Pain • Blisters • Glossy appearance to the skin • Possible loss of some skin
Third Degree Burns – penetrates the entire thickness of the skin and permanently destroys tissue	• Loss of skin layers • Often painless (pain may be caused by patches of first-and-second-degree burns) • Dry and leathery skin • Skin may appear charred or have patches which appear white, brown, or black

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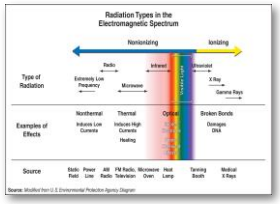
Slide 25

Radiological Hazards

Ionizing Radiation

- Alpha
- Beta
- Gamma
- Neutron



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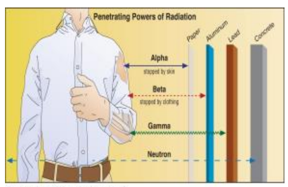
Radiological Hazards

Time

Distance

Shielding



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Radioactive Material / Radioactive Contamination

- Radioactive *Contamination*: Occurs when a material contains radioactive atoms is deposited on surfaces, skin, clothing or anyplace that it is not desired
- *Exposure*: To radiation occurs when a person is near a radiation source, is exposed to the energy from the source, and biological damage occurs
- *Contaminant*: Any foreign substance that compromises the purity of a given substance (i.e. radioactive material)

Slide 28

REVIEW QUESTION

What are the four types of ionizing radiation?

Describe each briefly.

Slide 29

Asphyxiation Hazards

- Substances that affect the oxygenation of the body and generally lead to suffocation
- ***Simple asphyxiants***: gases that displace the oxygen necessary for breathing *(i.e. carbon dioxide)*
- ***Chemical asphyxiants***: substances that prohibit the body form using oxygen *(i.e. carbon monoxide)*

Carbon dioxide delivery truck

Slide 30

Chemical Hazards

Exposure to hazardous chemicals may produce a wide range of adverse health effects

The likelihood of an adverse health effect occurring and the severity of the effect depend on the following:

- Toxicity of the chemical
- Pathway or route of exposure
- Nature and extent of exposure
- Factors that effect the susceptibility of the exposed person such as age and the presence of certain chronic diseases

Slide 31

Chemical Harm
Toxic Chemicals /Poisons

- Toxic / poisonous chemicals can have *a local toxic effect* or have *a systemic effect*
- Many have fast-acting, *acute toxic effects* while others may have *chronic effects*
- Exposures to toxins can cause damage to *target organs* or other parts of the body (i.e. liver, kidneys, nervous system)

Slide 32

Types of Toxins and Their Target Organs

Toxin	Target Organ	Chemical Examples
Nephrotoxins	Kidney	Halogenated Hydrocarbons, Mercury, Carbon Tetrachloride
Hemotoxins	Blood	Carbon Monoxide, Cyanides, Benzene, Nitrates, Arsine, Cocaine
Neurotoxins	Nervous System	Organophosphates, Mercury, Carbon Disulphide, Sarin
Endocrine Toxins	Endocrine System (including the pituitary, hypothalamus, thyroid adrenals, pancreas, thymus, ovaries, and testes)	Benzene, Cadmium, Chlordane, Chloroform, Ethanol, Kerosene, Iodine, Parathion
Mutagens	DNA	Aluminum Chloride, Beryllium, Dioxins
Teratogens	Embryo/Fetus	Lead, Lead Compounds, Benzene

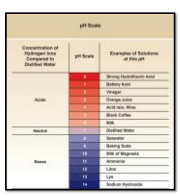
Slide 33

Chemical Harm Corrosives

Acids: Have a pH of 0-6.9
Immediate pain on contact

Base: Have pH of 8-14
No immediate pain normally

pH: Measure of acidity of an acid or the level of alkaline in a base



(Acids and Bases can be toxic, flammable, reactive, and/or explosive and some are oxidizers)

Slide 34

REVIEW QUESTION

The likelihood and severity of an adverse health effect resulting from a chemical exposure are dependent upon which factors?

Slide 35

REVIEW QUESTION

What is the difference between an acid and a base?

Slide 36

Health Hazards Vary

- Irritants
- Convulsants
- Carcinogens
- Sensitizers/Allergens
- Etiological/Biological
- Mechanical

Slide 37

Irritants

- Toxins that cause temporary but sometimes severe inflammation to the *eyes, skin, or respiratory system*
- Irritants often attack the mucous membranes of the body such as the surface of the *eyes, nose, mouth, throat, and lungs*

Slide 38

Convulsants

- Toxic materials that can cause convulsions (Involuntary muscle contractions)
- Some chemicals considered to be Convulsants are *strychnine*, *organophosphates, carbamates,* and infrequently used drugs such as *picrotoxin*

Slide 39

Carcinogens

Cancer causing agents

Polyvinylchloride, Benzene, Asbestos, Arsenic, Nickel, Some Pesticides

(Disease and complications can occur as long as 10 – 40 years after exposure)

Slide 40

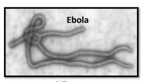
Sensitizers/Allergens

Allergens: Material that cause an allergic reaction of the skin or respiratory system

Sensitizers: Chemicals that cause a substantial proportion of exposed people or animals to develop an allergic reaction after one or more exposures to the chemical (i.e. latex, bleach)

Slide 41

Biological / Etiological



Virus

Bacteria


Biological Toxin
(Ricin made from castor beans)


Rickettsia's
(Rocky Mountain Spotted Fever)

Slide 42

Mechanical Hazards

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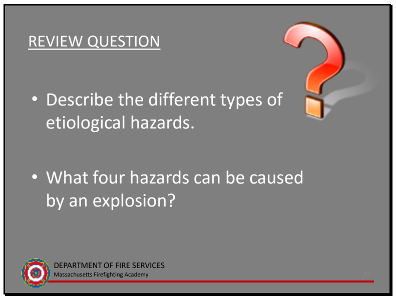

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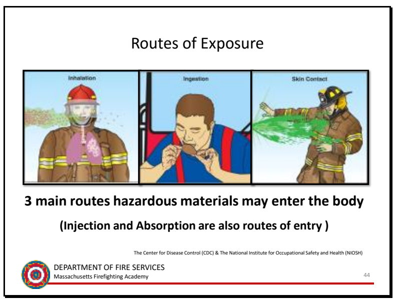

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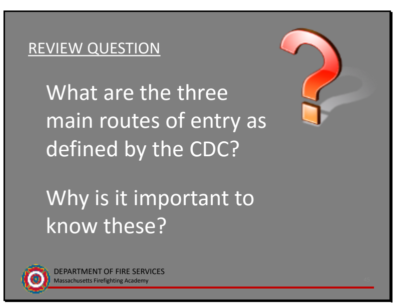

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United States HazMat Regulations

- Department of Transportation (DOT)
  (They address the transportation of hazardous materials in all modes: *Air, Highway, Pipeline, & Water*)
  (The regulation specifically governing the transportation of hazardous materials found in Title 49 *CFR* are sometimes referred to as the *Hazardous Material Regulations* or HMR)
- Environmental Protection Agency (EPA)
  (The EPA is responsible for researching and setting national standards for a variety of environmental programs)
- Comprehensive, Environmental Response, Compensation and Liability Act (CERCLA)
  (Enacted by Congress on 12/11/1980) Love Canal- Hooker Chemical Incident

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United States HazMat Regulations

- Superfund Amendments and Reauthorization Act (SARA)
  (Amended CERCLA on 10/17/1986) Original driver of the HAZWOPER regulations
- Environmental Planning and Community Right to Know Act (EPCRA)
  (EPCRA requires a company that handles chemicals to report storage type, quantity, and storage methods to the fire department and Local Emergency Planning Committee (LEPC)
- Resource Conservation and Recovery Act (RCRA)
  (This control includes generation, transportation, treatment, storage , and disposal of hazardous waste)
  (Also known as the *Cradle to Grave Law*)

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United States HazMat Regulations

- Toxic Substance Control Act (TSCA)
  (Enacted by Congress in 1976 to give the EPA the ability to track the 75,000 industrial chemicals currently produce or imported to the U.S.)

- Department of Labor (DOL)
  (The DOL is responsible for overseeing U.S. labor laws)
- Nuclear Regulatory Commission (NRC)
  (Regulates U.S. nuclear power plant and civilian use of nuclear materials)

  (Also possession, use, storage, and transport of radioactive material through Title 10 *CFR* 20)

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United States HazMat Regulations

- Department of Homeland Security (DHS)
  (Has three primary missions: 1 – Prevent terrorists attacks within the U.S. 2 – reduce America's vulnerability to terrorism and 3 – minimize the damage from potential attacks and natural disasters)
- Consumer Product Safety Commission (CPSC)
  (Oversees and enforces compliance with the Federal Hazardous Substance Act FSHA, which requires that certain household products carry cautioning labeling to consumers to the potential hazards that those products present and inform them of the measures needed to protect themselves from those hazards)
- Department of Energy (DOE)
  (Manages the national nuclear research and defense programs, including the storage of high level nuclear waste)

Slide 50

United States HazMat Regulations

- Department of Defense Explosives Safety Board (DDESB), Department of Defense (DoD)
  (Provides oversight of the development, manufacture, testing, maintenance, demilitarization, handling , transportation, and storage of explosives, including chemical agents on DoD facilities worldwide)
- Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF), Department of Treasury
  (Enforces the federal laws and regulations relating to alcohol, tobacco, firearms, explosives, and arson)
- Department of Justice (DOJ)
  (Assigns primary responsibilities for operational response to threats or acts of terrorism within the U.S. territory to the Federal Bureau of Investigation FBI)

Slide 51

Standards

- Issued by non-governmental entities and are generally consensus based
- The National Fire Protection Association (NFPA) is a body that issues consensus based standards

Slide 52

NFPA Standards

Two NFPA standards address hazardous materials response:

-NFPA 472 Competencies of Responders to HM/WMD

-NFPA 473 Competencies of EMS Personnel Responding to HM/WMD

The requirements in these standards are ***recommendations, not law or regulations,*** unless they are adopted as such by the **authority having jurisdiction (AHJ)**

Slide 53

Operations Level

Mission – specific competencies identified in NFPA 472

- •Personal Protective Equipment
- •Mass Decontamination
- •Technical Decontamination
- •Evidence Preservation and Sampling
- •Product Control
- •Air Monitoring and Sampling
- •Victim Rescue and Recovery
- •Response to Illicit Laboratory Incidents

Slide 54

Why Are Hazardous Materials Incidents Different?

Slide 55

Summary

- Hazardous materials are found everywhere;
  - -Homes
  - -Businesses
  - -Manufacturing processes
  - -Transportation
  - -Illegal activities such as drug labs and the like

Situational Awareness

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Slide 56

Summary

- It is imperative that firefighters recognize the presence of a hazardous materials incident and understand what actions can be taken
- Hazardous materials incidents require slowing down and taking actions based on the properties of the hazardous materials involved

Slow Down and Pay Attention !

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Slide 1

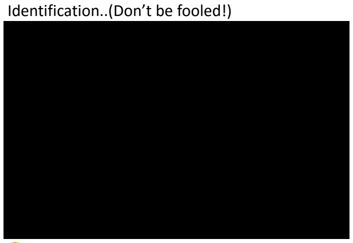
Hazardous Materials Operational Level Responder

Hazardous Materials Identification

Analyze
Plan
Implement
Evaluate

Slide 2

Identification..(Don't be fooled!)



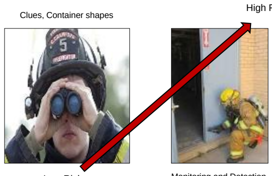
Slide 3

Learning Objective 1

Identify the seven clues to the presence of hazardous materials.

Slide 4

Risk increases when moving closer to identify hazardous materials.



Slide 5

Learning Objective 2

Discuss the occupancy types, locations, and pre-incident surveys that may indicate hazardous materials.

Slide 6

Pre-Incident Surveys

- Reduce on-site decisions for first responders
- Reduce oversights, confusion, and duplication of effort
- Identify items of concern
- Ongoing process; includes review and updates
- Not always accurate (Things change…)
  (Need to get out of the station and review sites)

Slide 7

DISCUSSION QUESTION

What are exposures?

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Slide 8

DISCUSSION QUESTION

What are some occupancies that are highly probable locations for hazardous materials storage within your response area?

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Slide 9

Some occupancies are highly probable locations for hazardous materials.

Courtesy of U.S. Customs and Border Protection, photo by Charles Csavossy

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Slide 10

Locations That May Indicate Hazardous Materials

- Roadways
- Railways
- Waterways
- Airways
- Pipelines
- Industrial /Commercial

Courtesy of Phil Linder

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Slide 11

Identify where a potential attack can do the greatest harm.

Courtesy of U.S. Customs and Border Protection, photo by Gerald L. Nino

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Slide 12

DISCUSSION QUESTION

What are some specific locations that may be terrorist targets within your jurisdiction?

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Slide 13

Potential terrorist targets that should be considered.

Mass transportation Critical infrastructure	Areas of public assembly and recreation High profile buildings and locations	Industrial sites Educational sites Medical and science facilities

Slide 14

Learning Objective 3

Describe the container shapes that may contain hazardous materials.

Slide 15

Categories of Containers

- Bulk and nonbulk
- Pressure and nonpressure
- Bulk-capacity fixed-facility containment systems and transportation packaging

Courtesy of Rich Mahaney

Slide 16

Bulk Packaging (Quick Version)

- Other than Vessel or Barge
- Maximum Capacity > **119gal** (450L)
  - **- Liquid**
- Maximum Net Mass > **882#** (400kg)
  - And Max capacity > **119gal**
  - **- Solid**
- Water Capacity > **1000#** (454kg)
  - **- Gas Container**

* PHMSA DOT

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Slide 17

Bulk Packaging (Quick Version)

- Placarding and Registration Requirements
- Class 9 Hazards (Haz Waste)
  - **> 3500gal** but do NOT require placards
    - Must be registered
  - **< 3500gal** but do NOT require placards
    - Do NOT require registration

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Slide 18

Nonbulk packaging is used to transport smaller quantities of hazardous materials.

- Bags
- Carboys and jerry cans
- Cylinders
- Drums
- Deward flasks

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Slide 19

There are several types of bulk-capacity fixed-facility containers.

- Buildings
- Aboveground storage tanks
- Machinery
- Underground storage tanks

Slide 20

Nonpressure/atmospheric storage tanks operate under little pressure.

Up to 0.5 psi inside

Slide 21

Pressure Storage Tanks

- Hold contents under pressure
- Low-pressure storage tanks – Operating pressures from **0.5 to 15 psi** (3.45 kPa to 103 kPa) {0.03 bar to 1.03 bar}
- Pressure vessels – Pressures of **15+ psi** (103 kPa) {1.03 bar} or greater

Slide 22

Examples of Pressurized AST's

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Slide 23

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Slide 24

There are several types of bulk-capacity fixed-facility containers.

- Pipelines
- Reactors
- Vats
- Open piles or bins
- Storage Cabinets

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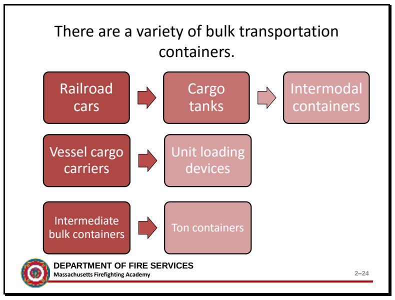

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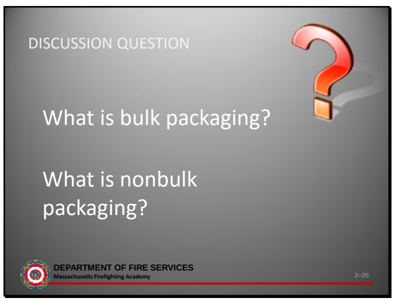

Slide 27

Slide 28

Pressure tank cars transport materials with higher pressures.

Courtesy of Rich Mahaney

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Slide 29

Cryogenic liquid tank cars carry low pressure and refrigerated liquids.

Courtesy of Rich Mahaney

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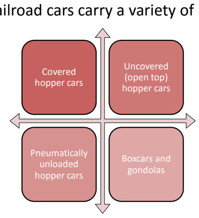
Slide 30

Other railroad cars carry a variety of materials.



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Cargo tank construction features are designed to fit specific uses.

Courtesy of Rich Mahaney

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Slide 32

Intermodal containers may contain hazardous materials or mixed loads.

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Slide 33

Some intermodal containers are tank containers.

Courtesy of Rich Mahaney

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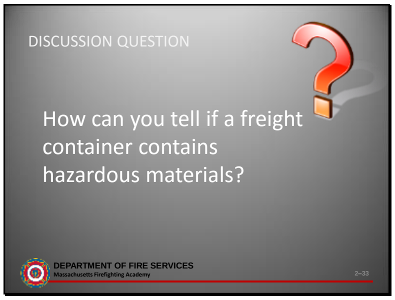

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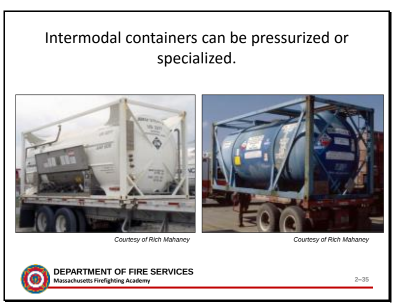
Slide 36



Slide 37

There are a variety of vessel cargo carriers that are likely to contain hazardous materials.

Tanker
- Petroleum carrier
- Chemical carrier
- Liquefied flammable

Cargo vessel
- Bulk carrier
- Break bulk carrier
- Container vessel

Barge

Slide 38

MC 306/DOT 406

Slide 39

MC 307 / DOT 407

Slide 40

MC 312 / DOT 412

Slide 41

MC331

Slide 42

MC 338

Slide 43

OTR Tube Trailer

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Slide 44

Unit loading devices are used to consolidate air cargo into transportable units.

Courtesy of John Demyan

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Slide 45

Intermediate bulk containers are designed for mechanical handling.

Courtesy of Rich Mahaney

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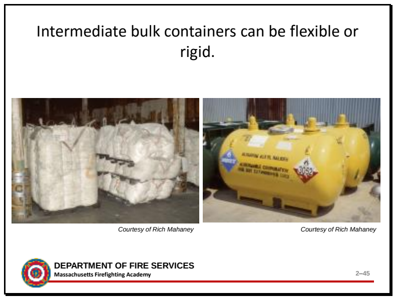

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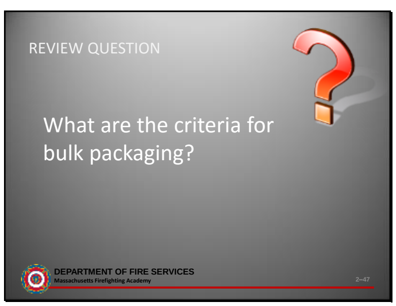
Slide 48



Slide 49

Containers for radioactive materials protect against increasing levels of hazards.

Type A Type B Type C

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Slide 50

Learning Objective 4

Identify placards, labels, and markings that designate the presence of hazardous materials.

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Slide 51

UN Recommendations on the Transport of Dangerous Goods

- Adopted by U.S., Canada, and Mexico
- Establishes minimum requirements for transport by all modes of transportation
- Facilitates trade and safe, efficient transport
- Includes standards for packaging and multimodal tanks

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Slide 52

UN hazard classes identify substances that pose significant hazard in transportation.

- Class 1 - Explosives
- Class 2 - Gases
- Class 3 - Flammable liquids
- Class 4 - Flammable solids, substances liable to spontaneous combustion, substances that emit flammable gases on contact with water

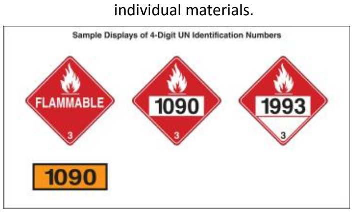
Slide 53

UN hazard classes identify substances that pose significant hazard in transportation.

- Class 5 - Oxidizing substances and organic peroxides
- Class 6 - Toxic and infectious substances
- Class 7 - Radioactive materials
- Class 8 - Corrosive substances
- Class 9 - Miscellaneous dangerous substances and articles

Slide 54

UN identification numbers are assigned to individual materials.



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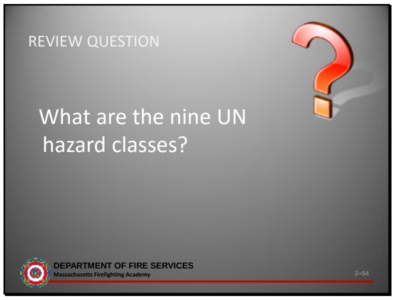

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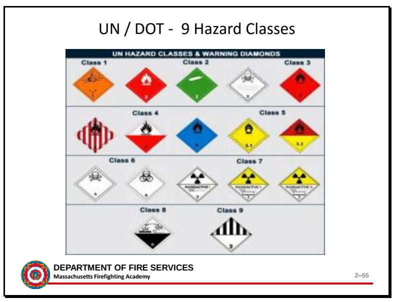

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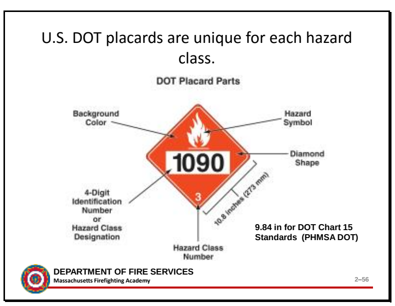

Slide 58

DOT Table 1

TABLE 25-1

Materials That Require Placarding at Any Amount

HAZARD CLASS OR DIVISION	PLACARD TYPE
1.1	Explosives 1.1
1.2	Explosives 1.2
1.3	Explosives 1.3
2.3	Poison gas
4.3	Dangerous when wet
6.1 (assigned to packing group I, inhalation hazard only)	Poison
7 (radioactive label III only)	Radioactive

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DOT Table 2

TABLE 25-2

Materials That Require Placarding at 1,001 Pounds

CLASS OR DIVISION	PLACARD TYPE
1.4	Explosives 1.4
1.5	Explosives 1.5
1.6	Explosives 1.6
2.1	Flammable gas
2.2	Nonflammable gas
3	Flammable
COMBUSTIBLE LIQUID	**COMBUSTIBLE**
4.1	Flammable solid
4.2	Spontaneously combustible
5.1	Oxidizer
5.2	Organic peroxide
6.1 (Packing Group I or II, other than PG I inhalation hazard)	Poison
6.1 (PG III)	Keep away from food
6.2	None
8	Corrosive
9	Class 9
ORM-D	None

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Slide 60

DISCUSSION QUESTION

What are ORM-Ds and MOTs?

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ORM-D

CONSUMER COMMODITY
ORM-D

Until December 31, 2013 and for the purposes of this subchapter, "ORM-D material" means a material such as a consumer commodity, cartridges, small arms or cartridges, power devices which, although otherwise subject to the regulations of this subchapter, presents a limited hazard during transportation due to its form, quantity and packaging. It must be a material for which exceptions are provided in Column (8A) of the § 172.101 Hazardous Materials Table.

Note: Though originally slated to expire December 31, 2013, the phase-out date for the ORM-D hazard class and the Consumer Commodity exception has now been extended until December 31, 2020.

(49CFR172.101/173 Subpart D)

Slide 62

MOT

- Mode of Transportation
  - The different ways of getting commodities from one point to another
    - Air
    - Rail Road
    - Road
    - Pipeline
    - Vessel

Slide 63

U.S. DOT labels provide the same information as placards.

Slide 64

REVIEW QUESTION

On DOT placards, what does the color orange indicate?

Slide 65

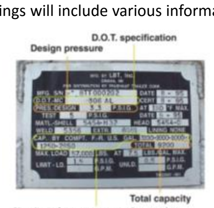
Canadian and Mexican placards, labels, and markings are based on *UN recommendations*.

Most Canadian transport placards do not have signal words on them. Labels and markings may be in both English and French.

Mexican Placards

Slide 66

Other North American highway vehicle identification markings will include various information.



Courtesy of Rich Mahaney

Slide 67

North American railroad tank car markings have a variety of styles.

Courtesy of Rich Mahaney

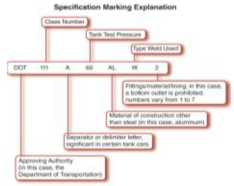
Slide 68

North American railroad tank car markings have a variety of styles.

Courtesy of Rich Mahaney

Slide 69

North American railroad tank car markings have a variety of styles.



Slide 70

International intermodal container/ tank markings are generally on the right hand side.

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Slide 71

Learning Objective 5

Describe the other markings and colors that may indicate the presence of hazardous materials.

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Slide 72

CAUTION

Read the container and understand all of the information provided!

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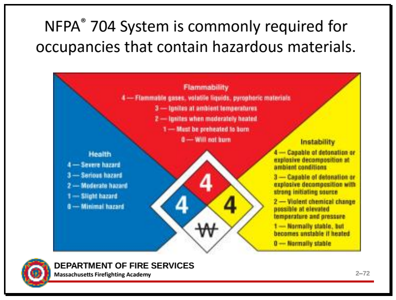

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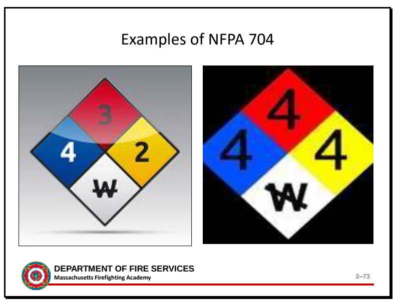
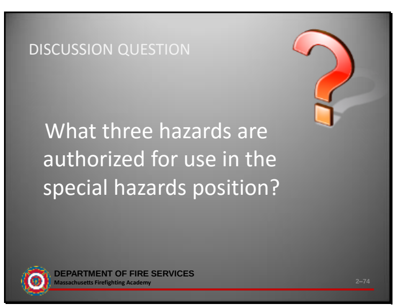


Slide 75



Slide 76

Found at the "6 O'Clock" position…

- **"OX"**
  - Oxidizers
- **"W with a Line through it"**
  - Use NO WATER!
- **"SA"**
  - Simple Asphyxiates

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Slide 77

U.S. Hazard Communications Labels and Markings

Requires employers to:

- Identify hazards in workplace and train employees how to recognize these hazards
- Ensure that all containers are labeled, tagged, or marked with identity of substances contained along with appropriate hazard warnings

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Slide 78

Canadian Workplace Hazardous Materials Information System (WHMIS) uses two types of labels.

WHMIS Label

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Slide 79

Mexican Hazard Communication System

- Equivalent to HCS
- Employers ensure that hazardous chemical substances in workplace are appropriately and adequately labeled
- Adopts NFPA® 704 and related label system as official
- Caution symbols triangular

Slide 80

FHSA* requirements for household products labels uses a system of signal words.

CAUTION
- Minor health effects

WARNING
- Moderate hazards

DANGER
- Highest degree of hazard

POISON
- In addition to DANGER on labels of highly toxic materials

- Federal Hazardous Substance Act 1995

Slide 81

FHSA Requirements for Household Products Labels

- Name, business address of manufacturer, packer, distributor, or seller
- Common/chemical name of ingredients
- Principal hazard(s)
- Precautionary statements
- First-aid instructions
- Instructions for special handling or care
- *Keep out of the reach of children*

Slide 82

Chemical Abstract Service® (CAS®) Numbers

- Unique numerical identifiers assigned to various products
- Can be used to search chemical databases
- Typically included on safety data sheets
- Another "Tool in the Toolbox"

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Slide 83

This EPA sign is an example of how other symbols and signs may vary by facility.

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Slide 84

Globally Harmonized System (GHS) symbols help create consistent labeling standards.

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Slide 85

ISO safety symbols are international safety signs used with OSHA hazard signs.

Slide 86

Military markings are not necessarily uniform.

Courtesy of Rich Mahaney

Slide 87

CAUTION

The military ships some hazardous materials and chemicals by common carrier. When this is done they are not required to be marked with DOT and TC transportation markings.

Slide 88

Pipeline markers are required where pipelines cross under or over roads, railroads, and waterways.

Courtesy of Rich Mahaney

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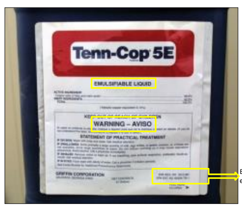
Slide 89

Pesticide labels are regulated by the EPA.



EPA registration and establishment

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Slide 90

Learning Objective 6

Explain the written resources available to indicate the presence of hazardous materials.

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Slide 91

Color Codes – ANSI Z535.1

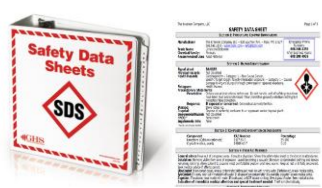
- Danger or Stop
- Warning
- Caution
- Safety Equipment
- Safety Information Signage

Slide 92

Shipping papers accompany hazardous materials shipments.

Slide 93

Safety Data Sheets (SDSs) are often the best source of detailed information available.



Slide 94

REVIEW QUESTION

What are the required sections of SDSs?

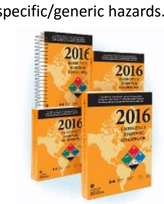
Slide 95

The 16 Required Sections…

1. Identification
2. Hazard(s) identification
3. Composition/information on ingredients
4. First-aid measures
5. Fire-fighting measures
6. Accidental release measures
7. Handling and Storage
8. Exposure controls/personal protection
9. Physical and chemical properties
10. Stability and reactivity
11. Toxicological information
12. Ecological information
13. Disposal considerations
14. Transport information
15. Regulatory information
16. Other information

Slide 96

The *Emergency Response Guidebook (ERG)* helps quickly identify specific/generic hazards.



Slide 97

DOT Chart 15

Slide 98

Other Records That May Provide Information About Hazardous Materials

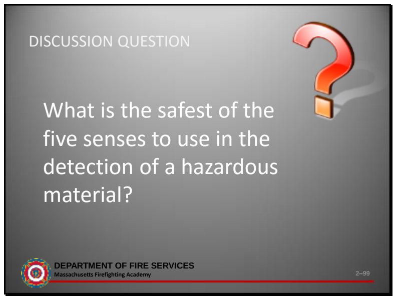
- Chemical Inventory Lists (CILs)
- Shipping and receiving documents
- Inventory records
- Risk management and hazardous communication plans
- Emergency response plans developed by the LEPC

Slide 99

Learning Objective 7

Discuss the limitations of using the senses to determine the presence or absence of hazardous materials.

Slide 100



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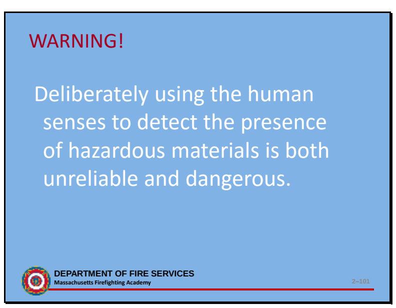

Slide 103

Visual and physical chemical indicators provide evidence of the presence of hazardous materials.

Courtesy of FEMA News Photos, photo by Liz Roll

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Slide 104

REVIEW QUESTION

What are some symptoms of chemical exposure?

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Physical signs and symptoms of chemical exposure can occur separately or in clusters.

Changes in respiration
- Difficult breathing
- Increase or decrease
- Tightness of chest
- Irritation
- Respiratory arrest

Changes in level of consciousness
- Dizziness
- Lightheadedness
- Drowsiness
- Confusion
- Fainting

Abdominal distress
- Nausea
- Vomiting
- Cramping

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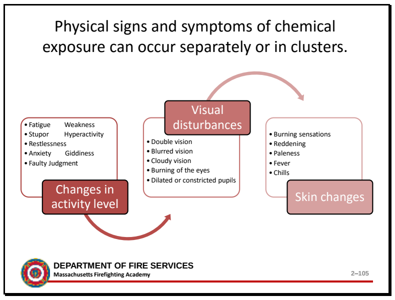

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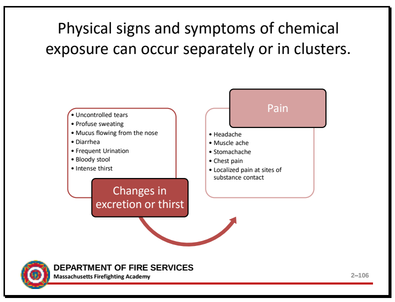

Slide 108

Slide 109

Monitoring and Detection Devices

- Can be useful in determining the presence of hazardous materials and concentrations
- Can be used to determine scope of incident
- Effective use requires actual contact; outside scope for Awareness-Level personnel

____
____
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Slide 110

4 Gas Meter "On the Piece…"

Types of Sensors (The "Basics")

- O_2
- LEL (What is it Calibrated too?)
  - Conversion Factors
  - REMEMBER…It is 10% of the Calibration Gas LEL (Safety Factor Built in)
- H_2S
- CO

____
____
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Slide 111

Other Types of Meters

- Single Gas (Product Specific)
  EMS / First Responder Calls / Overhaul
  - CO
  - HCN
  - Ammonia
  - Chlorine

** If you have a Specific Hazard to Monitor**

____
____
____
____
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____

Slide 112

Other Types of Meters

PID (Photo Ionization Detection)

Reads in eV Volts (Lightbulb)
- 9.4 / 10.6 (Most Common) / 11.7
- Used for VOC (Volatile Organic Compounds)

Slide 113

Learning Objectives 9-11

Analyze scenarios to detect the presence of hazardous materials.
Interpret representative shipping papers.
Interpret a safety data sheet (SDS).

These objectives are measured in Learning Activities 2-1 through 2-3.

Slide 114

Learning Objective 12

Explain how to identify terrorist attacks and illicit laboratories.

Slide 115

There are several key differences between hazardous materials and terrorist incidents.

- Size and capacity
- Number of casualties
- Presence of extremely hazardous materials
- Potential for armed resistance
- Booby traps
- Necessity of crime scene preservation
- Secondary devices
- Higher level of risk targets

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Slide 116

Cues to Possibility of Terrorist Attack

- Report of 2 or more medical emergencies in public locations
- Unusually large number of people with similar signs and symptoms arriving at physicians' offices or emergency rooms
- Reported explosion at public, historic, or government location

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DISCUSSION QUESTION

What types of agents are used in chemical attacks?

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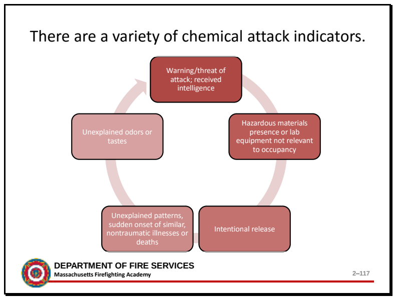

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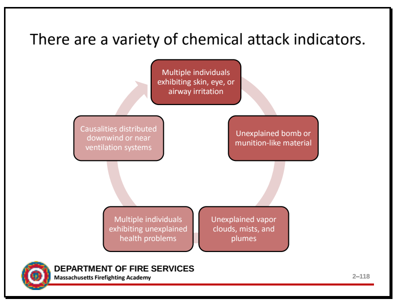

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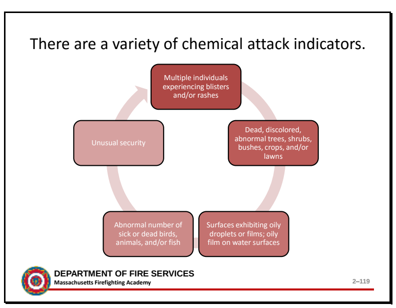

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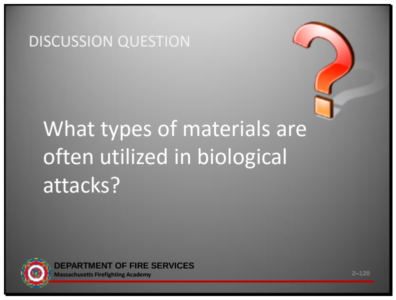
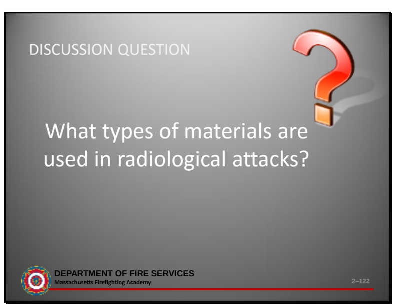


Slide 122

Slide 123



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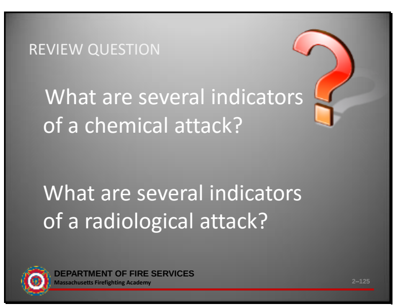
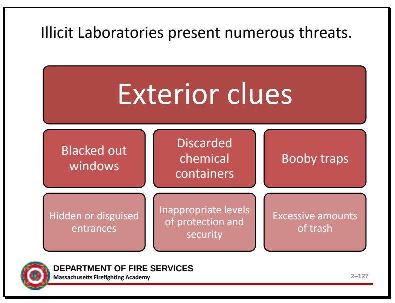
Slide 125

Slide 126



Slide 127

Slide 128



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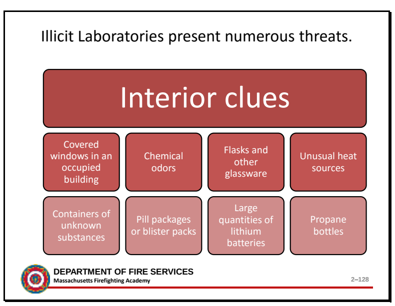


Slide 130

REVIEW QUESTION

What are some exterior clues to the presence of an illicit lab?

Slide 131

Secondary attacks and booby traps are always a possibility.

SITUATIONAL AWARENESS

Slide 132

Protecting Against
Possible Secondary Devices

- Anticipate the presence of a secondary device at any suspicious incident
- Visually search for a secondary device before moving into the incident area
- Limit number of emergency response personnel to those performing critical tasks
- If a known concern, change up your approach

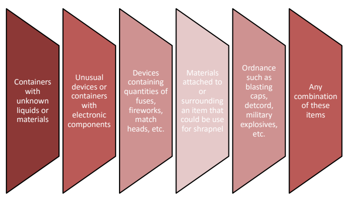
Slide 133

Protecting Against Possible Secondary Devices

- Avoid touching or moving anything that may conceal an explosive device
- Manage the scene with cordons, boundaries, and scene control zones
- Evacuate victims and nonessential personnel as quickly as possible
- Preserve scene as much as possible

Slide 134

Items that should arouse curiosity when looking for a secondary attack.



Slide 135

Summary

- Using the seven clues to the presence of hazardous materials, can help first responders take the first steps toward successful mitigation of a hazardous materials incident.
- Correctly identifying a hazardous material may be difficult and dangerous.

Slide 136

Summary

- First responders must be able to recognize when an incident may be the result of a terrorist attack, and to recognize the signs of illicit laboratories.

Slide 1

Hazardous Materials
Operational Level Responder

Awareness Level Actions At Hazardous Materials Incidents

Analyze
Plan
Implement
Evaluate

Slide 2

Objectives

Responsibilities of Awareness-Level personnel
(as opposed to *incidental releases* for which they may be trained to mitigate without calling for additional assistance)

- Describe predetermined procedures, also known as SOPs
- Describe emergency response plans
- Describe notification requirements for Awareness-Level-Responders

Slide 3

Objectives

- How to use the Emergency Response Guidebook & NIOSH Pocket Guide
- Describe basic procedures to isolate an incident
- Steps that should be taken in case an incident involves terrorists or criminal activity

(All of the actions discussed are applicable to *Operations-Level Responders* also)

Slide 4

Awareness Level Responsibilities

- Recognize the presence or potential presence of a hazardous material
- Recognize the type of container at a site and identify the material in it if possible
- Transmit information to an appropriate authority and call for appropriate assistance

Slide 5

Awareness Level Responsibilities

- Identify actions to protect themselves and others from hazards
- Establish scene control by isolating the hazardous area and denying entry

Slide 6

DISCUSSION QUESTION

What are the Awareness-Level personnel's responsibilities at an incident involving hazardous materials?

Slide 7

Predetermined Procedures/ Emergency Response Plans

- Standard Operating Procedures (SOPs)
- Standard Operating Guidelines (SOGs)
- Operating Instructions (OIs)
- Spell out the role of *Awareness-Level* personnel at emergency incidents, including those involving hazardous materials

Slide 8

REVIEW QUESTION

What is the purpose of predetermined procedures and emergency response plans?

Slide 9

Predetermined Procedures/ Emergency Response Plans

OSHA 29 *CFR* 1910.120 (q) (2) requires emergency response organizations In the U.S. to develop emergency response plans that must cover

- Pre-emergency planning and coordination with outside parties

Predetermined procedures/ Emergency response plans should consider the following:

- Personnel roles, lines of authority, training, and communication
- Emergency recognition and prevention
- Safe distance and places of refuge

Slide 10

Predetermined Procedures/ Emergency Response Plans

- Safe distance and places of refuge
- Evacuation routes and procedures
- Decontamination

Slide 11

Predetermined Procedures/ Emergency Response Plans

- Emergency medical treatment and first aid
- Emergency alerting and response procedures
- Critiques of response and follow up
- PPE and emergency response equipment

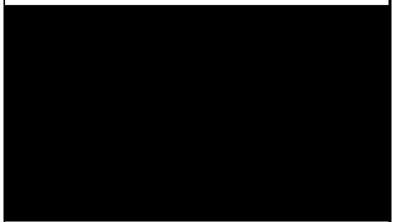
Slide 12

Notification Requirements

- Predetermined procedures, such as SOPs and the emergency response plan should define roles in the notification process
- *Awareness-Level personnel* notifications may be as simple as calling 911 to report the incident
- Fixed-facility personnel may have to notify internal response teams, such as a fire brigade or an emergency response team
- If criminal or terrorists activity is suspected, law enforcement should be notified

Slide 13

2016 ERG



Slide 14

Emergency Response Guide ERG

- Aides in quickly identifying specific or generic habits
- Aides in protecting responders and general public
- Does not address all possible circumstances
- Designed for use at highway or railroad incidents
- Associated with open areas
- Limited value in fixed-facility locations or urban settings

Slide 15

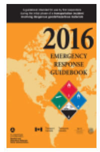
The 2016 edition offers a flow chart to use ERG on page 1.

Slide 16

Emergency Response Guide (ERG)

Quick list of the information found in the guide

- Hazard Classification System (page 6)
- Table of placards (page 8 - 9)
- Rail car identification (page 10 - 11)
- Road trailer identification (page 12 - 13)



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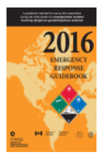
(Cont.)

Slide 17

Emergency Response Guide (ERG)

Quick list of the information found in the guide

- Hazard Globally Harmonized System (page 14- 15)
- identification numbers (page 16 - 19)
- Pipeline hazards (page 20 – 25)



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Slide 18

(yellow-bordered pages)

ID Number Index

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Slide 19

(**blue-bordered pages**)

Name of Material Index

Slide 20

REVIEW QUESTION

What is provided on the yellow-shaded pages of the *ERG*?

What is provided on the blue-shaded pages of the *ERG*?

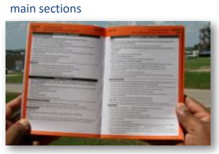
Slide 21

(**Orange-bordered pages**)

ERG Initial Action Guide

Each guide is broken into three main sections

- *Potential Hazards*
- *Public safety*
- *Emergency Response*



Slide 22

(Orange-bordered pages)

Potential Hazards

Two types of hazards are addressed in separate sections:

- Health Hazard
- Fire or Explosion Hazards
- Any material listed with **P** may polymerize and explode when heated or involved with fire

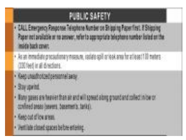
The Highest Potential is listed FIRST

Slide 23

(Orange-bordered pages)

Public Safety

Provides general information regarding immediate isolation of the incident site and recommended type of protective clothing and respiratory protection



Slide 24

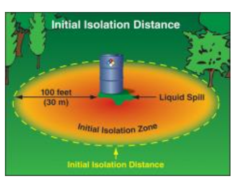
Initial Isolation Distance

Rule of thumb prior to using ERG

Solid – 75 Ft.

Liquid – 150 Ft.

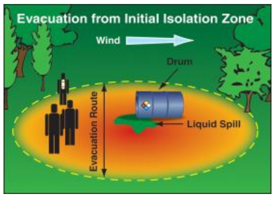
Gas – 300 Ft.



Found in Public Safety Section

Slide 25

Evacuation Zone



Slide 26

(Orange-bordered pages)

Protective Clothing

- ***Structural Firefighting Gear:*** Provide limited protection from heat and cold, but may not provide adequate protection from the harmful vapors or liquids encountered in a haz-mat incident
  (Some guide state that SFPC offers limited protection)
- ***Chemical Protective Clothing:*** This type of special clothing may protect against one chemical, yet be readily permeated by chemicals for which it was not designed
  (This type of clothing offers little or no protection against heat or cold)

Slide 27

(Orange-bordered pages)

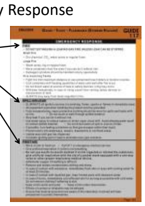
Emergency Response

Has three Sections

Small Spill: *0-55 Gals.*

Large Spill: *Over 55 Gals.*

Be sure to read all material
DO NOT SKIP READ



Slide 28

How to Calculate
Protective Action Distances

Page 294 & 295

Slide 29

Index entries highlighted in green
Table 1

- Material is listed by I.D. #
- Isolation distances are provided for small spills and large spills
- Protection distances are provided for these materials
- Also distances are broken down for a spill that should occur during the day or night

Page 293 to page 345

Slide 30

Index entries highlighted in green
Table 2

- Material listed by I.D. #
- Material which when spilled in water produce large amounts of ***Toxic Inhalation Hazard (TIH)*** gases
- Identified in Table 1 as their name is immediately followed by ***(When Spilled in Water)***

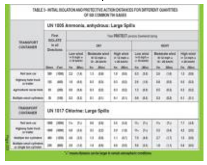
page 346-page 353

Slide 31

Index entries highlighted in green
Table 3

Lists Toxic Inhalation Hazards most commonly encountered

- Ammonia (UN1005)
- Chlorine (UN1017)
- Ethylene oxide (UN1040)
- Hydrogen Chloride (UN1050)
  Hydrogen Chloride, refrigerated liquid (UN2186)
- Sulfur dioxide/Sulphur dioxide (UN1079)



page 354 – page 357

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Slide 32

CAUTION!

First responders must be properly trained to conduct the actions recommended by the ERG before attempting to perform them.

They must also have the proper equipment to do so.

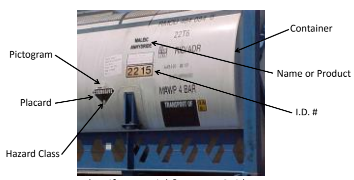
Practice makes perfect

____

Slide 33

Using the ERG

How many identification points



Identify Material & Proper Guide #

Slide 34

Using the ERG

Find Proper Guide # for each material

BONUS

Name the Container and Guide #

Slide 35

White Pages in Rear of Guide

- BLEVE safety Precautions (page 366 & 369)
- Criminal /Terrorists use of C,B,R Agents (page 370 & 373) (Chemical, Biological, & Radiological)
- Improvised Explosive Device (IED) Safe Standoff Dist. (page 374 - 375)
- Emergency Response Centers

Slide 36

Information Needed for Response Centers

- Caller's name, callback telephone number, and FAX number
- Location and nature of problem
- Name and ID number of material
- Shipper/consignee/point of origin
- Carrier name, railcar reporting marks, or truck number

Slide 37

Information Needed for Response Centers

- Container type and size
- Material quantity transported/released
- Local conditions
- Injuries, exposures, current conditions involving spills, leaks, fires, explosions, and vapor clouds, etc.
- Local emergency services that have been notified

Slide 38

REVIEW QUESTION

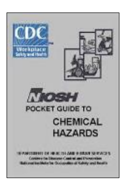
What is provided on the green-shaded pages of the *ERG*?

Slide 39

NIOSH Pocket Guide

Information Includes

- Chemical Structures
- Identification Codes
- Synonyms
- Exposure Limits
- Chemical & Physical Properties

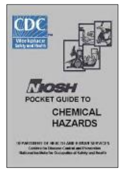


Slide 40

NIOSH Pocket Guide

Information Includes

- Incompatibilities & Reactivity's
- Respirator Selection
- Signs & Symptoms of Exposure
- Target Organs
- Emergency Treatment



Slide 41

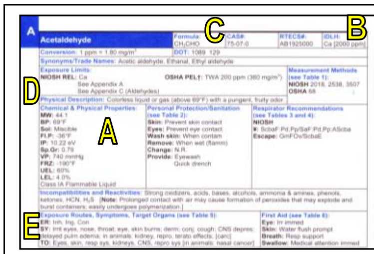
Roman Numeral Pages

Explain how to use the pocket guide

- Table 2 Personal Protection and Sanitation Codes
- Table 3 Symbols, Code Component, and Code used for Respiratory Selection
- Table 4 Selection of N-, R-, or P-Series Particulate Respirators
- Table 5 Abbreviation of Exposure routes, Symptoms, and Target Organs
- Table 6 Codes for First Aide Data

Materials are listed Alphabetically

Slide 42



A

C

B

Acetaldehyde | Formula: CH_3CHO | CAS#: 75-07-0 | RTECS#: AB1925000 | IDLH: Ca [2000 ppm]

Conversion: 1 ppm = 1.80 mg/m^3 | DOT: 1089 129

Synonyms/Trade Names: Acetic aldehyde, Ethanal, Ethyl aldehyde

D

Exposure Limits:
NIOSH REL: Ca
See Appendix A
See Appendix C (Aldehydes)
OSHA PEL†: TWA 200 ppm (360 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 2018, 2538, 3507
OSHA 68

Physical Description: Colorless liquid or gas (above 69°F) with a pungent, fruity odor.

A

Chemical & Physical Properties:
MW: 44.1
BP: 69°F
Sol: Miscible
Fl.P: -36°F
IP: 10.22 eV
Sp.Gr: 0.79
VP: 740 mmHg
FRZ: -190°F
UEL: 60%
LEL: 4.0%
Class IA Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, acids, bases, alcohols, ammonia & amines, phenols, ketones, HCN, H_2S [Note: Prolonged contact with air may cause formation of peroxides that may explode and burst containers; easily undergoes polymerization.]

E

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, nose, throat; eye, skin burns; derm; conj; cough; CNS depres; delayed pulm edema; in animals: kidney, repro, terato effects; [carc]
TO: Eyes, skin, resp sys, kidneys, CNS, repro sys [in animals: nasal cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Water flush prompt
Breath: Resp support
Swallow: Medical attention immed

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Using NIOSH & ERG

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Slide 45

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Slide 46

Isolation & Denial of Entry

- Scene control, site management, and personnel accountability are critical
- The course of a hazardous material incident is often determined in the first five to fifteen minutes

Slide 47

Isolation Perimeter

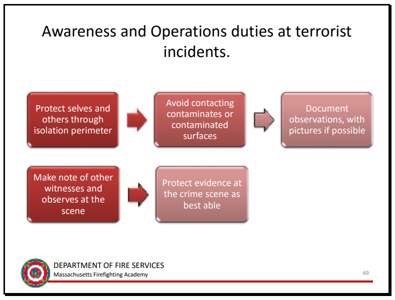
Outer boundary of an incident that is controlled to prevent entrance by the public or unauthorized persons

Slide 48

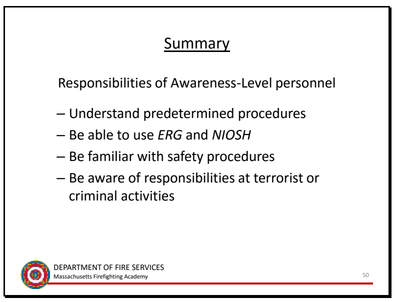
<u>REVIEW QUESTION</u>

What is an isolation perimeter?

Slide 49



Slide 50



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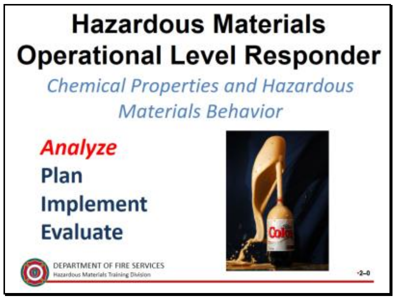

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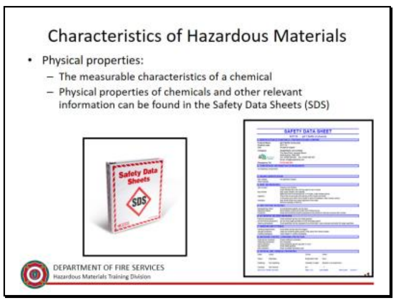

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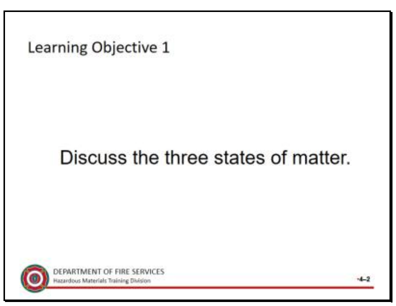

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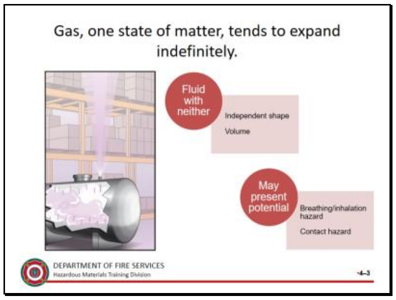

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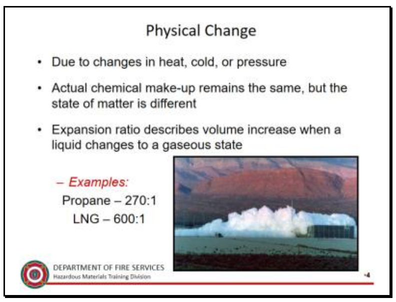

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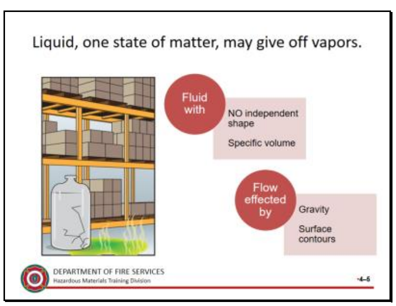

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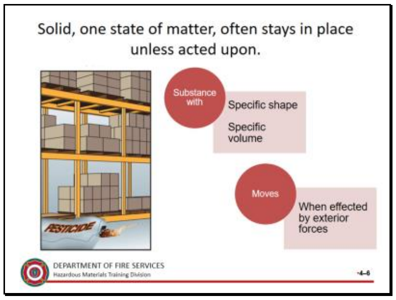

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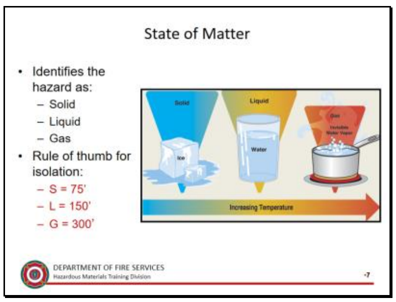

Slide 9

Slide 10

Learning Objective 2

Discuss the flammability of various hazardous materials.

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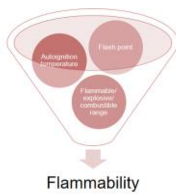
4–9

Slide 11

Flammability depends on three properties.



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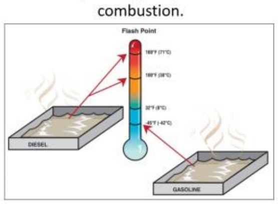
Hazardous Materials Training Division
4–10

Slide 12

Flash point is the temperature at which there are sufficient vapors to ignite, but not sustain combustion.



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4–11

Slide 13

Flash Point

- Temperature at which a liquid will give off enough vapor to ignite if subjected to an ignition source
- Some flammable solids also have FP's
  - Fire point is the temperature at which sustained combustion will occur
  - Usually a few degrees above the flash point

Gasoline Flash Point: -45 to – 50°F
Diesel fuel FP: 120 – 140°F
Ethanol FP: 55° F

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Slide 14

DISCUSSION QUESTION

What is fire point?
How is it different from flash point?

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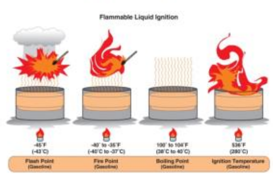
4-13

Slide 15

Autoignition temperature is the level to which the fuel in air must be heated to initiate self-sustained combustion.



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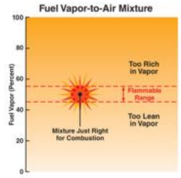
-4-14

Slide 16

The flammable, explosive, or combustible range helps to establish the lower and upper explosive limits.



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4-15

Slide 17

Flammable Range

- Range of mixtures of fuel and air that will support combustion if subjected to an ignition source
  - Lower Explosive Limit (LEL)
  - Upper Explosive Limit (UEL)
  - Examples:
    - Methane = 5-15%
    - Propane = 2.2-9.5%
    - Gasoline = 1.4-7.6%
    - Ethanol = 3.3-19%
    - Ethylene Oxide= 3-100%

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Slide 18

REVIEW QUESTION

Define lower explosive limit (LEL) and upper explosive limit (UEL).

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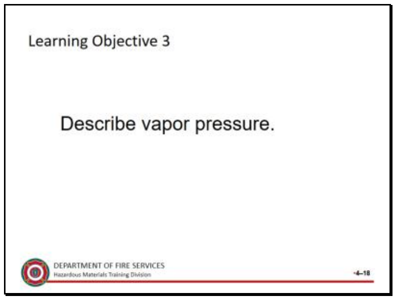
Hazardous Materials Training Division

Slide 19



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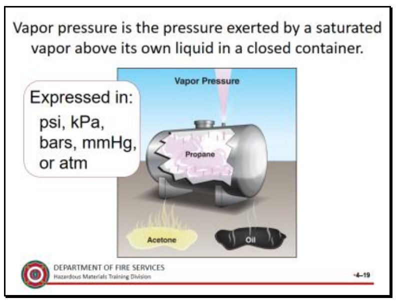

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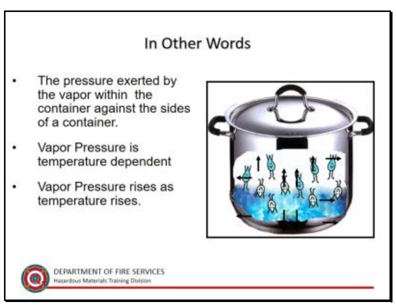


Slide 22

Vapor Pressure

- VP comparison:
  Acetone = 180 mmHg
  Water = 25 mmHg
  (Remember: wata is a quata)

Solids	Liquids	Liquids giving Off vapors	Gas
Powders, Gels, etc.	25mm/hg water	Gasoline, Ethanol, Polars	760mm/hg 14.7 psi 1 atm

Slide 23

Learning Objective 4

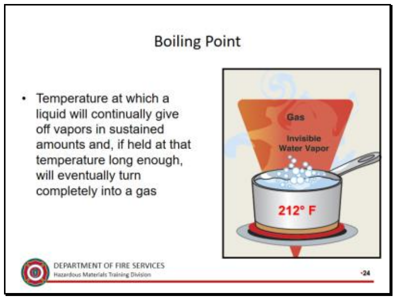
Explain boiling point.

Slide 24

Boiling Point

- Temperature at which the vapor pressure of a liquid is equal to or greater than atmospheric pressure
- Usually expressed in degrees Fahrenheit (Celsius) at sea level air pressure

Slide 25



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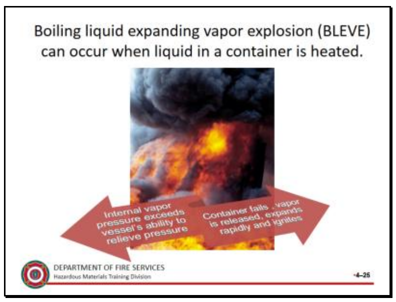


Slide 27

Slide 28

Learning Objective 5

Define melting point, freezing point, and sublimation.

Slide 29

Melting and freezing point definitions are based on normal atmospheric pressure.

Melting point
- Temperature at which a solid substance changes to a liquid state

Freezing point
- Temperature at which liquid becomes a solid

Slide 30

Sublimation is a change from solid to gas state without going into a liquid state.

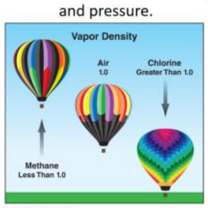
Slide 31

Learning Objective 6

Describe vapor density.

Slide 32

Vapor density is the weight of gases compared to the same volume of air at similar temperature and pressure.



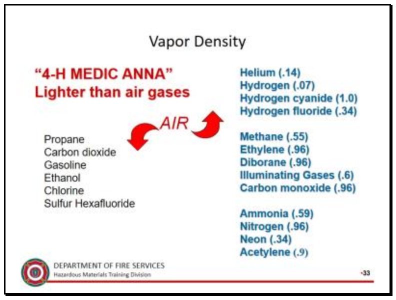
Slide 33

Vapor Density

- Weight of an airborne concentration (vapor or gas) compared to an equal volume of dry air
  - Vapor density of air at sea level is 1.0
    - Vapor density below 1.0 is lighter than air (rises)
    - Vapor density above 1.0 is heavier than air (sinks)

•Source; NIOSH: May also be referred to as RgasD
•(Relative gas Density) Molecular weight of Air = 28.9

Slide 34



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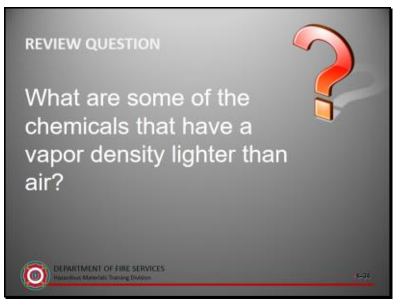

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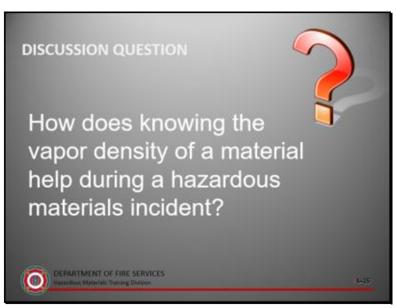


Slide 37

Learning Objective 7

Define solubility and miscibility.

Slide 38

Solubility is useful in determining spill clean up methods and extinguishing agents.

- Percentage of a material that will dissolve in water at ambient temperature
- Affects if substances mixes with water
- Important contributor in symptom development

Slide 39

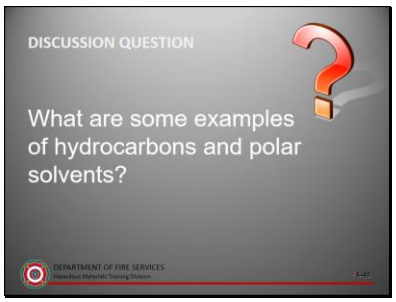
Water Miscibility

- Ability of a chemical to mix with water
- Not all chemicals mix well with water
  - Some substances react violently with water
    - Concentrated sulfuric acid
    - Metallic sodium
    - Magnesium

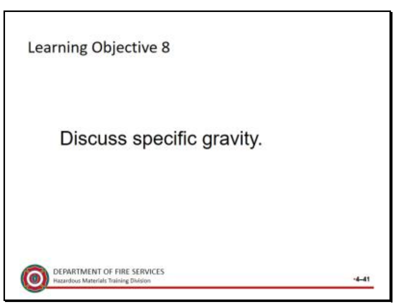
Diesel is immiscible in water
Photo Source: Wikipedia

Slide 40

Slide 41

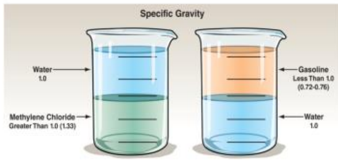


Slide 42



Slide 43

Specific gravity is directly influenced by solubility.



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Slide 44

Specific Gravity

- The ratio of a substance's density to that of *water*
- Specific gravity of water is 1.0
  - Specific gravity below 1.0 is lighter than water (floats)
  - Specific gravity above 1.0 is heavier than water (sinks)
- *Most flammable liquids have a specific gravity of less than 1.0*

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Slide 45

Learning Objective 9

Define persistence.

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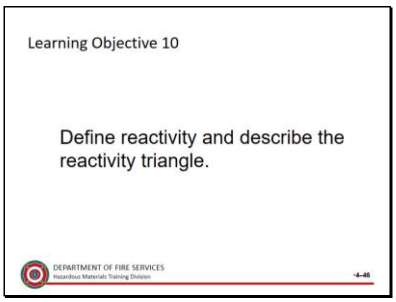
Slide 46

Slide 47



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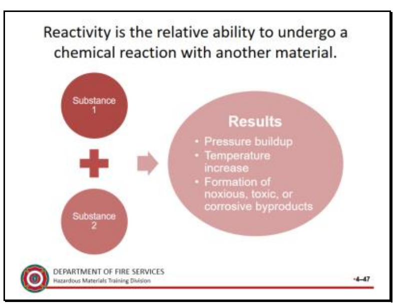


Slide 49

The reactivity triangle explains the basic components of many chemical reactions.

Slide 50

Reactivity can be effected by polymerization and inhibitors.

Polymerization

- Simple molecules combine to form long chain molecules
- May be marked with a *P* in the *ERG*

Inhibitors

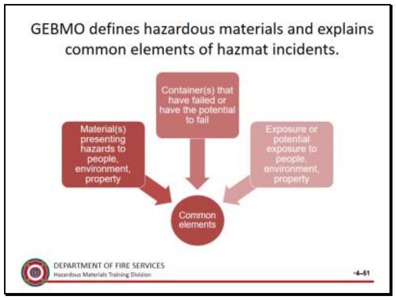
- Materials added to products that easily polymerize to control or prevent undesired reaction
- May be time sensitive

Slide 51

Learning Objective 11

Describe the General Hazardous Materials Behavior Model (GEBMO).

Slide 52



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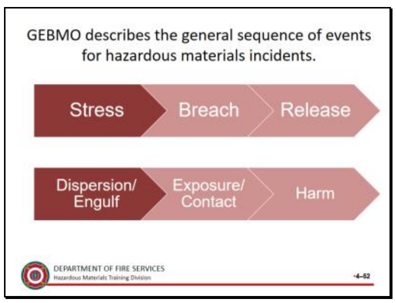
Slide 53



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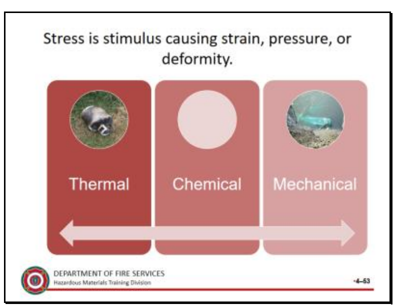

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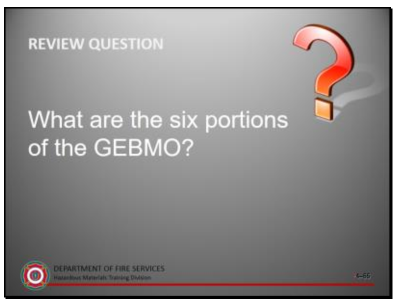

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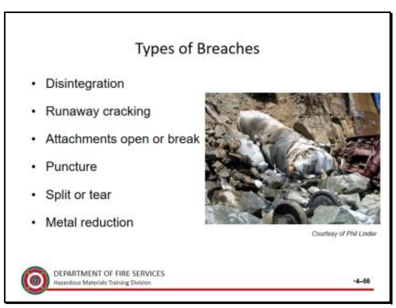

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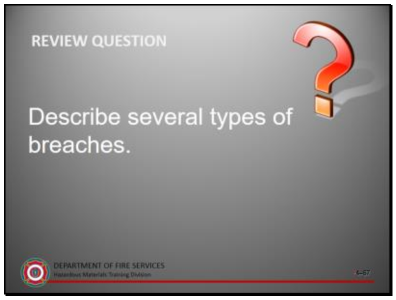

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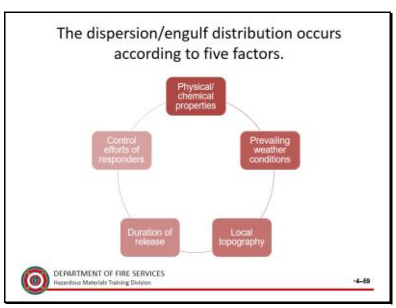

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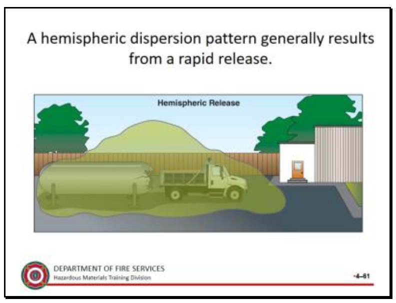

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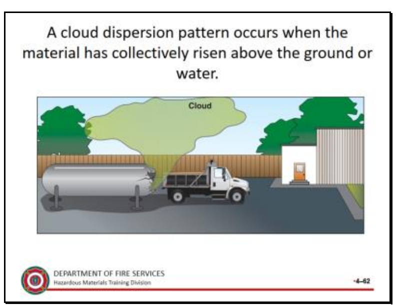

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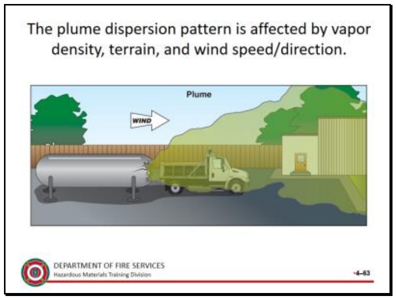

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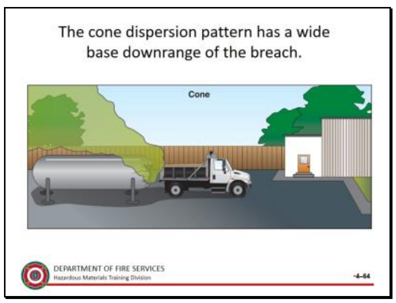

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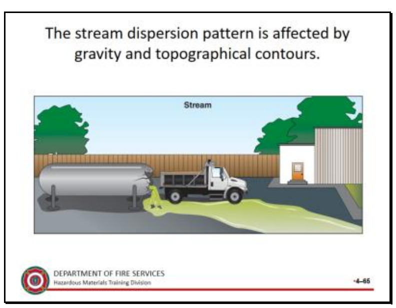

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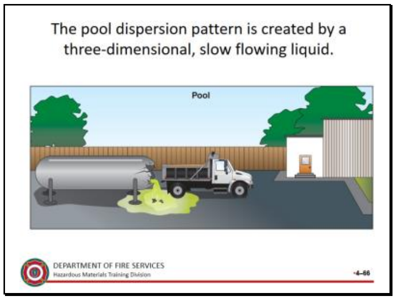

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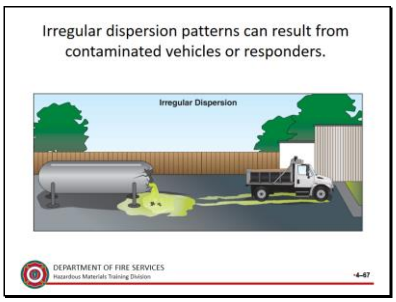

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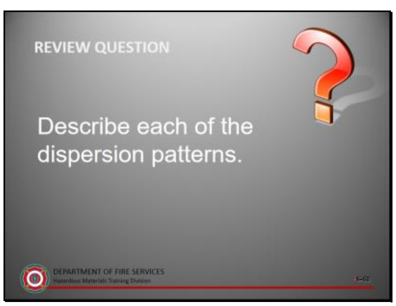

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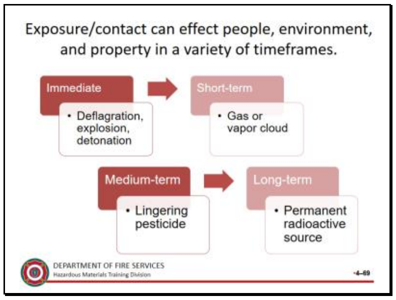

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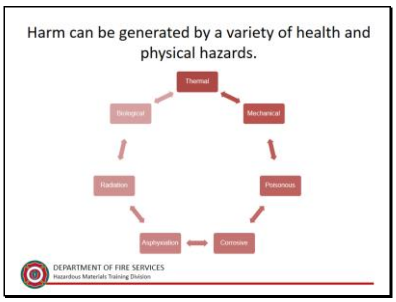

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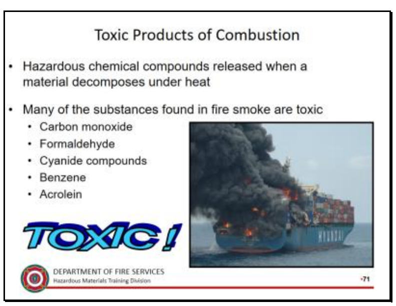

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Cyanide

- Cyanide production in a fire
  - Hydrogen cyanide is produced by incomplete combustion of nitrogen and carbon containing substances (-C≡N)
    - Natural Fibers (wool, silk, cotton, paper)
    - Synthetic polymers (nylon, polyurethane)
    - Synthetic rubber
    - Melamine (resins for molding, laminating, etc.)


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Cyanide-Dose Makes the Poison

Normal levels of whole blood are believed to be between 0 to 20 micrograms per deciliter (ug/dl).

Concentrations mg/m3	PPM	Effect
300 mg/m3	270 ppm	Immediately Lethal
200mg/m3	180 ppm	Lethal after 10 minutes
150mg/m3	135 ppm	Lethal after 30 minutes
120-150mg/m3	108-135 ppm	Highly dangerous (Fatal) after 30-60 minutes
20-40mg/m3	18-36 ppm	Light symptoms after several hours

Slide 75

Cyanide

- Cyanide and carbon monoxide were both important determinants of smoke inhalation-associated morbidity and mortality
- Cyanide concentrations were directly related to the probability of death
- Cyanide may have dominated over CO as a cause of death in some fire victims and Firefighters
- Cyanide and CO may have potentiated the toxic effects of one another

Slide 76

REVIEW QUESTION

What types of exposures should be considered in hazard and risk assessment?

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Contamination

- Residue of a chemical that has been released, and contacts people, the environment, animals, tools, etc.

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Secondary Contamination

- Occurs when a person or object transfer the contamination or the source of contamination to another person or object by direct contact

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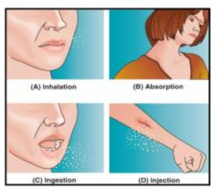
Types of Harm (TRACEM-P)

- Thermal
- Radiological
- Asphyxiation
- Chemical
- Etiological
- Mechanical
- Psychogenic

Slide 80

How Harmful Substances Enter the Human Body

- Four routes of entry:
  - Inhalation
  - Absorption
  - Ingestion
  - Injection



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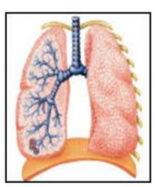
Inhalation

- Occurs when harmful substances are brought into the body through respiratory system
- SCBA and other respiration protection devices are best protection against inhalation hazards
- Size of the particles inhaled determines where the internal contamination will result



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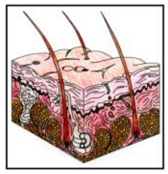
Absorption

- Process by which hazardous materials travel through body tissues until they reach the bloodstream
- Skin functions as a shield, but that shield can be pierced by some chemicals
- Turnout gear may not provide proper protection
  - Eyes and ears also absorption routes



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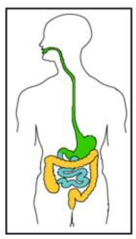
Ingestion

- Process by which chemicals enter the body through the gastrointestinal tract
  - Eating, drinking, chewing/smoking tobacco
- Contaminants can be ingested if the fire fighter does not wash thoroughly before eating or drinking after a fire or hazardous materials incident



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Injection

- Hazardous materials entering cuts or other breaches in the skin
- Any cuts or open wounds should be addressed before reporting for duty
- Open wounds are a direct portal to the bloodstream

Slide 85

Chronic Health Hazard

- Adverse effect occurring after a long-term exposure to a substance
  - Or multiple short exposures over a shorter period
- May result in cancer, loss of lung function, or skin rashes

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Acute Health Effects

- Adverse health effects caused by relatively short exposure periods that produce observable conditions such as eye irritation, coughing, dizziness, skin burns
  - Occurs after relatively short exposure periods, including one-time exposures

Slide 87

Sensitizer

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

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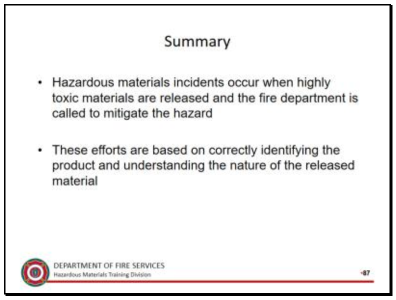

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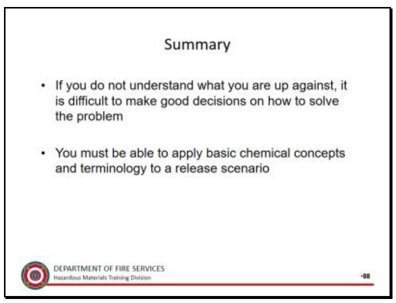

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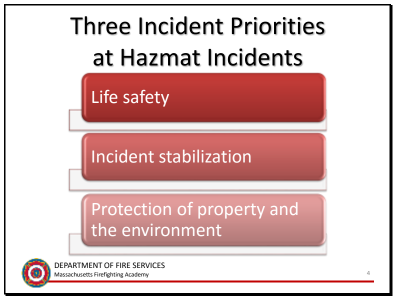

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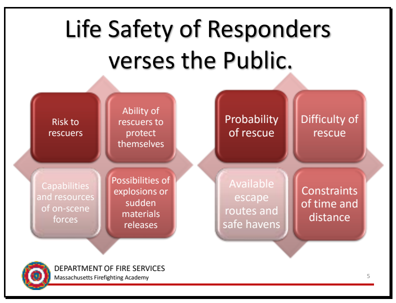

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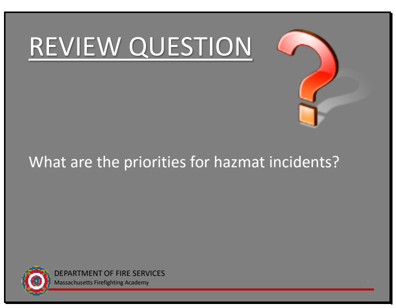

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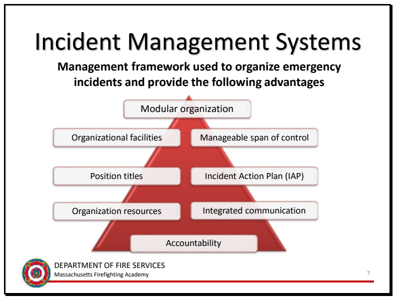

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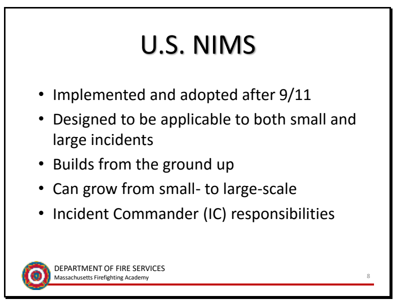

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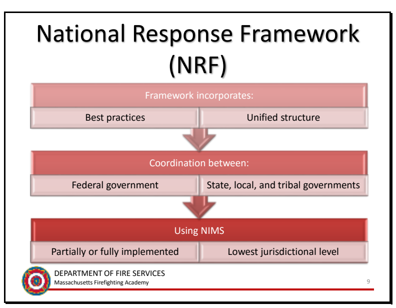

Slide 10

Command & Coordination Structures

NRF reflect that of NIMS

- Homeland Security
- Emergency Management
- Law Enforcement
- Fire Fighting
- Public Works
- Public Health
- Responder and recovery workers
- Health and safety
- Emergency Medical Services
- Private sector organizations

Slide 11

NRF's mission in the case of a catastrophic terrorist attack

- Save
- Protect
- Contain
- Preserve

Slide 12

NRF established teams and resources

- **Weapons of Mass Destruction-Civilian Support Teams (WMD-CST)**
- **Disaster Medical Assistance Teams (DMAT)**
- **Disaster Mortuary Operational Response Teams (DMORT)**
- **National Medical Response Team Weapons of Mass Destruction (NRMT – WMD)**
- **Urban Search and Rescue (US&R) Task Forces**
- **Incident Management Teams (IMT)**

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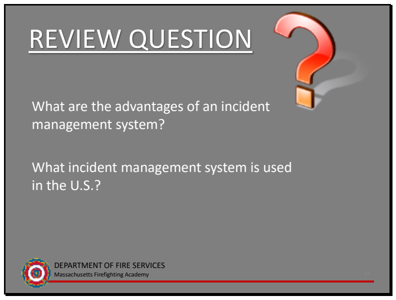

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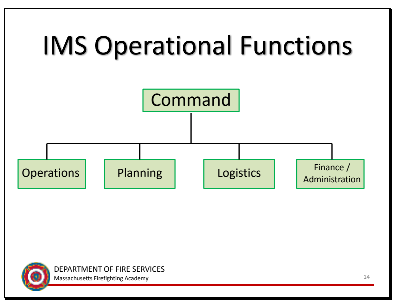

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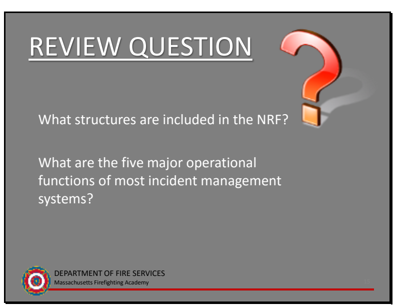

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Incident Commander

- The officer at the top of an incident chain of command and in overall command of the incident
- Responsible for formulating an incident action plan (IAP)
- Coordinate and direct all incident resources to implement the plan and meet its goals and objectives

Slide 17

Incident Commander Responsibilities

- Establishing the site safety plan
- Implement a site security and control plan to limit the number of personnel operating in the control zones
- Designate a safety officer
- Identify the material or conditions involved in the incident

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Incident Commander Responsibilities

- Implement appropriate emergency operations
- Ensure that all emergency responders wear appropriate PPE in restricted zones
- Establish a decontamination plan and operation
- Implement post-incident emergency response procedures

Slide 19

Command Post

- The main hub of the ICS
- ICP is the collection point for all information and resources
- Must be located in the cold zone upwind and upgrade from the spill or leak to keep it from becoming contaminated

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Safety Officer

- Responsible for monitoring and identifying hazardous and unsafe situations and developing measures for ensuring operational and personnel safety
- Besides the Incident Commander has the right to ***STOP*** the incident if deemed necessary

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Duties of a Safety Officer

- Obtain a briefing from the IC
- Review IAP's for safety issues
- Identify hazardous situations at the incident scene
- Participate in the preparation and monitoring of incident safety considerations, including medical monitoring of entry team personnel before and after entry

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Duties of a Safety Officer

- Maintain communications with the IC, and advise the IC of deviations from the incident safety considerations and of any dangerous situations
- Alter, suspend, or terminate any activity that is judged to be unsafe
- Conduct safety briefings

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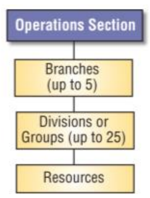
Operations Officer

- Responsible for the direct management of all incident tactical activities
- Operations Section Chief reports directly to the IC
- Also directs the tactical operations to meet the strategic goals developed by the IC



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Planning Section

- Responsible for gathering, assimilating, analyzing, and processing information needed for effective decision-making

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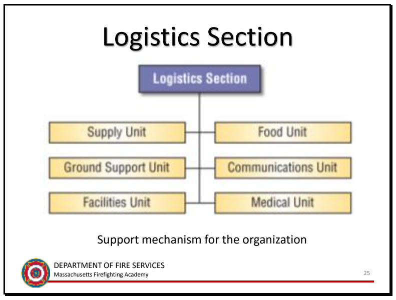

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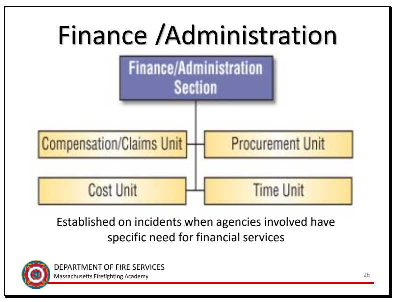

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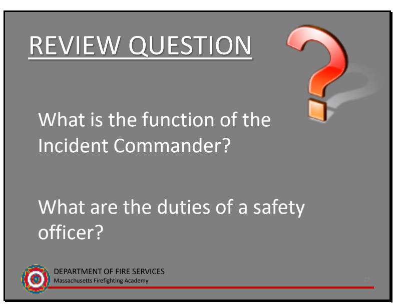

Slide 28

Staging Area

- Where personnel and equipment are waiting assignment to the incident are held
- Keeps responders and their equipment a short distance from the scene until they are needed
- Minimizes confusion at the scene

Slide 29

Establishment & Transfer of Command

- Person
- Arriving

First

Keeps until

- Rank
- Training

- Capable
- Accept

BEFORE transfer

Slide 30

Establishment & Transfer of Command

- Face to face
- Radio

Transfer

ONLY

- On-scene

- Briefing
- Status report

Clear picture

Slide 31

Establishment & Transfer of Command

- Information by repeating it back

Acknowledges

Transferred

- Several times
- ANNOUNCED by former IC

- One person issues all orders

ONE

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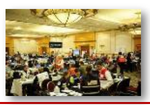
Slide 32

Unified Command

- Accomplishes control of an incident involving multiple agencies with overlapping authority and responsibility
- All agencies that have a jurisdictional responsibility at a multijurisdictional incident contribute to the process through various actions



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Unified Command

- Memorandum of understanding
- Agencies that may be involved in controlling hazardous material incidents
- Responsible or lead agency
- Objectives that can be accomplished when organizations work together to develop hazmat pre-incident surveys

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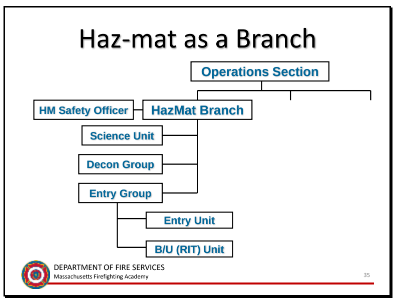

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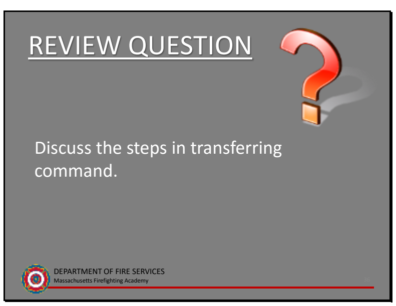

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Communications

Radio Procedures

- Use ***Plain Language***
- Transmit only ***essential information*** when sending information and orders
- Use appropriate channel to communicate with both the IC and the dispatcher
- Use appropriate number of channels for the size and complexity of the incident

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Communications

Requesting Additional Help

- Know what types of additional help are available
- Identify these items in the local emergency response plan

Slide 39

Communications

Emergency Radio Traffic

- Make the urgency clear to the tele communicator
- Wait while the tele communicator gives an alert tone (if used in the system), advise all other units to standby, and advise the caller to proceed with the emergency message

URGENT, URGENT

MAYDAY, MAYDAY, MAYDAY

Slide 40

Communications

Evacuation Signals

- Broadcast a radio message ordering evacuation
- Sound audible warning devices (siren and air horns) on the apparatus at the incident scene for an extended period
- Broadcast the message several times

Slide 41

Communications

- External
  - Onsite and offsite
  - Primary means
- Internal
  - Responders on scene
  - Examples

Slide 42

External Communications

- Radios
- Cell Phones
- Noisemakers
- Visual Signs

Slide 43

Internal Communications

- Alerting team members to emergencies
- Passing along safety information
- Communicating changes in the action plan
- Maintaining site control

Slide 44

REVIEW QUESTION

What are some guidelines for using communications equipment correctly?

Slide 45

Summary

- Emergency response to hazmat incidents must be conducted with a certain management framework and structure to ensure successful mitigation of the incident.
- IMS must be implemented at all incidents.

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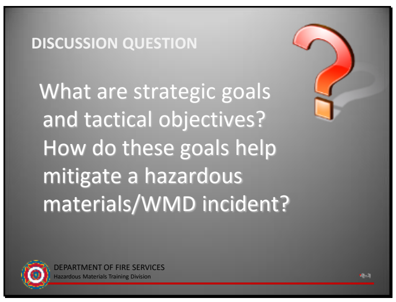

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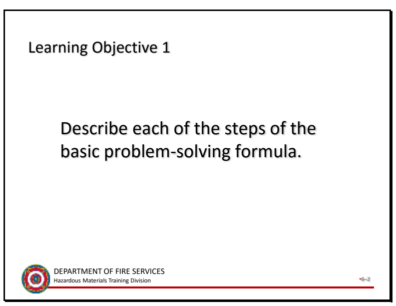

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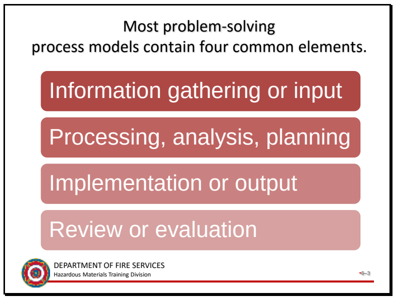

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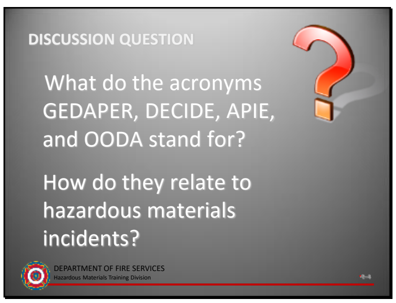

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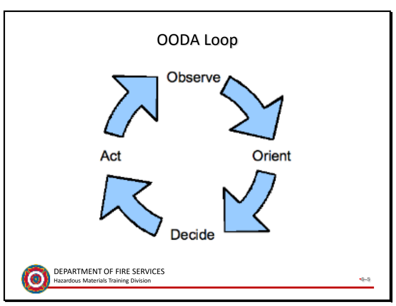

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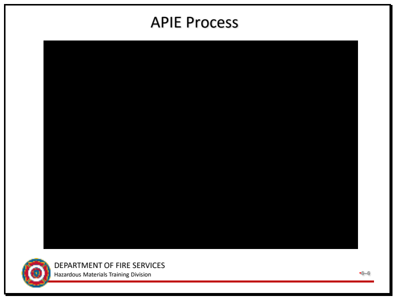

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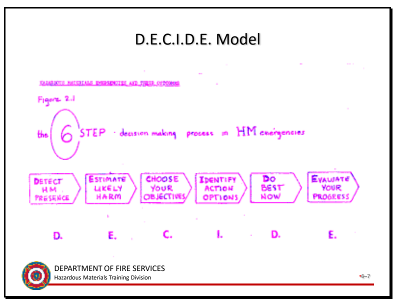

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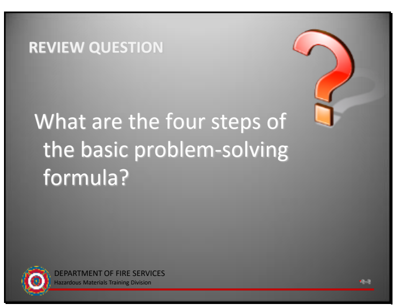

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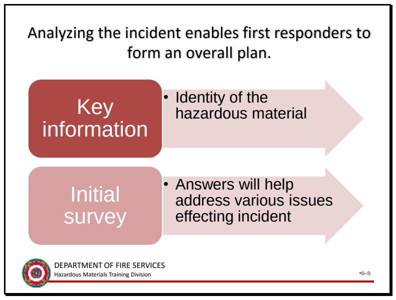

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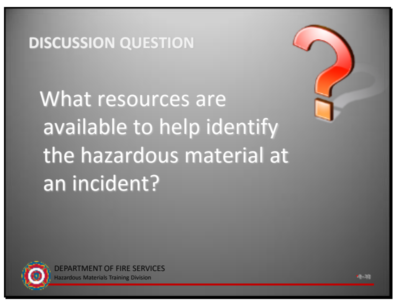

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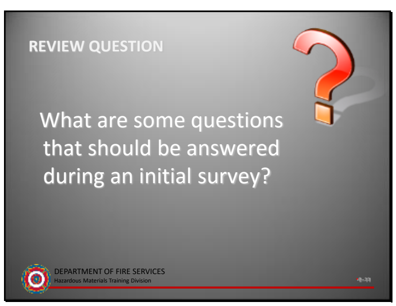

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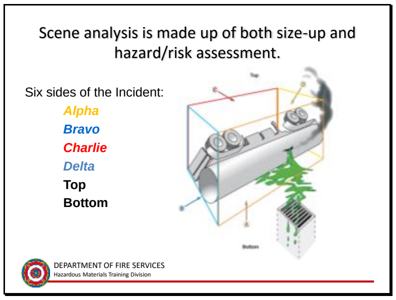

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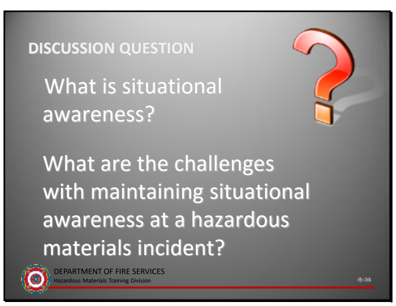

Slide 16

Identification

- When researching a chemical use readily available resource information sources
  - DOT-ERG/NIOSH Pocket Guide/MSDS
  - Consult at least three different sources if possible
- On-scene research should continue throughout the incident

We Must ID the Material !!

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Slide 17

An Incident Level I is within the capabilities of a fire and emergency services organization.

Courtesy of Rich Mahaney

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Slide 18

An Incident Level II is beyond the capabilities of a fire and emergency services organization.

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Slide 19

An Incident Level III requires outside resources and unified command.

Courtesy of Chris Mickal

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Slide 20

REVIEW QUESTION

Describe each of the incident levels.

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Slide 21

Planning the appropriate response uses strategic goals based on three abilities.

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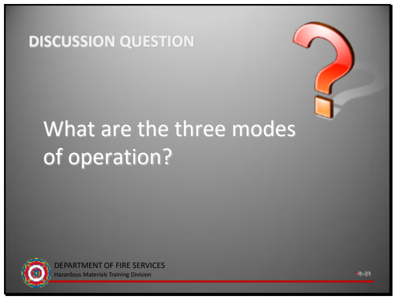

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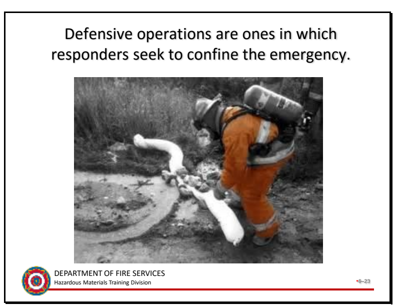

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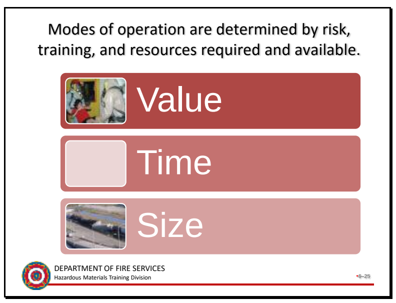

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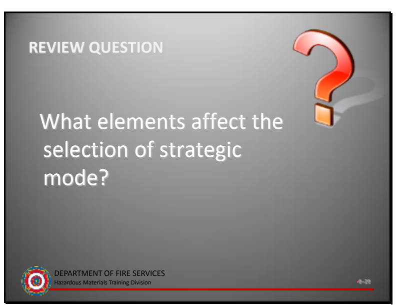

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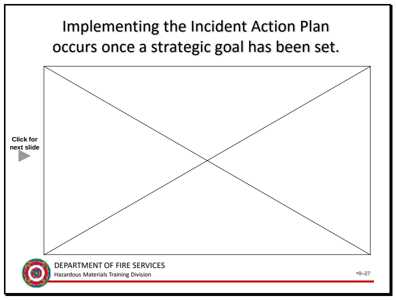

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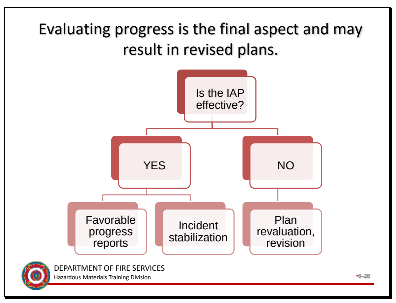

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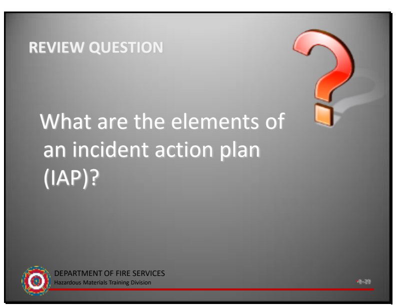

Slide 31

Learning Objective 2

Discuss isolation and scene control.

Slide 32

The isolation perimeter is determined by outcomes of an on-site risk assessment.

Slide 33

Scene Safety

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- Scene control, site management, and personnel accountability are critical
- The course of a hazardous material incident is often determined in the first five to fifteen minutes

Slide 34

What is a Risk-Benefit Response for Haz-Mat Incidents?

- If hazardous material is covering a large area and negatively affecting many people, responding personnel must withdraw for their own safety

Slide 35

Exposures

- People, property, structures, or the environment
- Number of exposures is dictated by location
  - Urban areas, many exposures
  - Rural areas, fewer exposures

Slide 36

Evacuation

- One of the top priorities of the first responder
  - Must be performed in PPE
- Has significant risks, even when properly planned
- May include traveling to homes to advise residents to leave

Slide 37

Evacuation

- Determine a safe and suitable shelter
- Temporary evacuation areas
- Transportation must be arranged

Slide 38

Evacuation

- Determine initial areas to be evacuated
  - Refer to DOT ERG
- Use devices to monitor concentrations and rate of movement of hazardous material

Slide 39

Shelter-in-Place

- Safeguarding people
- Doors and windows stay closed
- Ventilation systems shut

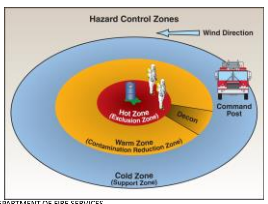
Slide 40

Evacuation or Shelter-in-Place

- Chemical properties of the material(s) determines whether to shelter-in-place or evacuate
- Expected duration of incident is a factor
- The ability to evacuate is determined by available resources

Slide 41

Hazard-control zones may be adjusted as the incident changes.



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Each hazard control zone helps protect both responders, the public, and the environment.

Slide 43

REVIEW QUESTION

Describe the hazard-control zones.

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Slide 44

Staging is located at an isolated, safe spot to reduce confusion and freelancing on scene.

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Learning Objective 3

Explain the notification process.

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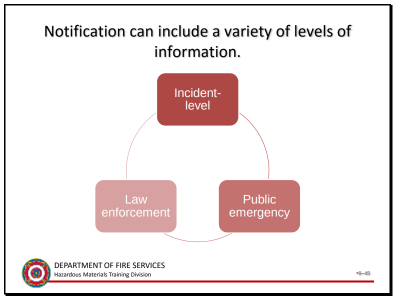

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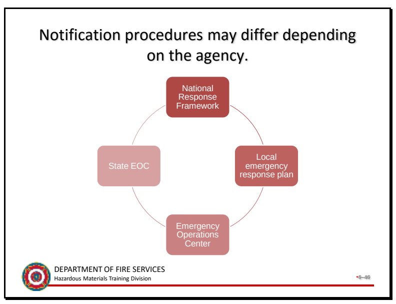

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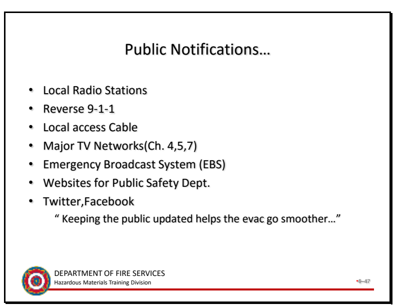


Slide 49

Learning Objective 4

Discuss protection of responders, the public, the environment, and property.

Slide 50

Protection is the overall goal of ensuring safety of responders and the public.

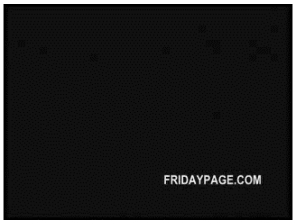
Courtesy of U.S. Air Force

Slide 51

Protection of responders is the first priority at any incident.

Slide 52

Situational Awareness



Slide 53

DISCUSSION QUESTION

How many members must make up a hazmat team working within the hazardous area?

Slide 54

Massachusetts Hazmat/CBRNE Incident Response Activation Levels

Tier Response	*Situation*
1- TOMs Unit (ORU Optional) (5 Techs) *Modified Tier 1	Hazard & Risk Assessment or Suspicious Substance Investigation *Air Monitoring at Fire Scenes
2- TOMs Unit & ORU (1/2 the Team)	Short Term Entry Operation
3- TOMs Unit & ORU(s) (Full Team)	Long Term and/or Immediate Life Safety Risk
4- Multi-Team	Major Release or Extended Operation
5- Full Hazmat System, plus Bomb Squad and CST activated	WMD or Mass Casualty Event

Slide 55

Massachusetts Chemical/Radiological/Biological Incident Response Activation Levels

Statewide Mass Decontamination Response System

Level	Response	Situation	State HM Response
Mass Decon **A**	I/C requests specific MDUs event (deployment not pre-planned)	Limited/Controlled	Tier 3
Mass Decon **B**	1-2 District MDU's to scene & MDUs to <u>local</u> hospitals	<u>Moderate:</u> single facility limited occupancy (office building)	Tier 3

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Massachusetts Chemical/Radiological/Biological Incident Response Activation Levels

Statewide Mass Decontamination Response System

Level	Response	Situation	State HM Response
Mass Decon **C**	5 - 7 MDUs to scene & hospitals in effected & surrounding fire districts covered by MDUs	<u>Major</u>: Shopping Mall, Public Arena or multiple buildings	Tier 5
Mass Decon **D**	Up to 17 District MDUs to scene. Most hospitals in the state covered by MDUs	<u>Extreme</u>: Wide geographic area or major event	Tier 5

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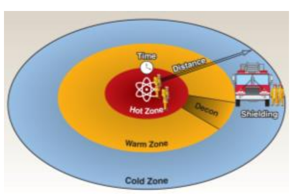
Protection of responders includes use of time, distance, and shielding.



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Protection of the public is based on several factors.

Material considerations → Environmental conditions → Population at risk

Courtesy of FEMA News Photos, photo by Win Henderson.

Slide 59

DISCUSSION QUESTION

How do responders determine who is most threatened by the incident?

Slide 60

Protection of the public can include several methods of providing safety.

- Evacuation
- Sheltering in place
- Protecting/ defending in place
- Rescue

Slide 61

Protection of the environment and property is a defensive control tactic.

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REVIEW QUESTION

What tactics are used to accomplish protection goals?

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Learning Objective 5

Describe recovery and termination.

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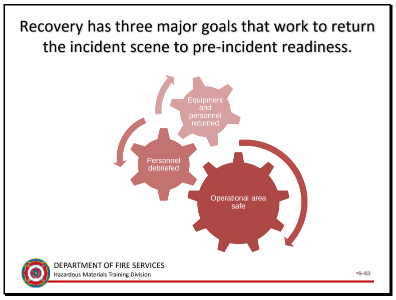

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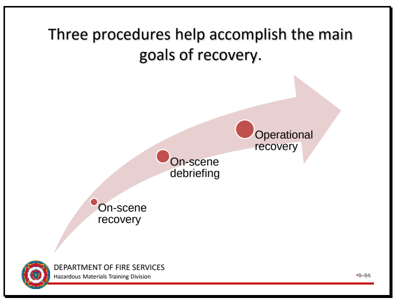

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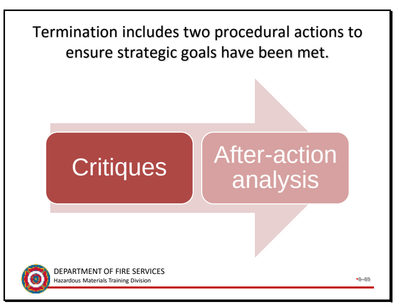

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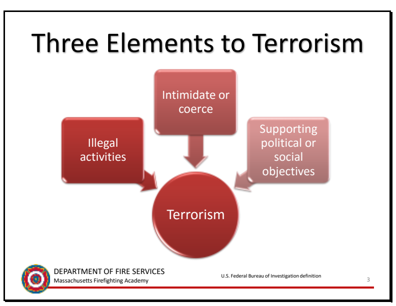
Summary

- By using IMS, responders can focus on the problem-solving process.
- The IC must determine the strategic goals and tactical objectives that will begin to stabilize the incident and bring it to a successful conclusion with the least amount of harm and damage.

Slide 1

Slide 2

Slide 3



Slide 4

Terrorism is designed to cause disruption, fear, and panic.

Courtesy of U.S. Department of Defense

Slide 5

REVIEW QUESTION

What is the definition of terrorism?

Slide 6

Routine Emergency / Terrorist Attack

Some of the key differences between more routine emergencies and terrorist attacks

- Intent
- Severity & Complexity
- Crime Scene Management
- Command Structure
- Secondary Devices/Attacks and Armed Assault

Slide 7

Intent

An act of terrorism is essentially different from normal emergencies in that it is intended to cause damage, inflict harm and kill

Boston Marathon Bombing
(Google Images)

Slide 8

Severity & Complexity

- Terrorists events may involve large numbers of casualties or materials with which first responders have little experience (i.e. radioactive material)
- Secondary contamination from handling patients may present a threat

Slide 9

Crime Scene Management

- Terrorists attacks are crimes, and preservation of evidence becomes extremely important consideration during a response to a terrorist attack
- For this reason, notification of federal law enforcement is very important

Pan AM Flight 103 Lockerbie Scotland
(Google Images)

Slide 10

Command Structure

- Most terrorist incidents require some type of unified command structure
- Law enforcement will have jurisdiction over all incidents involving terrorism

Slide 11

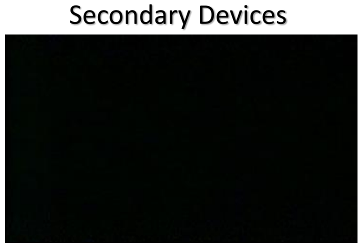
Secondary Devices

Terrorists may specifically target emergency responders in an attempt to incapacitate them of kill them

- Secondary events intended to incapacitate or delay emergency responders
- Armed resistance and assault
- Use of weapons
- Booby traps

Slide 12

Secondary Devices



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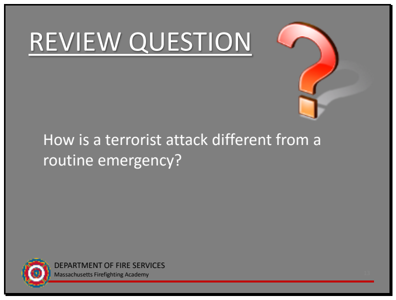

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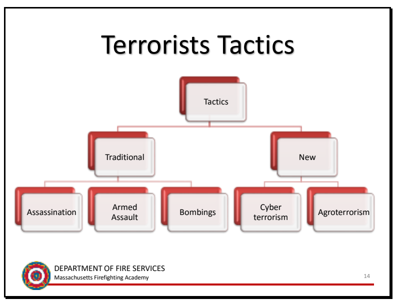

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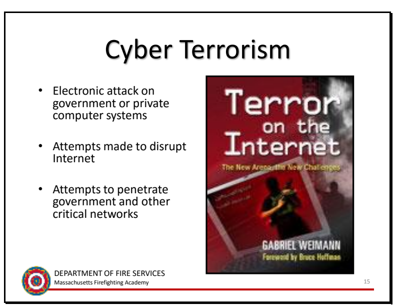

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Agro-terrorism

- Use of chemical or biologic agents to attack agricultural industry or food supply
- Introduction of disease to livestock
- Billion dollar financial loss possible

Slide 17

Weapon of Mass Destruction

Can be divided into five categories

- Chemical
- Biological
- Radiological
- Nuclear
- Explosive

Slide 18

Explosive devices are designed to kill, maim, or destroy

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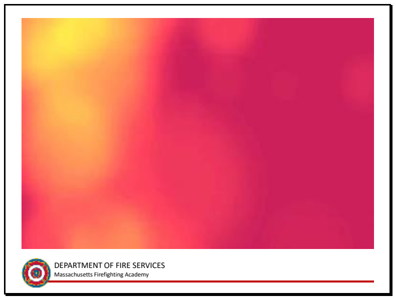

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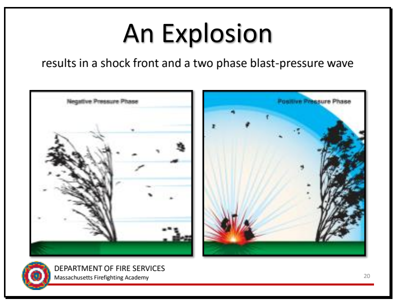

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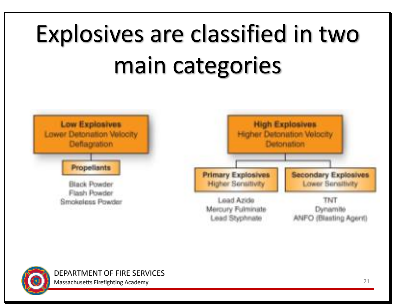

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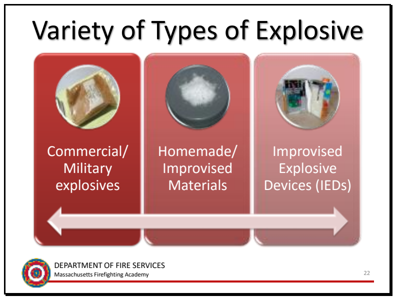

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Slide 25

Improvised Explosive Devices (IED)

They are homemade, usually constructed for a specific target, and can be contained within almost any object


Often include nails, tacks, broken glass, bolts & other items

Slide 26

IEDs Categorized by Container Type

Vehicle bombs

Pipe bombs

Slide 27

IEDs Categorized by Container Type

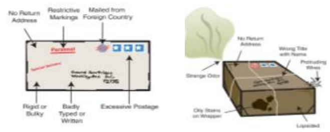
Satchel, backpack, knapsack, duffle bag, briefcase, or box bombs

Person-borne bombs

Slide 28

Mail, Package, & Letter Bombs

Common indicators



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IEDs Found in Various Forms

Slide 30

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Slide 32

Identification of IEDs

be cautious of out-of-the-ordinary items.

Containers with unknown	Devices containing quantities of	Materials attached to or surrounding items such as	Ordinance such as
liquids	fuses, fireworks, match heads	nails, bolts, drill bits	blasting caps, detcord
materials	black powder, smokeless powder	marbles, etc.	military and commercial explosives, grenades, etc.
	incendiary or unusual materials		

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Person-Borne Improvised Device

The FBI has designated indicators of a possible Suicide Bomber

Alone and Nervous
Loose and/or bulky clothing
Exposed wires (poss. through sleeve)
Rigid mid-section (explosive device or weapon)
Tightened hands (may hold a detonator)

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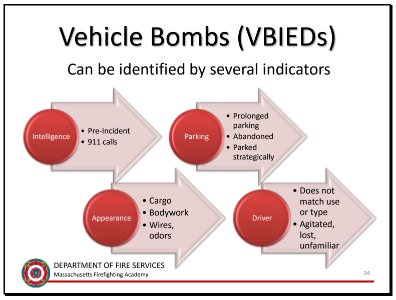

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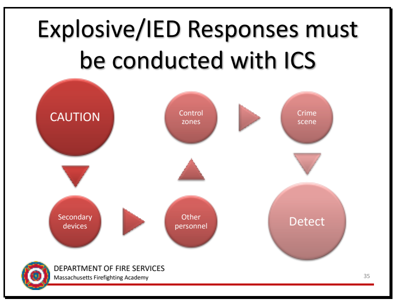

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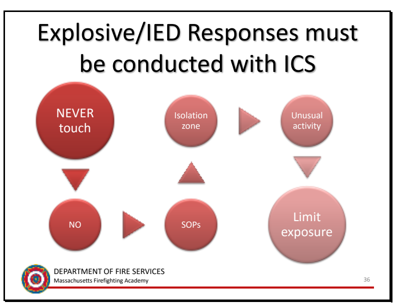

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Chemical Attack

The deliberate release of a toxic gas, liquid, or solid that can poison people and the environment

Chemical agents

Toxic industrial materials

Slide 38

Nerve Agents

Salivation
Lacrimation
Urination
Defication
Gastroenteritis
Emisis
Miosis

Most toxic
- Stable
- Easily dispersed

Absorption
- Liquid
- Aerosolized liquid

Types
- Tabun
- Sarin
- Soman
- Cyclohexyl sarin
- V-agent

Slide 39

Blister Agents

Exposure to Mustard Gas

Act on
- Eyes
- Mucous membranes
- Lungs
- Skin
- Blood forming organs

Damage
- Inhaled
- Ingested

Types
- Sulfur mustards
- Nitrogen mustards
- Arsenical vesicants
- Halogenated oximes

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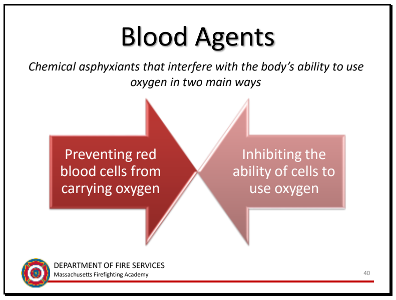

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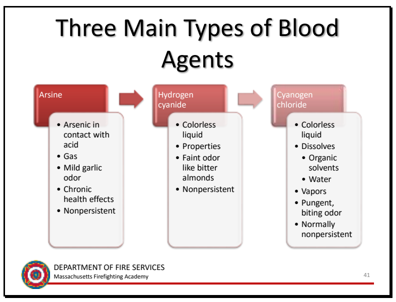

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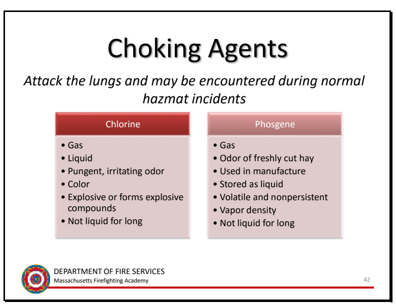

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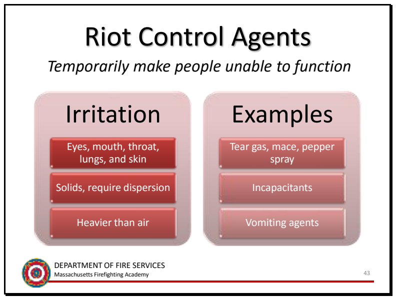

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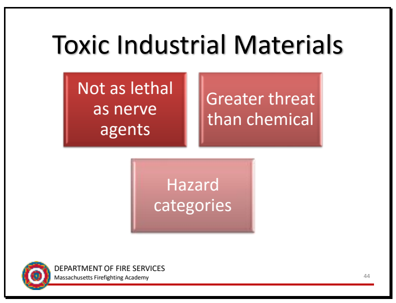

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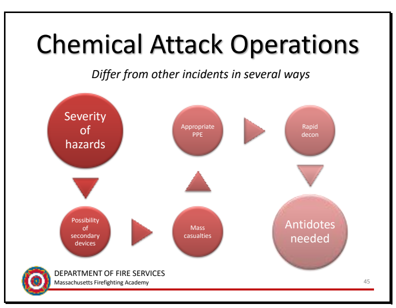

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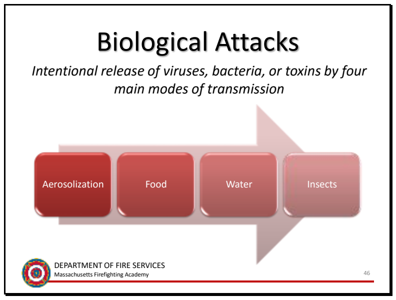

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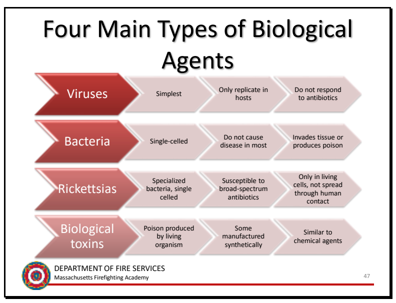

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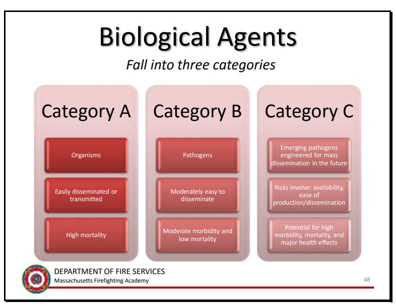

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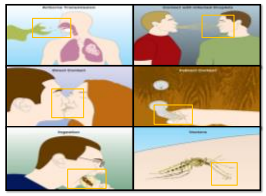
Infectious Disease Transmission



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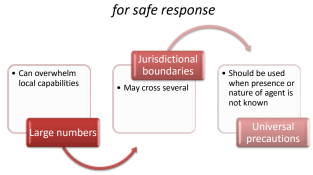
Biological Attack

Incident operations require both training and equipment for safe response



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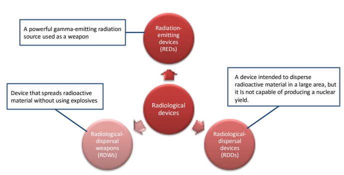
Radiological Devices

commonly categorized in three ways



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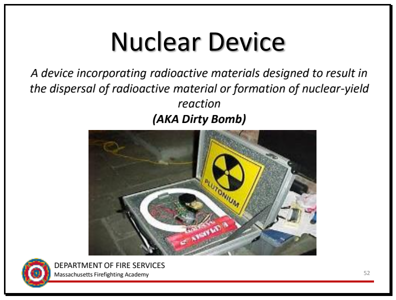

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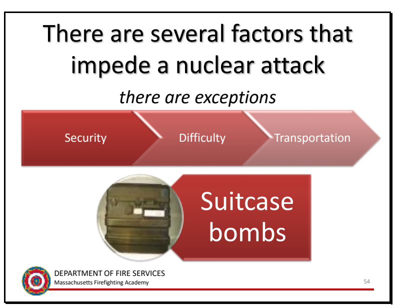

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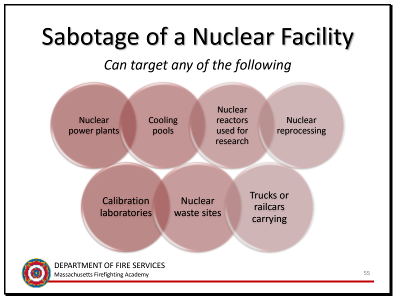

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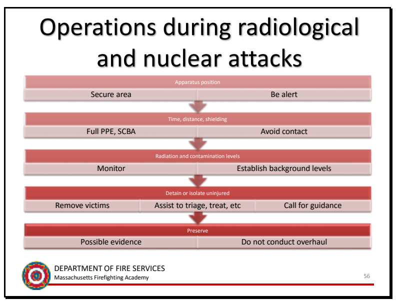

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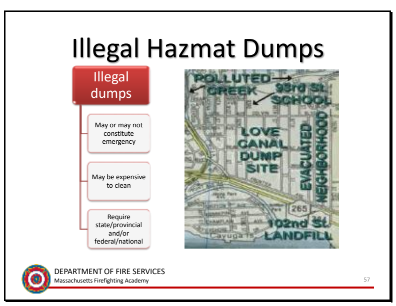

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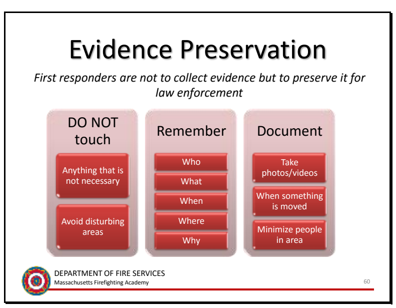


Slide 61

Evidence Preservation

First responders are not to collect evidence but to preserve it for law enforcement

Isolate	Identify	Evidence
Leave fatalities undisturbed	Witnesses	Collection points
Secure areas where evidence is found, report to law enforcement	Victims	Isolate possible contaminated food
	Evidence	Follow SOPs for crime scenes
	Preserve transient evidence	

Slide 62

Disasters can create haz-mat incidents in a variety of ways.

Containers can wash away and/or release contents.

Slide 63

Summary

- By using IMS, responders can focus on the problem-solving process.
- The IC must determine the strategic goals and tactical objectives that will begin to stabilize the incident and bring it to a successful conclusion with the least amount of harm and damage.

Slide 1

Hazardous Materials Operational Level Responder

Personal Protective Equipment

Analyze
Plan
Implement
Evaluate

Slide 2

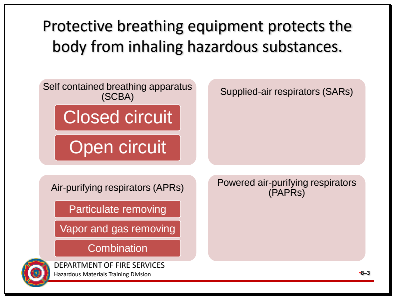
Learning Objective 1

Discuss respiratory protection.

Slide 3

Respiratory protection is a primary concern for first responders.

Slide 4



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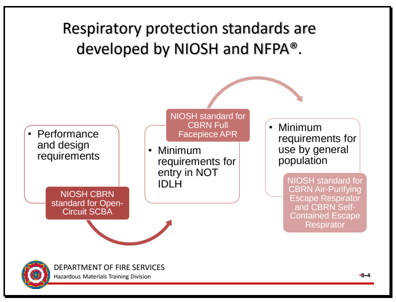

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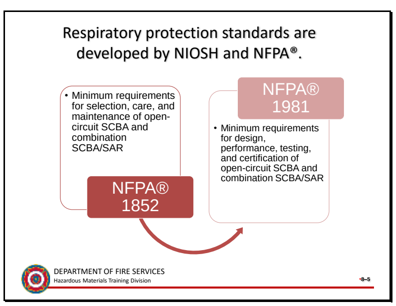

Slide 7

Respiratory protection standards are developed by NIOSH and NFPA®.

- Establishes major requirements for respiratory protection

OSHA Regulation
29 CFR 1910.134

NIOSH Regulation
42 CFR Part 84

- Establish
- Provide
- Specify

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Slide 8

A Self-Contained Breathing Apparatus (SCBA) can be one of the most important pieces of PPE.

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Slide 9

Only positive-pressure open-circuit or closed-circuit SCBAs are allowed in haz mat incidents.

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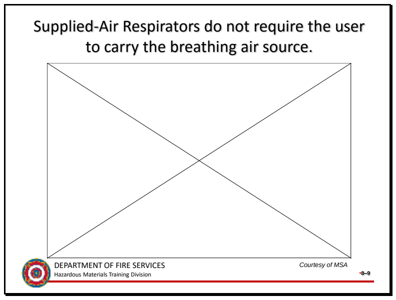

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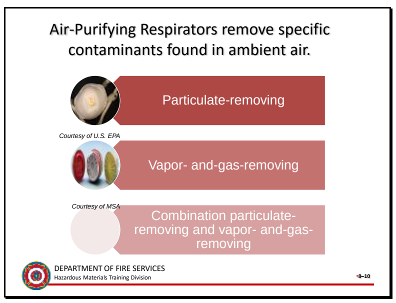

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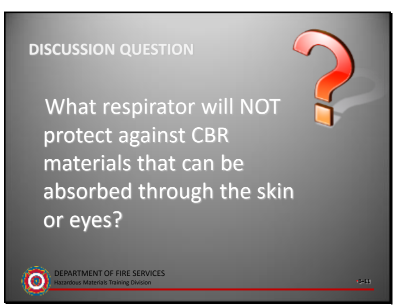

Slide 13

Responders must know the hazards present in the atmosphere in order to select the appropriate filter.

Courtesy of FEMA News Photos, photo by Jocelyn Augustino

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Slide 14

Precautions before using APRs include knowing the conditions at the incident.

KNOW	ENSURE
• What is present • How much is present	• Oxygen level is between 19.5-23.5 percent • Atmospheric hazards are below IDLH

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Slide 15

Particulate-removing filters may be used with either half or full facepiece masks.

9 classes	
3 levels of filtration	• 95 • 99 • 99.97
3 categories of filter degradation	• N- not resistant to oil • R – resistant to oil • P – used when oil or nonoil lubricants are present

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Slide 16

Vapor-and gas-removing filters use sorbent material to remove targeted vapor or gas from the air.

Courtesy of MSA

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8–15

Slide 17

Power Air-Purifying Respirators (PAPRs) offer a greater degree of safety than standard APRs.

Courtesy of New South Wales Fire Brigades

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Slide 18

Combined respirators can provide more flexibility and extended work duration in hazardous areas.

Courtesy of MSA

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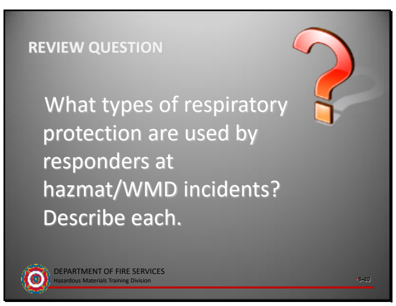
Slide 20

Slide 21



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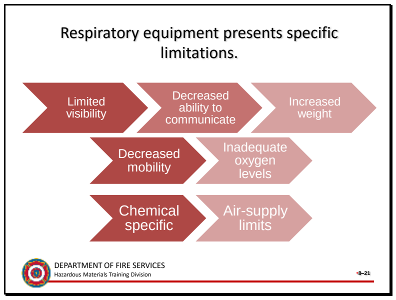

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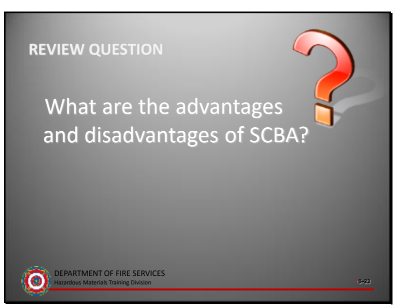

Slide 25

Learning Objective 2

Discuss protective clothing and ensembles.

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Slide 26

Protective clothing must be worn whenever the user faces potential hazards.

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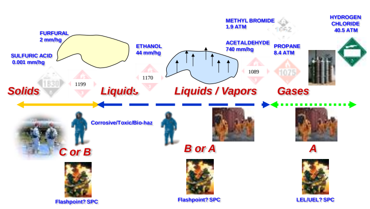
Slide 27

PPE



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Slide 28

Garment Construction

- Single-piece
- Multi-piece
- Material used in construction
  - Butyl rubber, Tyvek®, Saranex, PVC, Viton

Slide 29

Standards for protective clothing and equipment are developed by several agencies.

NFPA® 1991
- Minimum levels against vapor, liquid-splash, and particulate

NFPA® 1994
- Class 2 ensembles
- Class 3 ensembles
- Class 4 ensembles

NFPA® 1951
- Performance requirements for entry into CBRN not IDLH

Slide 30

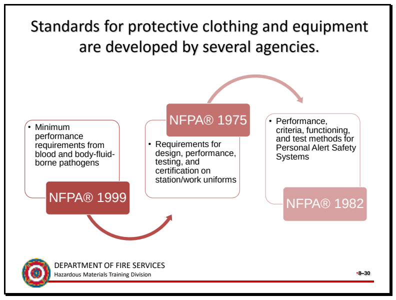
Standards for protective clothing and equipment are developed by several agencies.

NFPA® 1971
- Optional protection from CBRN hazards

NFPA® 1851
- Minimum selection and care for structural fire fighting protective ensembles

NFPA® 1992
- Minimum design, performance, certification, and documentation for liquid splash-protective ensembles and clothing

Slide 31



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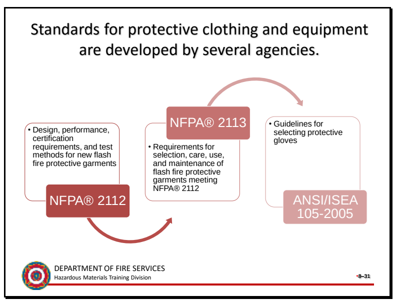

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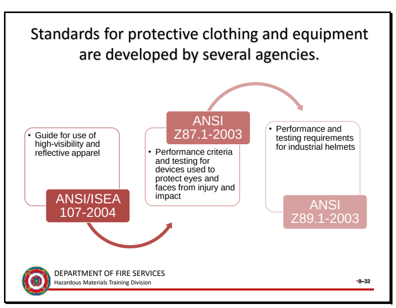

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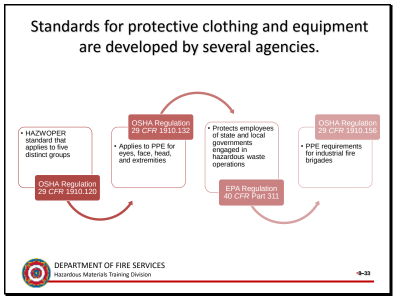

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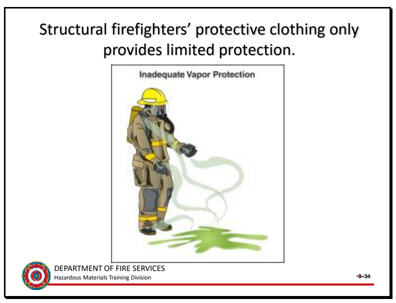

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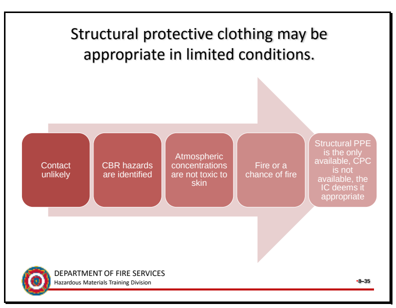

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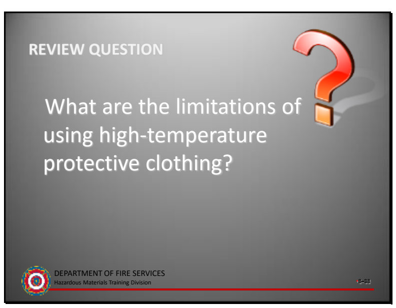

Slide 40

Chemical protective clothing (CPC) works to shield from hazards that may be at hazmat operations.

- Materials
  - Each material protects but has limitations
- KNOWN
  - Designed to protect if fitted properly and worn correctly
-
  - Impermeable to moisture
  - Decontaminated before storage/disposal

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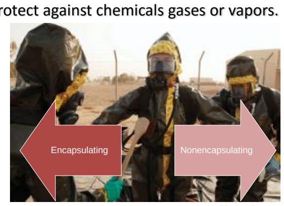
Slide 41

Liquid-splash protective clothing does not protect against chemicals gases or vapors.



Courtesy of the U.S. Air Force, photo by Airman 1st Class Jason Epley

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Slide 42

Vapor-protective clothing is designed to offer a greater level of protection but with limitations.

Courtesy of the U.S. Air Force, photo by Senior Airman Taylor Marr

Not all hazards → Impairs → Heat stress

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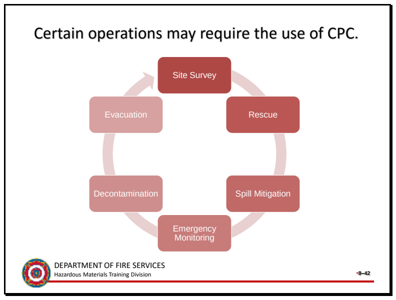
Slide 43



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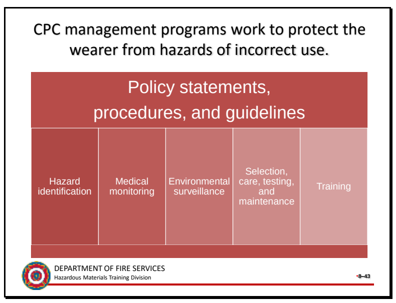

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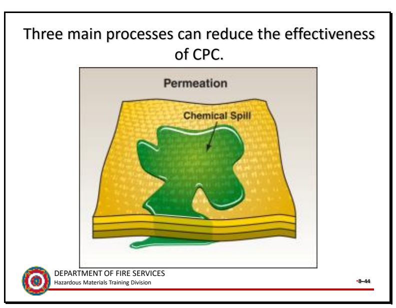

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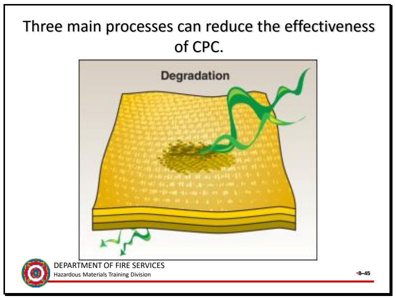

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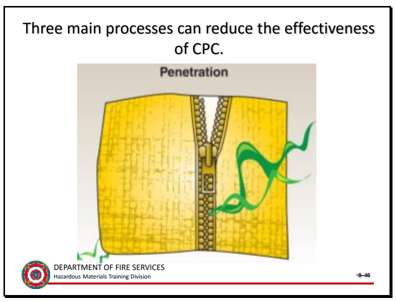

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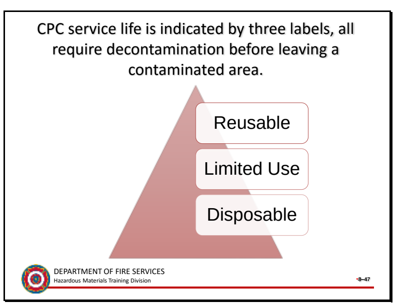

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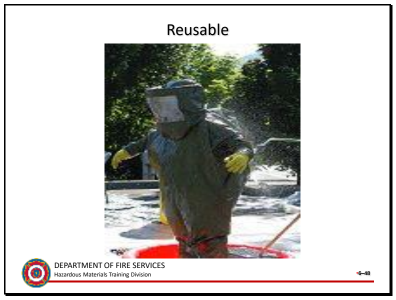

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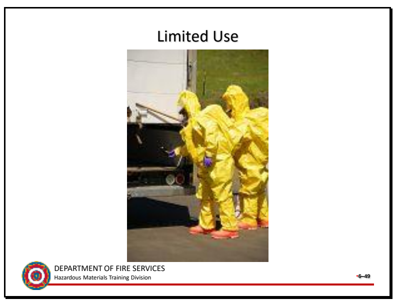

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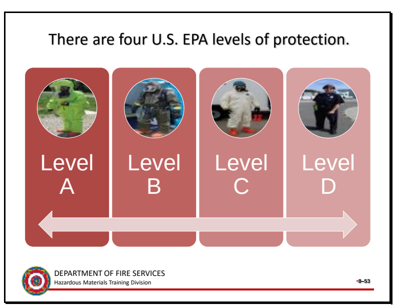
Slide 52

Slide 53

Slide 54



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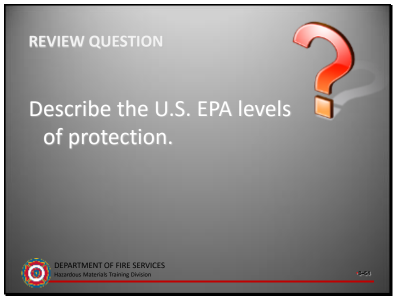

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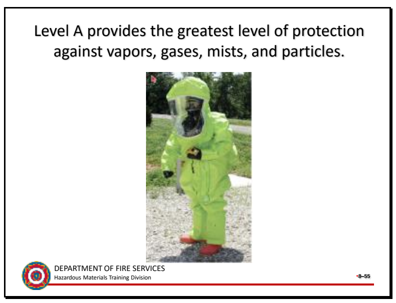

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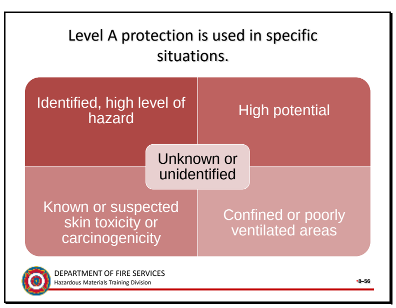

Slide 58

Level B protection is worn when the highest respiratory, but a lesser level of skin, protection is needed.

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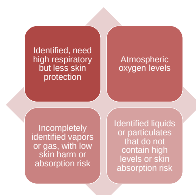
Slide 59

Level B protection is used in specific situations.



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Level C protection is not used unless this protection level has been approved by the IC.

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Level C protection is used in specific situations.

- Air contaminants identified, measured, APR to remove
- Criteria for APR use are met
- Affect on skin or absorption
- Atmospheric concentration does not exceed IDLH levels
- Atmospheric oxygen levels

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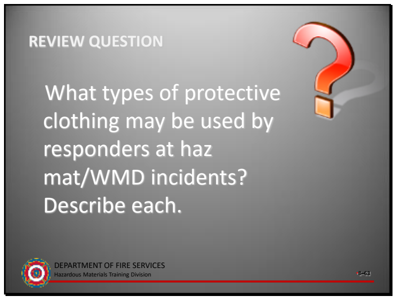
Level D protection is worn when no atmospheric hazards exist, includes structural firefighter clothing.

Slide 63

Level D protection is used in specific situations.

- No hazards
- Work precludes exposure

Slide 64



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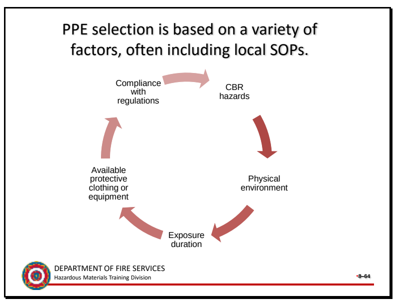

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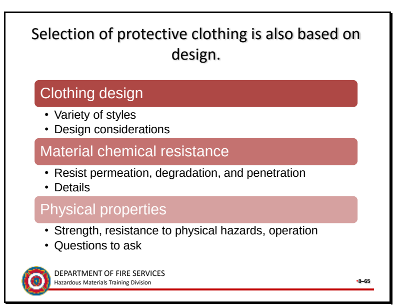

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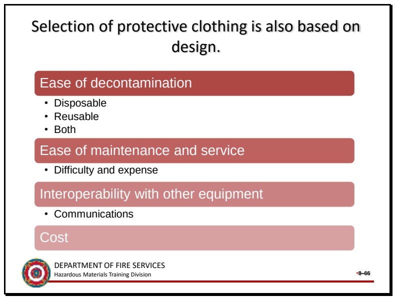

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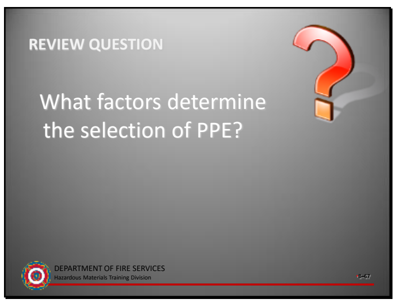

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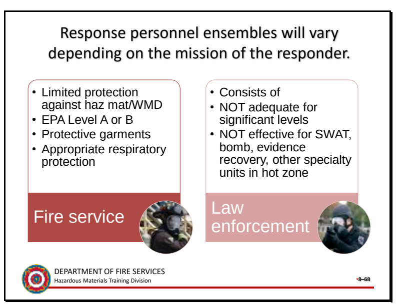


Slide 70

Response personnel ensembles will vary depending on the mission of the responder.

- Must provide
- Should include
- NO partial protection
- When not in hot zone

EMS

- Protects against
- Consists of
- Higher MOPP, greater protection
- Joint service lightweight integrated suite technology (JSLIST)

Mission-Oriented Protective Posture (MOPP)

Slide 71

Don't Forget…

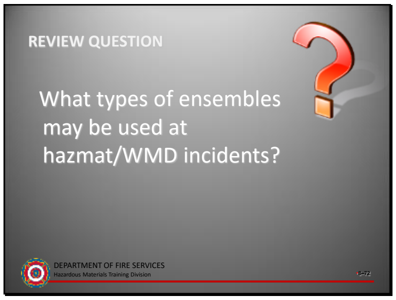
- Read the Ensemble paperwork for the PPE you use
- Compatibility Charts for what's good and what's NOT good to use it with

Slide 72

Skin Contact Hazards

- Toxicity, flammability, and reactivity
- Inadequately protected body
- Assume the worst and leave the largest possible safety margin

Slide 73



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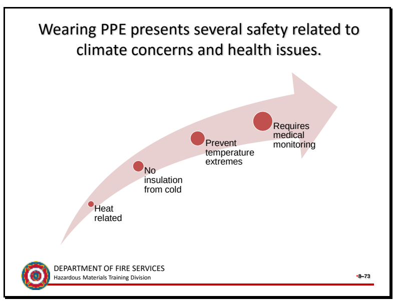

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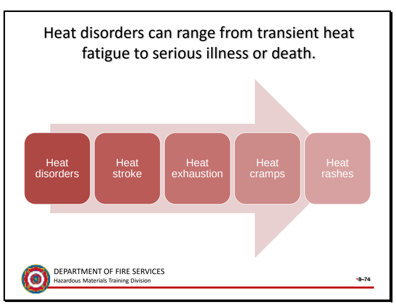

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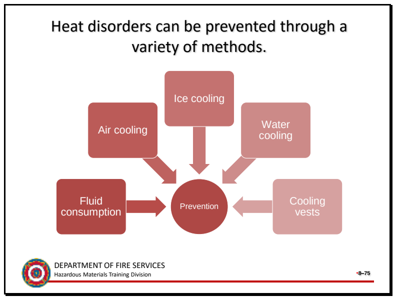

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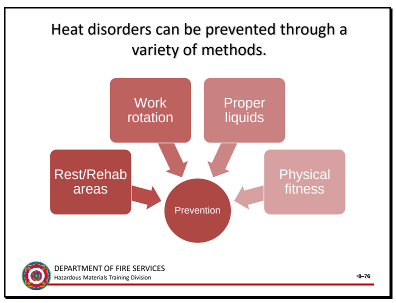

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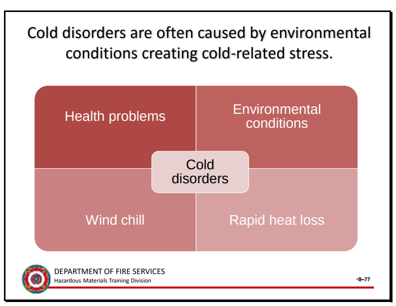

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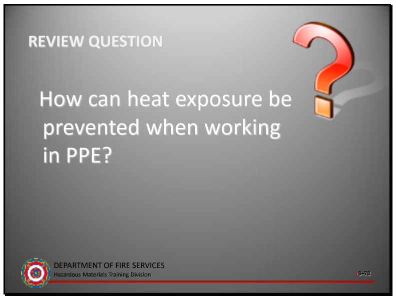

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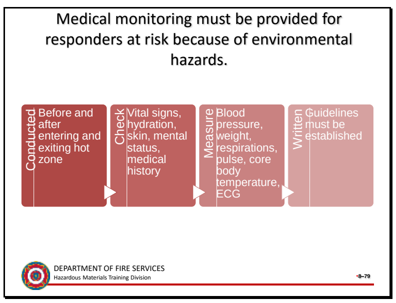

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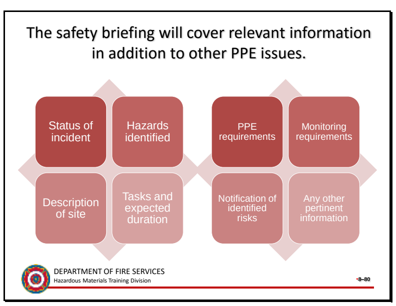
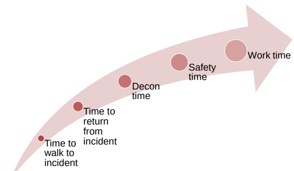


Slide 82

Air management is another safety procedure used to protect responders.



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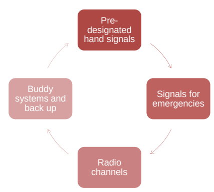
Another method to address safety and emergency procedures is communications.



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Slide 84

Learning Objective 3

Discuss inspection, storage, testing, and maintenance of PPE.

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Slide 85

Inspection, storage, testing and maintenance of PPE is a vital aspect to ensure it performs as expected.

- Conduct in accordance
- Include records
- Stored properly
- Inspection

Slide 86

REVIEW QUESTION

How should PPE be stored?

Slide 87

Learning Objective 4

Given hazardous materials scenarios, determine proper PPE for each incident and report and document decision.

This objective is measured in Learning Activity 8-1.

Slide 88

Summary

- Personal protective equipment is needed to protect emergency responders from the hazards present at haz mat and WMD incidents.
- No type of PPE can protect against all hazards.
- All protective clothing used at haz mat/WMD incidents should meet recognized standards such as NIOSH or NFPA®.

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Slide 1

Hazardous Materials
Operational Level Responder

Decontamination

Analyze
Plan
Implement
Evaluate

Slide 2

Decontamination

The process of removing hazardous materials to prevent the spread of contaminants beyond a specific area and reduce contamination levels that are no longer harmful

- Preformed at ***all*** hazmat and WMD incidents
- Removes hazardous materials from responders, victims, PPE, tools, and equipment
- Provides victims with psychological reassurance

Slide 3

Decontamination

Get it off → Keep it off → Contain it

Slide 4

Before Initiating Decontamination (Answer these questions)

- **Immediately or can it wait?** — Do victims need immediate decon?
- **SAFE?** — Is it safe to conduct decon?
- **Alternative?** — Are alternative decon methods available?
- **Adequate resources?** — Are adequate resources available? If not, Can additional resources be obtained in a timely manner?

Slide 5

Before Initiating Decontamination (Answer these questions)

- **Time limit?** — Can decon be concluded before victims further deteriorate?
- **Reusable or disposable?** — Can equipment being decontaminated be reused? / Is it better to replace equipment?
- **Save money or add value?** — $$$$$$?

Slide 6

REVIEW QUESTION

What is decontamination?

What questions should be answered before initiating decontamination?

Slide 7

Four Various Types of Decontamination

- Wet
- Dry
- Physical
- Chemical

The most effective means of decontamination is often as simple as the removal of the outer clothing or PPE that has been contaminated by a hazardous material

Slide 8

Wet

- Usually involve washing the contaminated surface with solutions or flushing with a hose line
- May necessitate the collection of runoff water in wading pools or other liquid-retaining devices

Slide 9

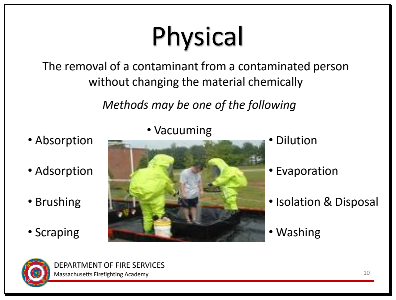
Dry

May be a simple as removing contaminated clothing and placing in to a suitable container or allowing the contaminate to evaporate

Other methods of dry decon

- Vacuuming
- Brushing
- Scraping
- Using sticky tape

Slide 10



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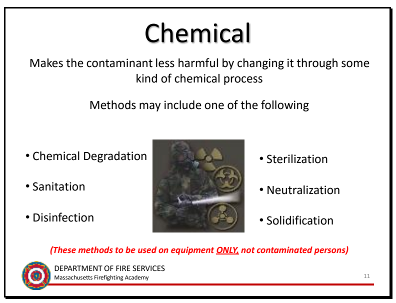

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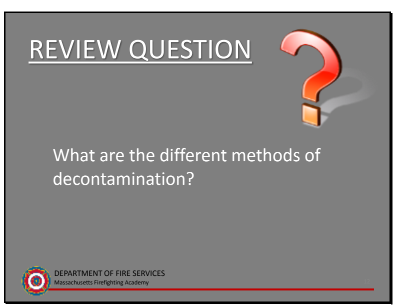

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General Guidelines for Decon

- Technical decon setup before hot zone entry
- Emergency/mass decon speed determined by material/type of incident
- Wear appropriate PPE
- Avoid contact with haz materials, including victims
- May be coupled with separation of victims

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Slide 14

General Guidelines for Decon

- Establish treatment and triage outside decon
- Communicate clearly with victims
- Provide privacy, warm water for washing
- Preserve and record belongings
- Provide clean/alternative clothing

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Slide 15

Recipients of Decon

- First Responders
- Victims
- Pets/Service Animals
- Infants – Elderly
- Physically Impaired
- Variety of Cultures

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Triage

START Medical Triage System

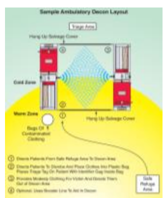
START Category	Decon Priority	Classic Observations	Chemical Agent Observations
IMMEDIATE Red Tag	1	Respiration is present only after repositioning the airway. Applies to victims with respiratory rate >30. Capillary refill delayed more than 2 seconds. Significantly altered level of consciousness.	• Serious signs/symptoms • Known liquid agent contamination
DELAYED Yellow Tag	2	Victim displaying injuries that can be controlled/treated for a limited time in the field.	• Moderate to minimal signs/symptoms • Known or suspected liquid agent contamination • Known aerosol contamination • Close to point of release
MINOR Green Tag	3	Ambulatory, with or without minor traumatic injuries that do not require immediate or significant treatment.	• Minimal signs/symptoms • No known or suspected exposure to liquid, aerosol, or vapor
DECEASED/ EXPECTANT Black Tag	4	No spontaneous effective respiration present after an attempt to reposition the airway.	• Very serious signs/symptoms • Grossly contaminated with liquid nerve agent • Unresponsive to autoinjections

Procedures for conducting triage should be predetermined within the local emergency response plan

Slide 17

Ambulatory Victims

- Used for large groups of people
- Quick performance of gross decontamination
- Wash off contaminant



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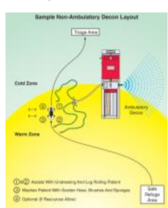
Non Ambulatory Victims

- Unconscious, Unresponsive, Unable to move unassisted
- May have to remain in place in the hot zone if sufficient personnel are not available



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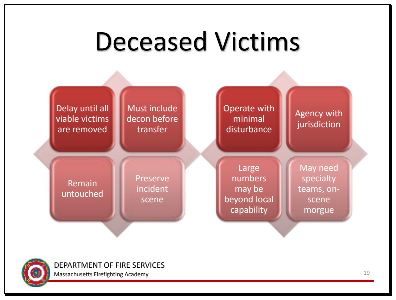

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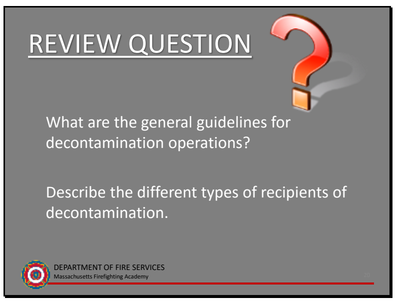

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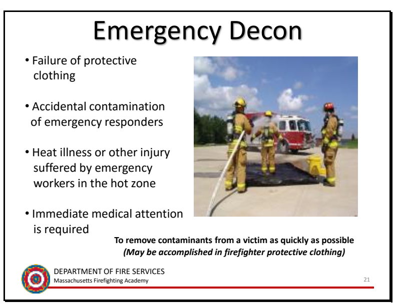

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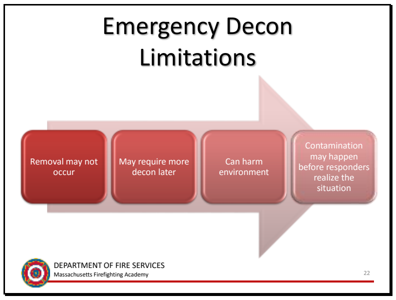

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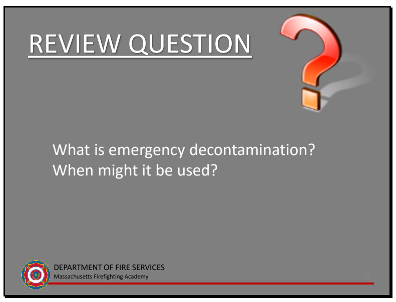

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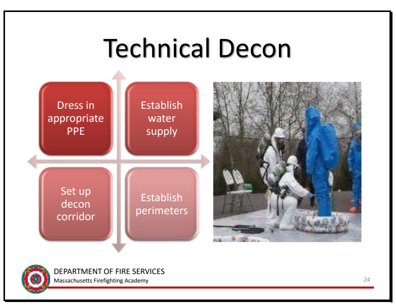

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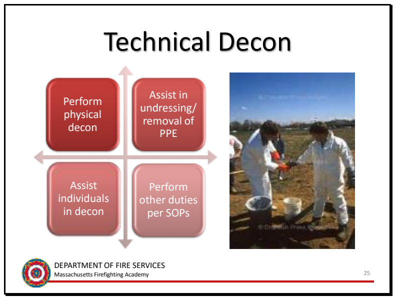

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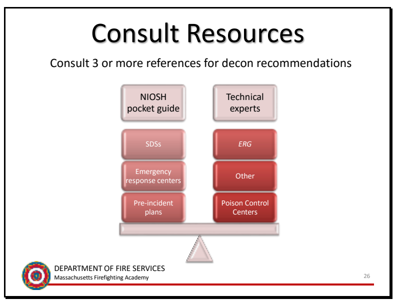

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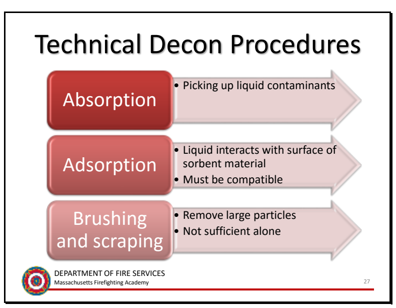

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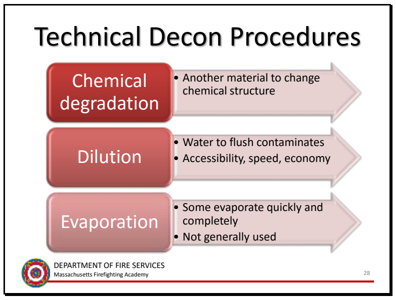

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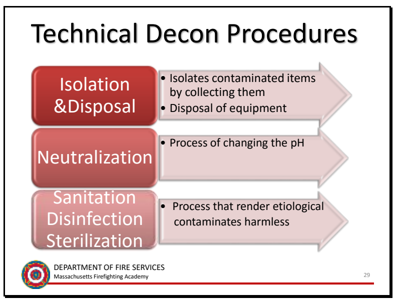

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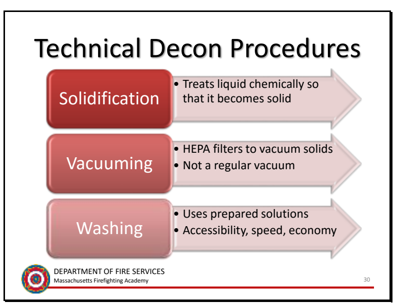

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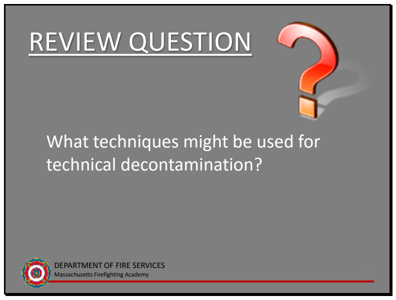

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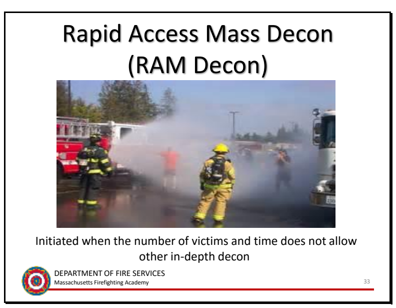


Slide 34

Preventing Chaos

- Communicate
- Clear, short, specific directions
- Use highly visible methods to mark corridors

Slide 35

RAM Decon Shower System

- Cleans
  - Dilutes
  - Washes away
- Water
  - Large volumes of low-pressure
  - Delivered in fog pattern
- Time
  - Varies
- Consider
  - Overhead sprinklers
  - Wading in public water

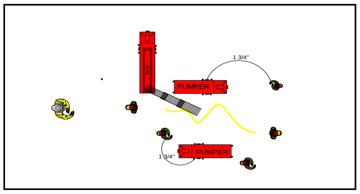
Slide 36

Clothing Removal

- Remove clothing to level of comfort
- Secure victims personal belongings
- Secure **privacy** to victims
- Removed clothing placed in proper container

Slide 37

RAM Decon Setup



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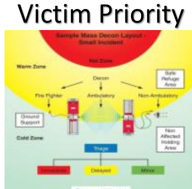
Victim Priority



Takes into consideration both medical needs and decontamination

Slide 39

Mass Decon Units

- Provides privacy for victims
- Segregated for male and female ambulatory victims
- Non ambulatory victims treated in center section

Slide 40

Mass Decon

Advantages
- Accommodates large number of victims
- Can be implemented quickly using limited amount of personnel and equipment
- Reduces contamination quickly

Disadvantages
- Does not always totally decontaminate victims
- Relies on the cooperation of the victim
- Can create contaminated runoff that can harm the environment and other exposure

Slide 41

Determine the Effectiveness of Decontamination Operations

Victims
- Large numbers checked briefly
- Checked as they exit decon corridor
- If contamination is detected, redirect to decon
- Victims still complaining of effects

Tools and equipment
- Stored in decon until emergency ops over
- Checked for contamination
- Includes apparatus

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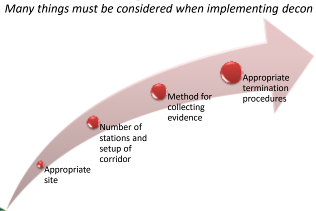
Decon Implementation

Many things must be considered when implementing decon



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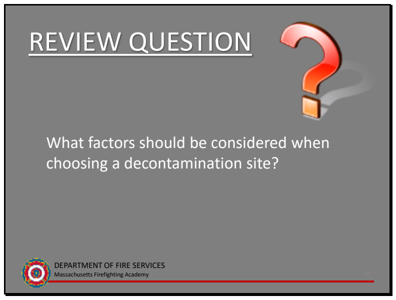

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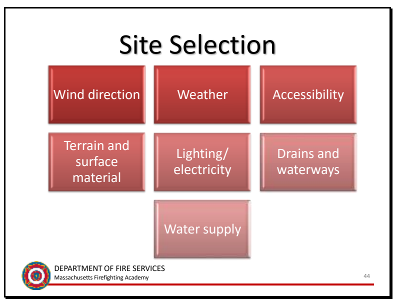

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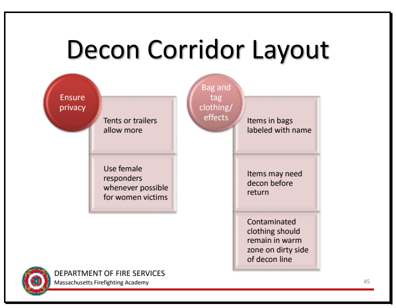

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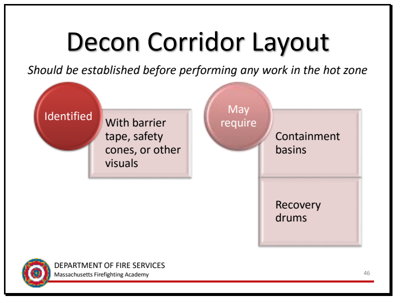

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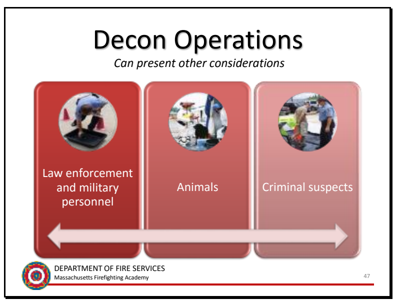

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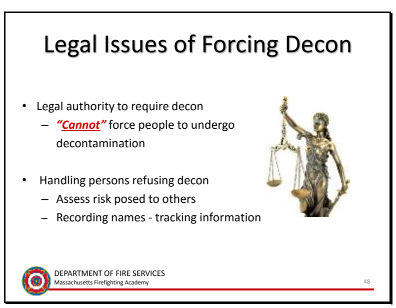

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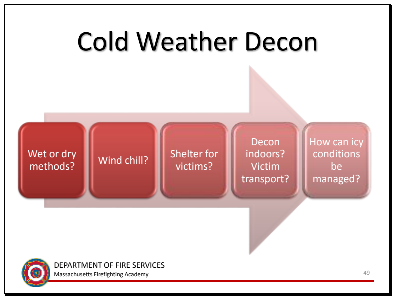

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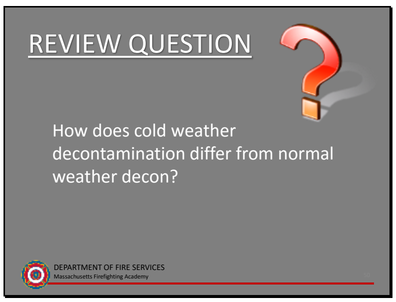

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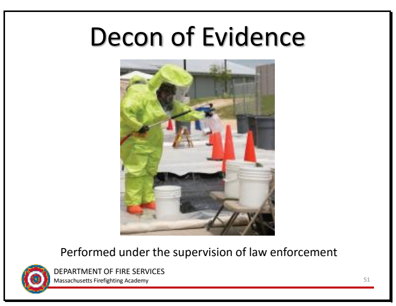

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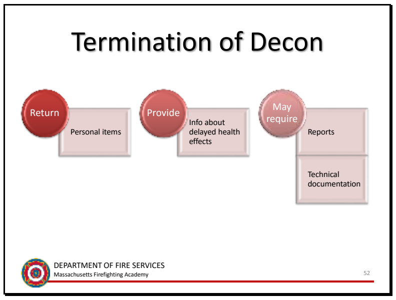

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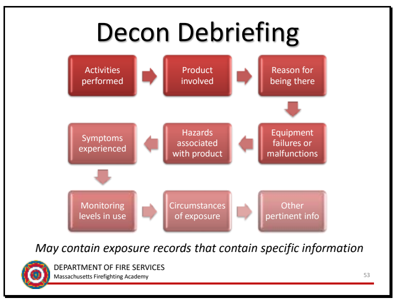

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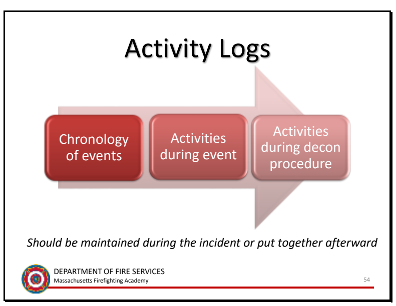

Slide 55

Summary

- Contamination is a concern at hazardous materials incidents.
- Exposure can occur and cause harm.
- Decontamination is conducted to prevent the spread of contaminants.

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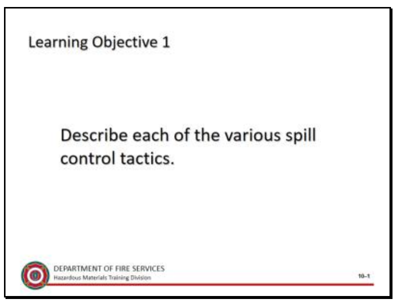
Slide 1

Slide 2



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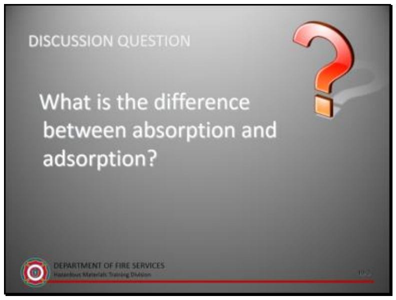

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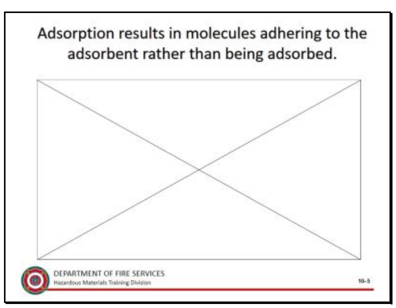

Slide 7

Safety Consideration

- Absorption/adsorption materials:
  - Soaked with gasoline, still produce flammable vapors and will readily ignite
  - Soaked with toxins, still produce toxic vapors

Slide 8

Blanketing or covering the surface of a spill prevents dispersion of materials.

Courtesy of the U.S. Department of Defense, photo by Senior Amn Christopher J. Wiant.

Slide 9

Dam, dike, diversion, and retention all are actions taken to control the flow of materials.

Slide 10

On Scene.. Defensive Operations

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Slide 11

Vapor suppression reduces the emission of vapors at a hazmat incident.

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Hazardous Materials Training Division
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Slide 12

Fire-fighting foams are effective on spills if the foam concentrate is compatible with the material.

- Proportioned and aerated
- System must match up (Discharge Tools)
- Categories
  - Class A (Deep Seated – Brush,Dumpster,Residential)
  - Class B (Flammable / Combustible Liquids)
  - Polar Solvents
  - Non-Polar Solvents
  - Hydrocarbon Based
- Must match the fuel applied to

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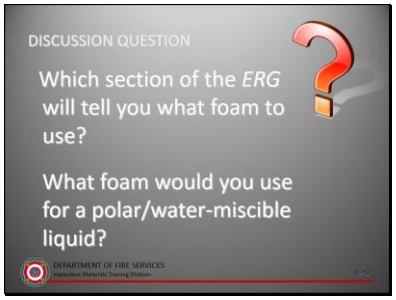
Slide 13



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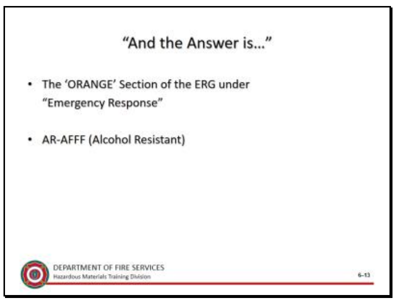

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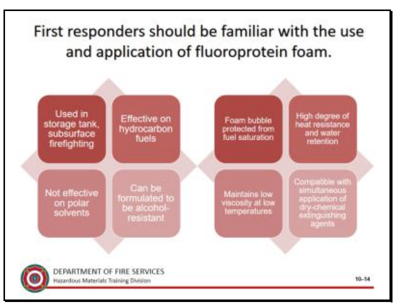

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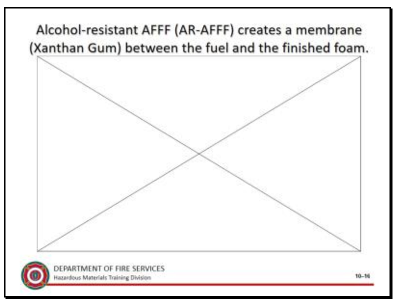

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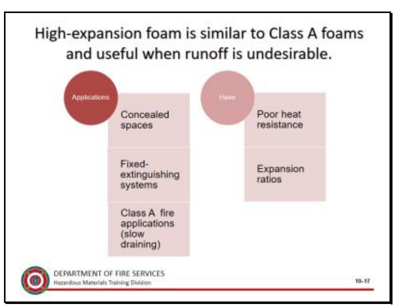

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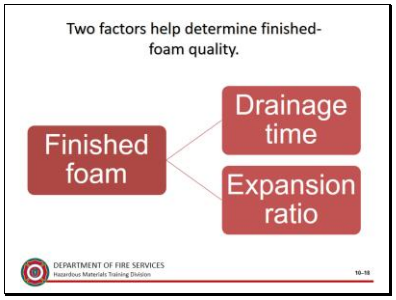

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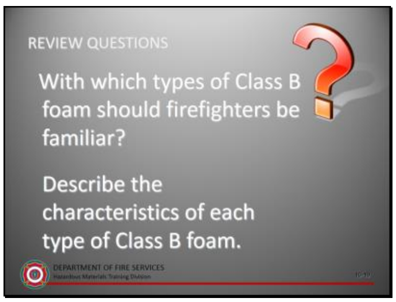

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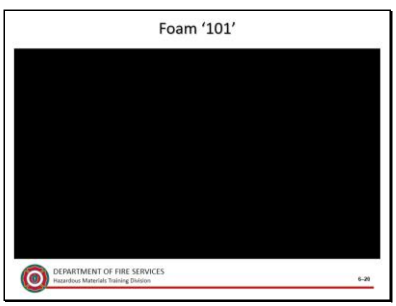

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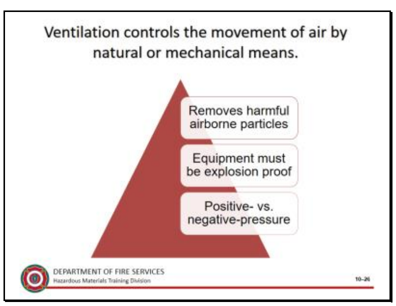

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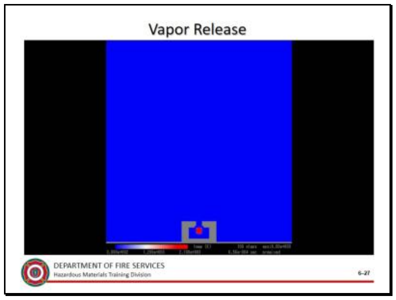

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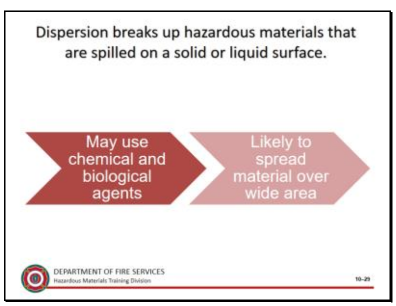

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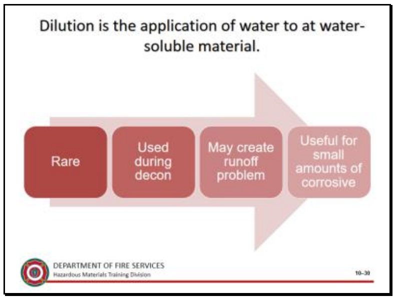

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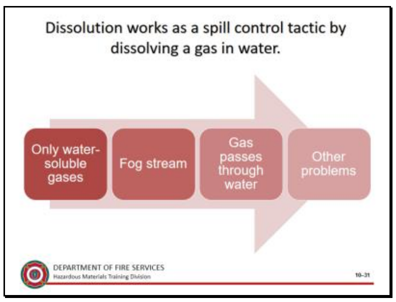

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Slide 34

Neutralization raises or lowers the pH of corrosives to render them neutral. (Tech Level Only)

Slide 35

REVIEW QUESTIONS

What sorts of tactics are aimed at reducing the amount of harm caused by the material?

Slide 36

Learning Objective 2

Discuss leak control.

Slide 37

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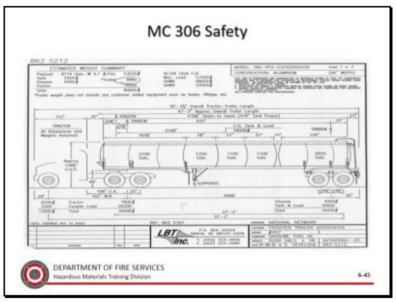

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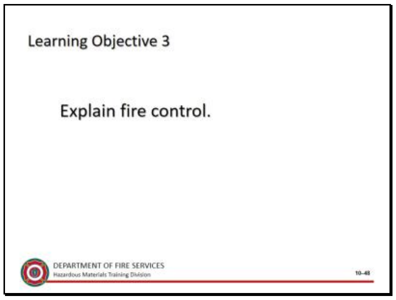

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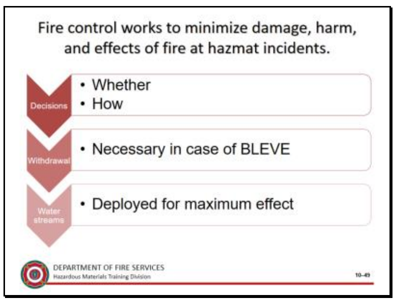

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Slide 52

Things to Consider…

- ICS (A must!)
- Logistic Concerns (Enough H2O??)
- Foam??
- Mutual Aid
- Metering
- Evacuation vs Shelter in Place
- Defensive Operations

Slide 53

REVIEW QUESTIONS

How can a BLEVE be avoided?

Slide 54

BLEVE

Slide 55

Slide 56

Slide 57

Slide 58

AFV technology

Slide 59

Summary

- Operations-Level personnel may use defensive spill control tactics to confine released materials.
- Personnel may also contain a release by operating remote emergency shutoff devices.

Slide 60

Summary

- Fire control tactics may involve fighting fires, protecting exposures, and suppression of flammable vapors.
- Responders must know the correct application of various foam concentrates for operations.

Slide 1

Hazardous Materials
Operational Level Responder

Air Monitoring and Sampling

Analyze
Plan
Implement
Evaluate

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Slide 2

Air Monitoring & Sampling

Allows first responders to:

- Detect
- Identify
- Measure

Hazardous Materials

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Slide 3

Assists in Several Aspects

- Identification (What materials are involved in the incident and the concentrations present)
- Determining appropriate PPE, tools, and equipment needed
- Determining perimeters and the scope of the incident
- Checking the effectiveness of ***defensive*** operations

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Slide 4

Assists in Several Aspects

- Ensuring that decon operations are effective
- Detecting leaks from containers or piping systems
- Monitoring decon runoff for contamination levels

Slide 5

Understanding Capabilities

- Know the capabilities of the meters that your dept. uses
- Know what is being measured (Parts Per Million , Percentage in air)
- Reaction time of the device
  (may take the device several seconds to draw in the sample and and analyze it)

No instrument is any better than the knowledge, skill, and ability of the individual using it

Slide 6

Understand Measuring

Must have an understanding of the behavior of the hazardous material coupled with an understanding of the detection device

Because vapor densities vary and air currents can move hazardous gases and vapors in unexpected ways, samples must be taken at different heights

Slide 7

Understand Your Device

- Capabilities and Limitations of device
- Able to interpret data accurately
- Properly maintain, field test, and calibrate device
- Able to use the device in accordance with the incident action plan
- Effects of weather and humidity have on the meter

Slide 8

REVIEW QUESTION

How does air monitoring and sampling assist responders?

Slide 9

Concentration & Exposure Limit

Values expressing the maximum ***dose*** or ***concentration*** to which individuals should be exposed given a specific time frame

DOSE: Quantity of a chemical material ingested or absorbed through skin contact for purposes of measuring toxicity

CONCENTRATION: (1) Quantity of a chemical material inhaled for purposes of measuring toxicity

(2) Percentage (mass or volume) of a material dissolved in water (or other solvent)

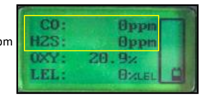
Slide 10

Concentration

Concentration of a substance is often expressed in the following terms

- ***Parts per million (ppm)*** – Concentration of gas or vapor in air; parts (by volume) of the gas or vapor in a million parts of air; also the concentration of a particular substance in a liquid or solid.

CO & H2S are displayed in ppm



Slide 11

Concentration & Exposure Limit

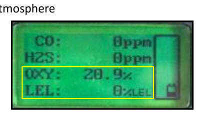
Exposure Limits	Definition	Maximum Exposure	Exposure Reduction	Remarks
TLV-STEL	Threshold Limit Value/Short-Term Exposure Limit	Up to 15-minute intervals, up to four times a day without damage	Minimum one hour rest between exposures	The lower the TLV-STEL, the more toxic the substance
TLV-TWA	Threshold Limit Value/Time Weighted Average	Up to 8 hours a day, 40 hours a week with no ill effects		The lower the TLV-TWA, the more toxic the substance
TLV-C	Threshold Limit Value/Ceiling	Maximum concentration a worker should not be exposed to, even for an instant		The lower the TLV-C, the more toxic the substance
TLV-S	Threshold Limit Value/Skin	Possible and significant exposure by absorption through the skin, mucous membranes, and eyes		Minimize skin absorption so that the TLV/TWA is not exceeded
PEL	Permissible Exposure Limit	95% of healthy adults can be exposed over a 40-hour workweek without damage		Comparable to the TLV-TWA PEL set by OSHA (enforceable by Law)
REL	Recommended Exposure Limit	Same as above		REL set by NIOSH **(does not have the force of Law)**
IDLH	Immediately Dangerous to Life and Health	Three types of IDLH atmospheres: ➤ Toxic ➤ Flammable ➤ Oxygen-deficient (<19.5%) An atmospheric concentration of any toxic, corrosive, or asphyxiate that poses an immediate threat to life or could cause irreversible or delayed adverse health effects	SCBA or equivalent protection	The lower the number the higher the toxicity

Slide 12

Percentage of Material

Rather than providing concentration of specific material, some meters will provide the percentage of a material in the atmosphere

O2 & LEL are displayed as %



0.1% drop in O2 indicates there is 5,000 ppm of something else in the air

Chris Wrenn
"TWA Meters" Confused by IDLH Atmospheres 8/1/2013

Slide 13

Safety Points

- Wear appropriate PPE for potential and suspected hazards until detection and monitoring determines the actual hazard present
- The lower the exposure limit(s), the more potentially harmful the substance is
- As long as your exposure level never exceeds the lowest number indicated by any of the listed exposure levels for the material, you should be safe from any toxic effects
- Exit IDLH atmospheres immediately, and ***NEVER*** enter them without appropriate PPE, which must include self-contained breathing apparatus

Slide 14

Monitoring Basics

- Know what material
- Monitor oxygen levels
- Preplan monitoring plan

Slide 15

Monitoring Plan

Why monitor?

- What readings?
- Which instruments?
- More than one hazard?
- Current conditions?

should be pre-planned and consider specific questions

Slide 16

Safe Monitoring Procedures

- Operate under the direction of a hazmat technician, specialist, or allied professional or ***follow written procedure***
- Understand the limitations of the instruments and detection devices being used, and always follow manufacturers instructions for ***calibration*** and usage
- Take any damaged device out of service immediately because it may not be intrinsically safe, also may give false readings
- Always wear appropriate PPE *(Provide respiratory protection, avoid direct contact with spills and product, protect against fire hazards)*

Slide 17

Safe Monitoring Procedures

- Always work with a partner and have a back up team in appropriate PPE ready
- Approach the hazard from ***upwind***
- Follow local protocols and SOPs established for what to do should an alarm sound or hazardous material is detected

Slide 18

Safe Monitoring Procedures

- Pay particular attention to low lying areas, confined spaces, and containers where vapors and gases are likely to concentrate
- Move slowly, making allowances for instruments with significant response times
- Monitor for vapors and gases at ground level, waist level, and above the head

Slide 19

Monitoring for the Unknown

- Usually performed on a priority basis:
  - Radiation/radioactive material
  - Corrosive vapors
  - Oxygen levels
  - Flammable atmospheres
  - Other toxics
    - Organics/in-organics

Slide 20

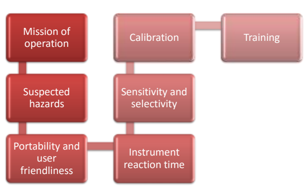
REVIEW QUESTIONS

What factors should be considered when creating a monitoring plan?

What are some guidelines to stay safe while monitoring?

Slide 21

Selecting & Maintaining Monitoring Devices



Slide 22

Maintenance and Calibration

- Use calibration gas recommended by the manufacturer, and calibrate them frequently
- Store devices in accordance with manufacturers recommendations and be mindful of the expiration dates and shelf-life of some sensors, test strips, and colorimetric tubes
- Test instrument routinely to ensure proper operation

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Slide 23

Zeroing Instruments

- Responders will need to zero many instruments in the field to adjust these units to the existing environment at those locations
- Care must be taken to avoid zeroing the instrument in locations with potential contaminants

Example:
Zeroing a multi gas meter near running vehicles where carbon monoxide levels may be high

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Slide 24

REVIEW QUESTION

What factors must be considered when selecting detection and monitoring devices?

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Slide 25

Detecting Hazards

The type of hazard present will define the meter or detection device needed to detect it's presence and/or concentration

- Corrosives
- Oxygen
- Flammables
- Toxics

- Oxidizers
- Radiation
- Reactives

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Slide 26

Corrosives

- A large percentage of hazmat incidents involve corrosive materials
- Corrosive gases and vapors can ***damage*** detection and monitoring instruments as well as PPE
- pH should always be one of the first hazards monitored unless the hazards are known

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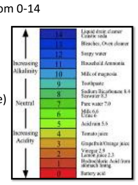
Slide 27

Corrosives

pH scale ranges from 0-14

- Acids: 0 to 6.9 (<2.5 = Strong acid)
- Neutral: 7
- Bases: 7.1 to 14 (>12.5 = Strong base)



Acids = Quick burn , Quick decon
Bases = Slow burn , Slow decon

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Slide 28

Corrosives

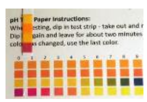
Concentration – Acids and bases are usually created by dissolving a chemical (usually a gas or liquid) in water

Example: A 85% solution of formic acid is composed of 85% formic acid and 15% of water

Slide 29

pH Paper

- Designed to change color when it comes in contact with a corrosive material
- There is no standard color system



Slide 30

Limitations of pH Paper

- Need for close proximity and/or contact with the hazardous material in order to conduct testing
- Inability to detect the concentration of the material
- Difficulty reading the paper if the material sampled is contaminated with oil, mud, or other opaque materials
- Difficulty reading the paper if the material sampled chemically strips the paper or alters it in unexpected way

(Such as with highly concentrated acids and bases, certain oxidizers, and hydrocarbons)

Slide 31

Oxygen

Oxygen meters detect the percentage of oxygen in the air

- Below 19.5% - Atmosphere is considered oxygen deficient
- Above 23.5% - Atmosphere is considered oxygen enriched

Oxygen is required for many other detection devices to function correctly

Slide 32

Percentage of Oxygen

- Normal air contains 20.9% Oxygen, 78.1% Nitrogen, and 1% other gases
- Any reading ***below 20.9%*** indicates that some other contaminant is in the air displacing the oxygen, potentially at toxic or extremely hazardous levels

0.1% drop in oxygen = 5,000ppm of something else in the air

Even if oxygen levels are not low enough to trigger an alarm , responders should be aware that reduced levels of oxygen potentially represent a significant hazard in the form of toxic contaminants

Chris Wrenn
"*TWA Meters*" Confused by IDLH Atmospheres 8/1/2013

Slide 33

Limitations of Oxygen Meters

- Corrosive gases can cause rapid sensor failure
- Strong oxidizers such as chlorine, bromine, and fluorine can cause abnormally high readings (False Positive)
- Sensors deteriorate steadily over time and need frequent replacement
- Change in temperature (and temperature extremes), humidity, and atmospheric pressure can effect the monitor

Slide 34

Combustible Gas Indicators

Measure the amount of flammable vapors and gasses in three ways

Percentage of LEL → Parts per million → Percentage of gas per volume of air

Limitations → Catalyst poisons → Concentrations

Slide 35

Flammables

Combustible Gas Indicators (CGI's)

- Most meter for LEL in percent
- Typically an alarm will sound at 10% of the LEL of the calibration gas
- Even low percentages of LEL indicate that something is in the air, potentially at dangerous toxic levels

Watch the readout display of the meter

Slide 36

Flammables

The meter is calibrated to a specific flammable gas (usually methane, propane, pentane, or hexane)

- When measuring other gases/vapors, the actual LEL of the gas being measured may differ from the reading being provided
- Will need the use of conversion factors

Known Gas Present	K-factor
n-Butane	0.6
Methanol	1.04
Ethane	0.8
Hydrogen	1.1
Methane	1
Propane	0.65
n-Pentane	0.5
n-Hexane	0.45
n-Octane	0.4
Ethanol	0.8
Isopropanol	0.69
Acetone	0.7
Ammonia	1.3
Toluene	0.35
Gasoline	0.6
Isobutanol	0.53
Xylene	0.49
Styrene	0.46

SCOTT Scout conversion factors

Slide 37

Readings Influenced By

- Catalyst poisoning
- Concentrations exceeding 100% of the LEL
- Concentration exceeding the UEL
- Chlorinated hydrocarbons
- Oxygen – acetylene mixtures

Slide 38

Limitations of CGI Meters

- Sensitive to battery life; as the battery power decreases, the meter may lose responsiveness
- Corrosive gases may damage the sensors
- Meter response may be sluggish in extremely cold weather
- Cell phones, magnetic fields, high voltage lines, radios, and static electricity may interfere with readings
- Sensitivity to oxygen levels; too little or too much oxygen will interfere with accurate readings

Slide 39

Toxics

Many different technologies are used to detect toxic materials

- Chemical specific electromechanical cells
- Test strips and paper
- Photoionization detectors (PIDs)

Slide 40

Toxics

Many different technologies are used to detect toxic materials

- Colorimetric indicator
- Flame ionization detectors (FIDs)
- Raman spectrometers

Slide 41

Toxicity

Lethal Dose: Minimum amount of solid or liquid that when ingested, absorbed, or injected through the skin will cause death.

Lethal Concentration: Minimum concentration of an inhaled substance in gaseous state that will be fatal to the test group (usually within 1 to 4 hours)

Slide 42

REVIEW QUESTION

What is the difference between lethal dose and lethal concentration?

Slide 43

Chemical Specific Sensors

Designed to detect a single chemical:
- Carbon Monoxide
- Hydrogen Sulfide
- Ammonia
- Chlorine

Just to name a few

These sensors in these devices are prone to degrade over time and may be affected by temperature and humidity

Slide 44

Photoionization Detector (PID)

- Used an ***ultraviolet lamp*** to ***ionize*** samples of gaseous materials
- Used to detect low to very low concentrations of many organic and some inorganic gases and vapors
- Capable of detecting and measuring concentrations in ***real-time***

Slide 45

Photoionization Detector (PID)

Should be used In the following situations

- At the edge of a release, where concentrations may be too low to be detected by a CGI
- When atmospheric contamination is suspected involving either flammable and/or non-flammable atmospheres
- Investigating complaints about odors or strange smells

Slide 46

Photoionization Detector (PID)

Should be used In the following situations

- Locating low-volume chemical release
- Evaluating the extent of contamination from a release and assessing risk to the public and environment

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Limitations of PID's

- Cannot be used to identify unidentified/unclassified substances
- Most PID's use several different lamps to measure the ionization potential (IP) of a material
- Need to have some suspicion of what material you are looking for to ensure you have the proper lamp installed
- The NIOSH Pocket Guide provides the ionization potential numbers for many materials

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Limitations of PID's

- Must be calibrated to isobutylene
- Do not respond to any product with IP's greater than the ultraviolet lamp that is being used
- Should not be used in rain or high humidity environments
- Do not draw liquid into the device
- Tiny particulates of dust may effect readings

Typical Lamp Strengths: 9.5eV, 10.0eV, 10.2eV, 10.6eV, 11.7eV; lamp strength must be higher than IP for the material to be detected

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REVIEW QUESTION

In what situations would a PID be used?

Slide 50

Colorimetric Indicator Tubes

- Sealed glass tubes filled with a reagent that will change color when exposed to a specific chemical family
- Chemical specific, but react to and rely on chemical cross reactivity

Reagents:

Substances that are known to react to other chemicals in a specific way

Used for the purpose of detection typically undergo a known color change when coming in contact with a specific substance

Slide 51

Colorimetric Indicator Tubes

Easy to use

- Select the proper tube to match material being tested for
- Break each end of the tube, then insert into pump device to draw air into the tube
- The number of pump strokes needed will vary depending upon the type of tube and material
- If the material is present in the air, the tube will change color

Follow manufactures instructions on how to use these devices

Slide 52

Colorimetric Indicator Tubes

Limitations

- They are cross sensitive (they may react to other chemicals in the same chemical family)
- They have limited shelf life
- They have a significant error rate (25%-35%), and some will give false positives for products other than their labeled use
- To get accurate readings, the number of pump strokes must be exact and complete to ensure full air movement through the tube

Slide 53

Colorimetric Indicator Tubes

Limitations

- Temperature may effect the tubes
- Humidity and atmospheric pressure may effect the tubes, and require the use of a correction table
- Exposure to light, even for a few hours, can cause the tubes to degrade and become non functioning

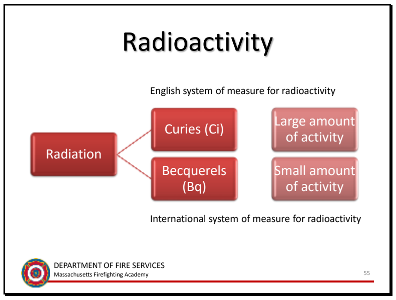
Slide 54

Colorimetric Indicator Tubes

Limitations

- Reagents may react with other vapors and gases present, causing unanticipated and unusual color changes
- Responders with impaired color vision may not be able to accurately read colorimetric tubes
- May be difficult to read the color change in certain kinds of lighting

Slide 55



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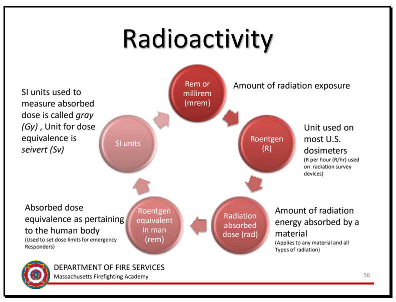

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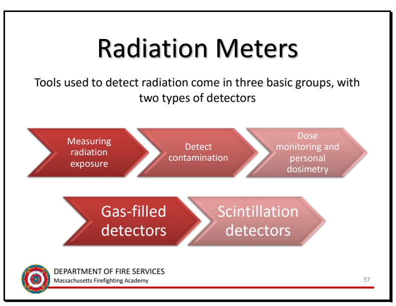


Slide 58

Gas-filled Detectors

Measure ions after radiation ionizes the gas inside

- Reading can be affected by humidity and temperature
- Calibrated so the response is directly related to the intensity of the radiation

Slide 59

Scintillation Detectors

Produce a small flash of light when radiation interacts with a crystal

- Most useful for detecting small amount of radiation
- Use a photomultiplier tube attached to the crystal
- Scintillation crystals that are sealed in a metal body are better suited for measuring penetrating gamma radiation

Susceptible to breakage if not handled properly

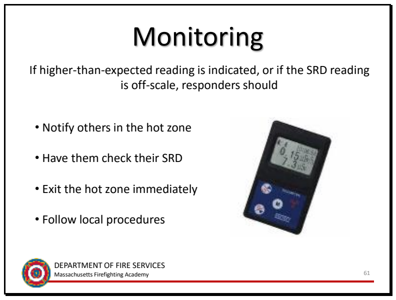
Slide 60

Dosimetry Devices

Useful for keeping track of the wearer's total accumulation radiation dose

- Self reading dosimeters (SRD) are the most commonly used
- Measure radiation dose in roentgens (R), milliroentgens (mR), sieverts (Sv), or gray (Gy)
- Should be read prior to entering hot zone, every 15-30 minutes in hot zone, and upon exiting the hot zone

Slide 61



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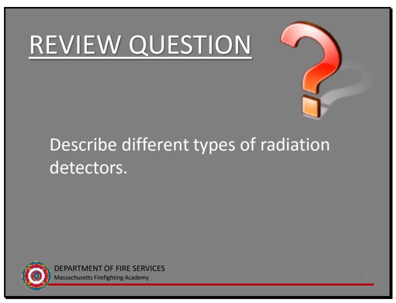

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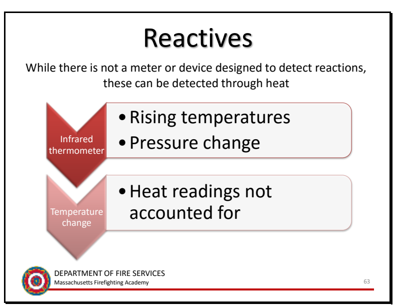


Slide 64

Summary

- First responders conducting monitoring and detection at hazmat/WMD incidents must be thoroughly trained in the operation, limitations, and maintenance of the devices they use.
- Responders must wear appropriate PPE for the mission and follow safety procedures.

Slide 1

Hazardous Materials Operational Level Responder

Victim Rescue and Recovery

Analyze
Plan
Implement
Evaluate

Slide 2

DISCUSSION QUESTION

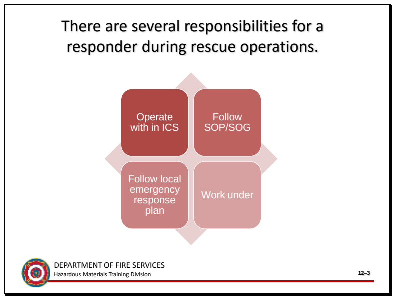
What is the difference between rescue and recovery?

Slide 3

Learning Objective 1

Discuss rescue operations.

Slide 4



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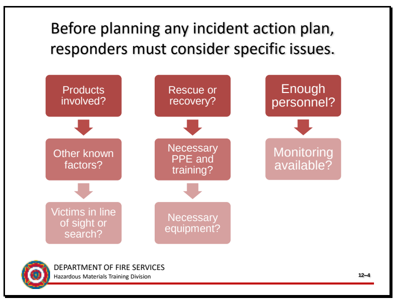

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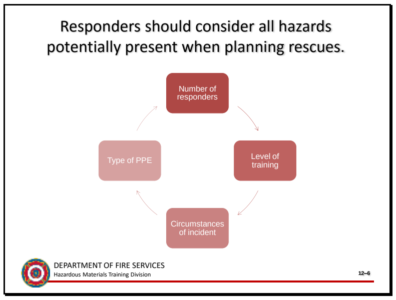

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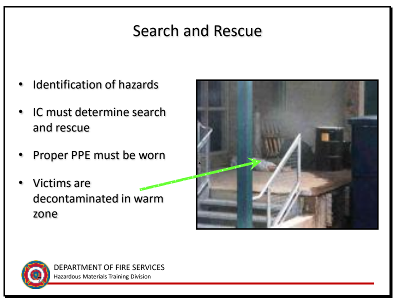

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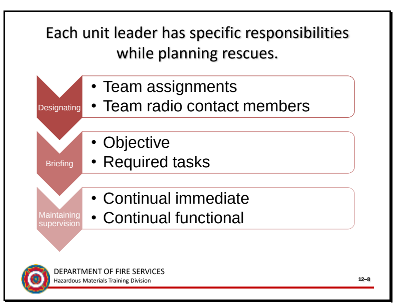

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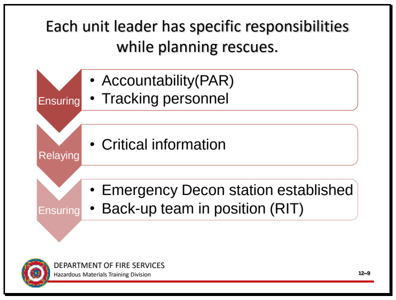

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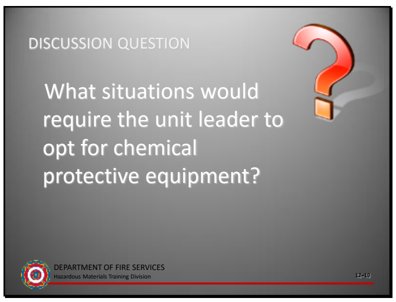

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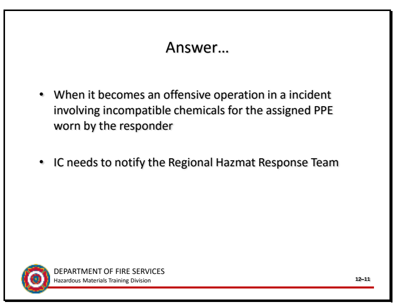


Slide 13

REVIEW QUESTION

What questions should be asked to determine the feasibility of conducting rescue operations?

Slide 14

REVIEW QUESTION

What are the unit leaders' responsibilities when planning rescue?

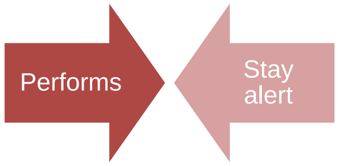
Slide 15

Answer…

- Risk Based Scenario
  - Rescue vs Recovery
- Compatible Protective gear at the FR level
  - Refer to ERG / NIOSH Guides
- SDS / Shipping Papers / Product Knowledge
- Tier Response option from Regional Hazmat Team

Slide 16

The entry team must consist of at least two trained members in the appropriate PPE.



Slide 17

The back-up team is on standby to perform only one task- the removal of a down member. Safety is Priority!!

- **Tech Level**

- **FR level**

Slide 18

Buddy System and
Backup Personnel

- Ensure safety of emergency crews
- Decontamination team in place before anyone enters the hot zone
- No one should enter the hot zone alone
- Always remain within sight, sound, or touch of each other

Only for those trained above the Operations Level; i.e., Haz-Mat Teams

Slide 19

REVIEW QUESTION

What is the purpose of a decontamination station?

What guidelines should be followed when entering the hot zone?

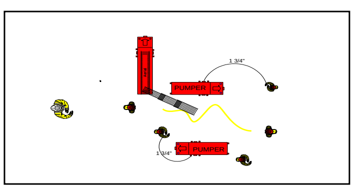
Slide 20

The decon station(RAM decon/Emergency decon) must be established prior to any entry/exit into/from the HOT zone.

Courtesy of the U.S. Air Force, photo by Master Sgt. Jim Varhegyi

Slide 21

RAM Decon 2 & 1 Set-up
(Rapid Access Mass Decon)



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Emergency Decon Setup

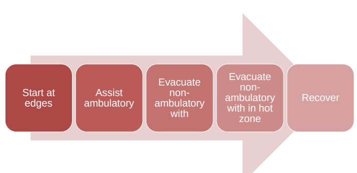
- PPE and SCBA worn properly
- Stay clear of product
- Direct victims to suitable location
- Flush victims w/clothes on
- Have victim remove clothes
- Flush victim again
- Obtain medical treatment/transport

Slide 23

There are basic guidelines to observe when entering the hot zone.

Slide 24

Rescue priorities at haz mat incidents differ from other emergency incidents.



Slide 25

Recovery is performed after rescue and is coordinated by the IC with law enforcement or a coroner.

Not implemented until

May be necessary to leave in place

Slide 26

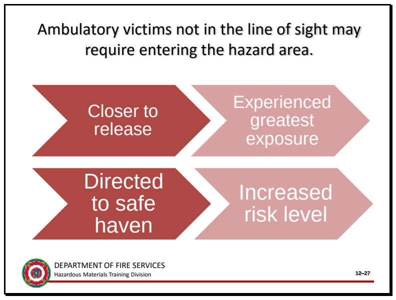
Ambulatory victims within the line of sight should be addressed first.

Slide 27

Non-ambulatory victims within the line of sight are addressed next.

Courtesy of U.S. Navy, photo by Photographer's Mate 2nd Class Phillip A. Nickerson Jr.

Slide 28



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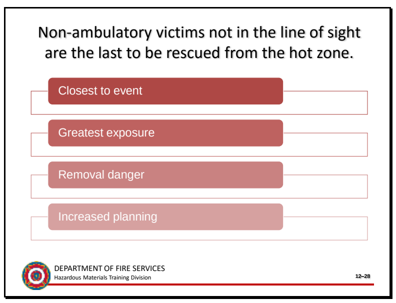

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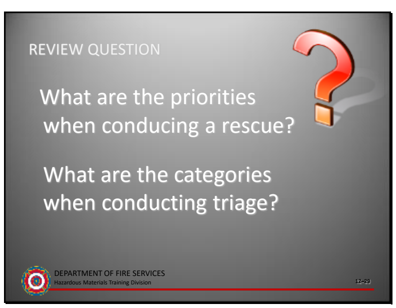

Slide 31

Triage should be conducted after victims have been removed to refuge area for decon.

Priority 1	• Life-threatening
Priority 2	• Serious, not life-threatening
Priority 3	• Minor injuries
Priority 4	• Dead or fatally injured

Slide 32

Learning Objective 2

Identify rescue tools and equipment.

Slide 33

Rescue tools and equipment may be used to perform recovery operations.

- PPE and equipment
- Triage tags
- Backboards and stokes baskets

Slide 34

Rescue tools and equipment may be used to perform recovery operations.

Courtesy of U.S. Marine Corps

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Slide 35

Rescue tools and equipment may be used to perform recovery operations.

Courtesy of U.S. Marine Corps

Extrication equipment

↓

Technology

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Slide 36

Learning Objective 3

Describe various rescue methods.

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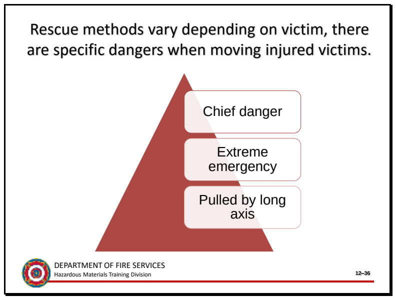

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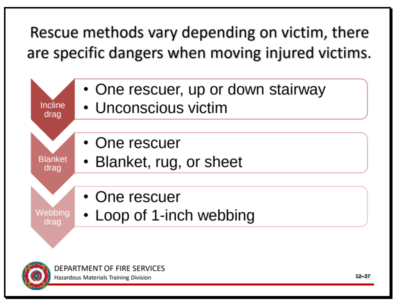

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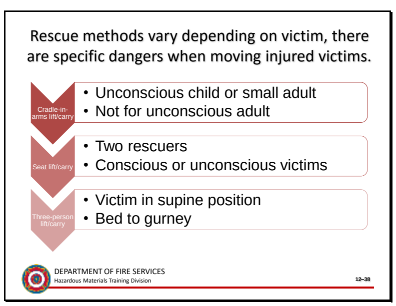

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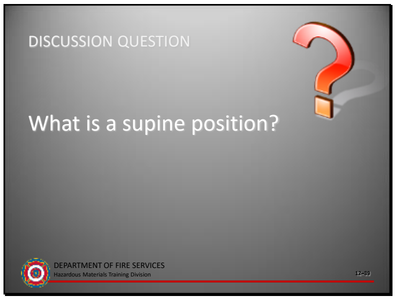

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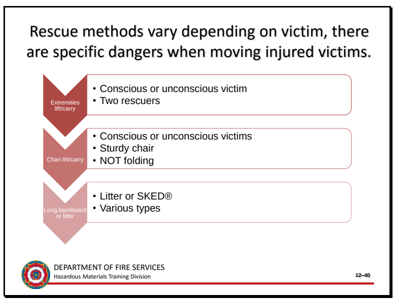

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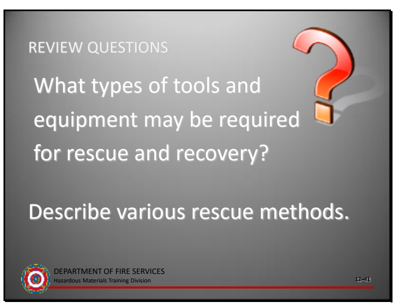

Slide 43

Lets See what's going on…

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Slide 44

Atmospheric Monitoring

- Usually performed on a priority basis:
  - Radiation/radioactive material
  - Corrosive vapors
  - Oxygen levels
  - Flammable atmospheres
  - Other toxics
    - Organics/in-organics

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Slide 45

Atmospheric Monitoring

- Lower Flammable Limit increase
- Carbon monoxide increase
- Oxygen level increase or decrease
- Hydrogen sulfide increase

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Slide 46

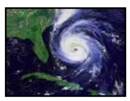
Meter Specifics

- What will it tell you?
  - Carbon Monoxide levels in parts per million
  - Hydrogen Sulfide levels in parts per million
  - Oxygen levels in percentage
  - Lower Explosive (Flammable) Limit in percentage

Slide 47

Meter Specifics

- What ***won't*** it tell you ?
  - If radiation or radioactive material is present
  - If explosive material is present
  - If biological material is present
- When can it be used based on ***weather*** ?
  - Check manufacturer's specifications
  - False readings can occur due to temperature and humidity



Slide 48

Emergency Decontamination

- Used in potentially life-threatening situations
- Involves rapid removal of contaminants
- Remove contaminated clothing
- Douse victim with water

Slide 49

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Slide 50

Learning Objective 4

Discuss recovery operations.

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Slide 51

Summary

- All rescue operations must be conducted by responders who have appropriate training and equipment to do so safely.
- A variety of rescue methods can be used to move victims, including common lifts, drags, and carries.

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Slide 52

Summary

- First responders must also be able to recognize incident response conditions based upon the status of the victim in a hazardous materials recovery.

Slide 1

Hazardous Materials Operational Level Responder

Evidence Preservation and Sampling

Analyze
Plan
Implement
Evaluate

Slide 2

Learning Objective 1

Discuss various hazards at crimes involving hazardous materials or weapons of mass destruction (WMD).

Slide 3

Operations-Level responders are required to perform several tasks.

Situational Awareness

Slide 4

Evidence preservation and Air Monitoring is a top priority after life preservation, hazard mitigation, and environment.

Courtesy of FEMA News Photos, photo by Jocelyn Augustino

Slide 5

Illicit laboratories present specific issues for responders to consider.

Courtesy of MSA

Security measures → Hazardous agents → Must secure first

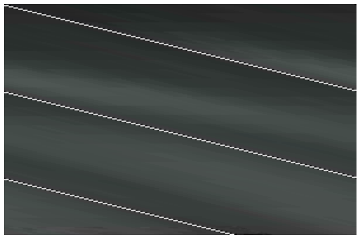
Slide 6

Illicit Laboratories

- Drug labs are most commonly found:
  - Typically primitive
- Signs of lab presence:
  - Everyday items modified to produce illegal drugs
  - Large quantities of cold tablets, acid, paint thinner, drain cleaner, and other such products
  - Should be considered as significant hazardous materials scenes

What Do You See ?

Slide 7



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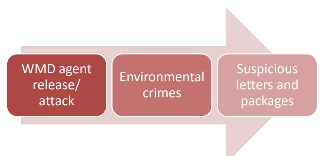
Slide 8

Other types of hazards incidents require responders to understand issues specific to each type of event.



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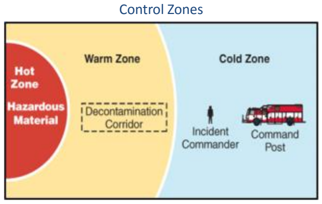
Slide 9

Just a reminder…

Control Zones



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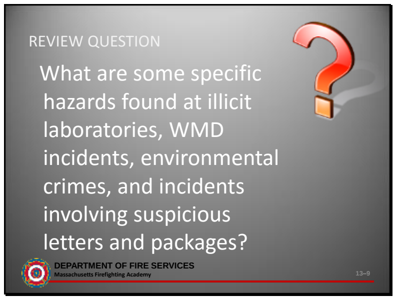

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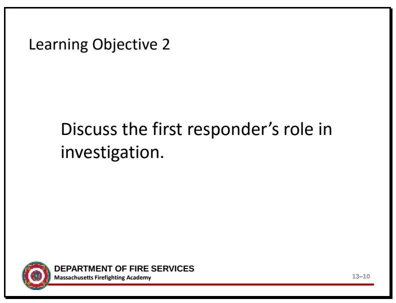

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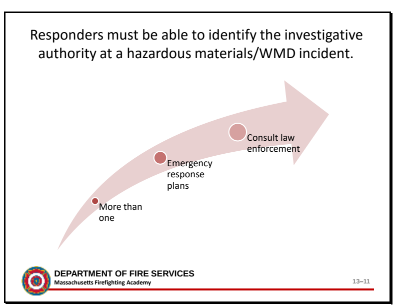


Slide 13

REVIEW QUESTION

What agencies may be involved in investigating hazardous materials or WMD incidents?

Slide 14

Interagency Cooperation…

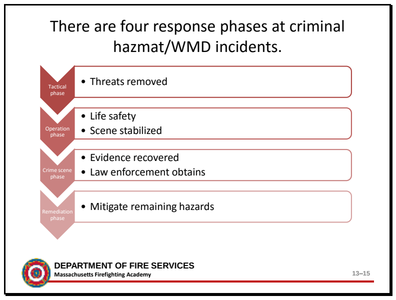
- MA State Police(EOD,Crime Scene Serv)
- Local PD
- Local FD
- Regional Hazmat Response
- Military CST Response
- FBI (AHJ with Terrorism Incidents)
- EPA / DEP
- USCG (Waterway issues)

Slide 15

Learning Objective 3

Describe the different response phases at criminal hazardous materials/WMD incidents.

Slide 16



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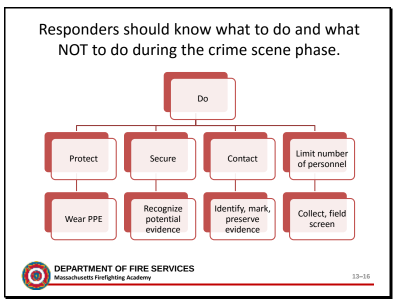

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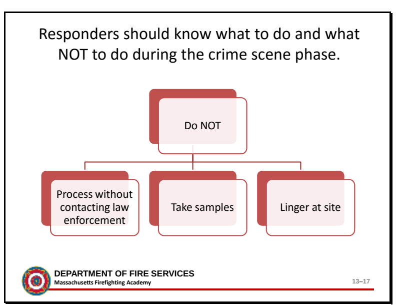

Slide 19

REVIEW QUESTION

What agencies may be involved in investigating hazardous materials or WMD incidents?

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Slide 20

Responders should understand and observe the procedures for proper care of evidence.

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Slide 21

Learning Objective 4

Explain the FBI's twelve-step process for collecting evidence.

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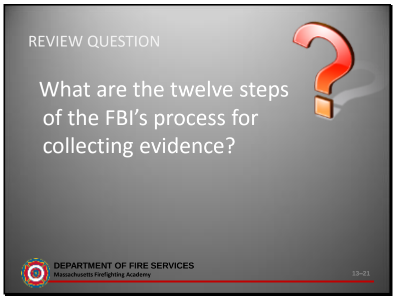
Slide 22



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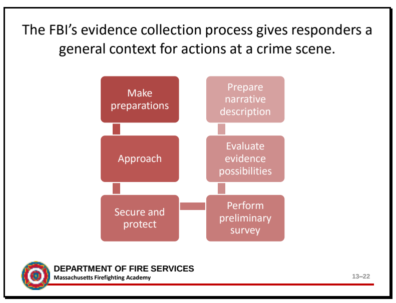

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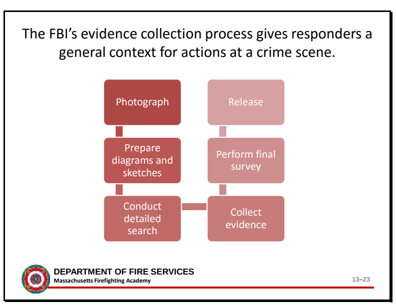


Slide 25

Making preparations involves many steps, one is to determine which laws have been potentially violated.

Courtesy of FBI

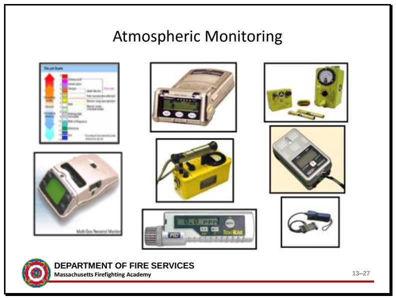
Slide 26

When approaching the scene, safety of personnel is a primary concern.

Slide 27

When securing and protecting the scene, responders should establish an access control point.

Slide 28



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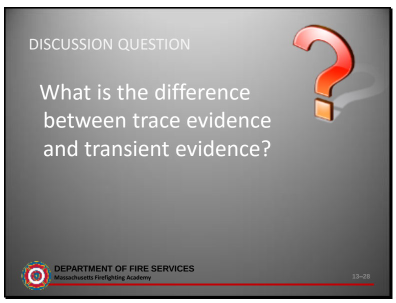

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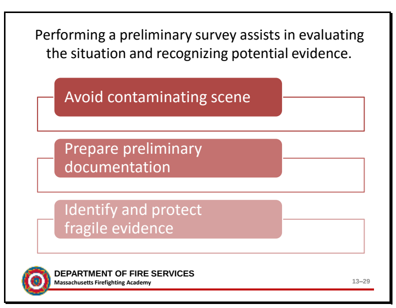

Slide 31

Evaluating evidence possibilities helps investigators plan for evidence collection.

- Careful and methodical → Easily accessible areas → Systematic search pattern
  - Least to most intrusive
- Continually assess environment → Be aware of multiple scenes → Recognize other methods

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Slide 32

Preparing a narrative description records a description of the scene in detail.

- General to specific detail
- Includes weather, etc.
- Very systematic
- Supplement with photos/ sketches

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Slide 33

Photographing the scene should occur as soon as possible, starting with fragile areas.

Courtesy of U.S. Army, photo by Kevin Stabinsky

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Slide 34

Preparing diagrams and sketches of the scene assists in detailing distance and size relationships.

Courtesy of U.S. Army

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Slide 35

Wear proper protection when conducting a detailed search to prevent evidence contamination.

Courtesy of U.S. Department of Defense

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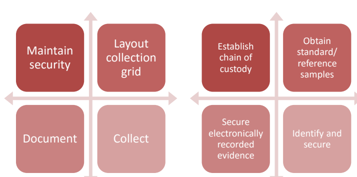
Slide 36

There are several steps to take when collecting evidence at a crime scene.



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Slide 37

There are several steps to take when collecting evidence at a crime scene.

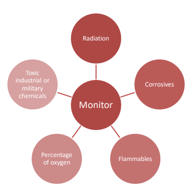
- Document condition
- Avoid excessive handling
- Avoid cross - contamination
- Diminish degradation or loss
- Transport and submit for secure storage

Slide 38

Chain of custody is a written history that includes who maintains control over an item.

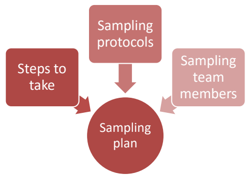
Slide 39

Site characterization is used to monitor for potential problems, some are unique to hazmat scenes.



Slide 40

Evidence should be collected in accordance with the written sampling plan of the AHJ.



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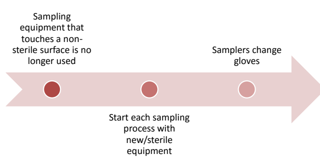
Specific precautions should be taken to prevent cross-contamination of samples and evidence.



Slide 42

The type and amount of material will determine the sampling method and equipment needed.

Slide 43

Wipe samples, used when contaminates are visible, need several pieces of equipment are for collection.

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Slide 44

Liquid sample kits can come with specific instructions for testing various suspected contaminants.

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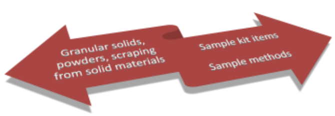
Slide 45

Solid samples of evidence are collected in a way similar to wipe samples.



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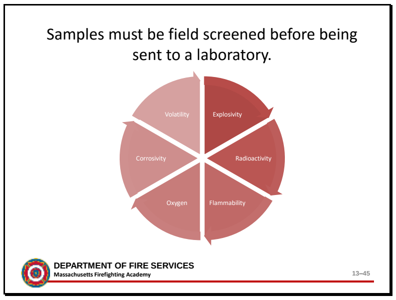

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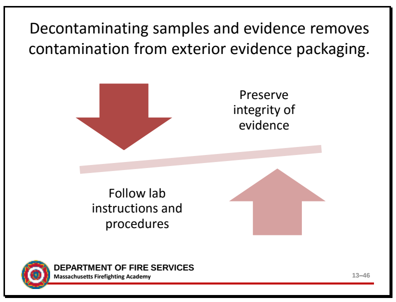

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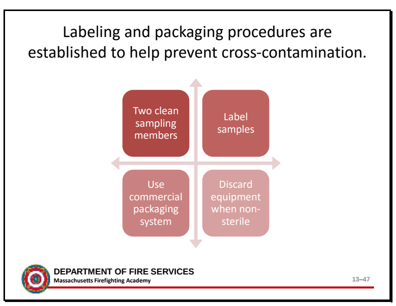

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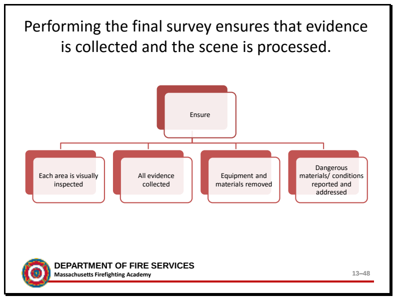

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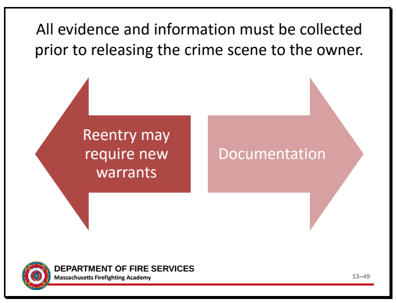

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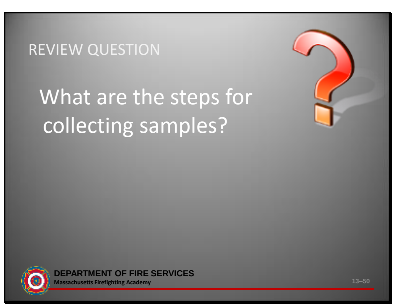

Slide 52

Summary

- Operations-Level responders with appropriate training may be asked to assist with evidence preservation.
- There are four response phases: tactical, operational, crime, and remediation.

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Slide 53

Summary

- Responders should follow local SOPs for investigations.
- Evidence must be carefully documented and protected from contamination.

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Slide 1

Hazardous Materials Operational Level Responder

Illicit Labs

Slide 2

General Hazards

Illicit Lab Response – Tactical Guideline

Hazard	Responsibility
Operator present within the Laboratory, with access to weapons	Law enforcement tactical teams specifically trained to operate within a hazardous environment
Anti-personnel devices (booby-traps) around and within the laboratory	Bomb Squad personnel trained for these procedures
Hazardous materials/WMD within the illicit laboratory	Technician – and Operational Level responders

Responders should always maintain good situational awareness and stay alert

Slide 3

Interactions with Illicit Lab Operators

Must be conducted by law enforcement tactical teams

Protection based on:

- Information on materials
- Information about protective clothing used by operator
- Activity of animals in area
- Interviews with neighbors
- Other intelligence

Slide 4

Booby Traps are Common

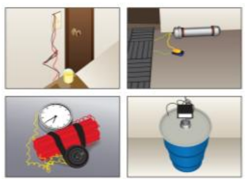
Specific information about them should be obtained from a bomb squad

- Bottles that will break causing chemicals to produce toxic fumes
- On/Off switches reversed
- Animals (dogs, poisonous snakes)
- Holes in the floor
- Hooks, Spikes, Acid

Slide 5

Location of Booby Traps

Inside or outside and include a variety of types



Slide 6

Actions to Avoid Booby Traps

- Situational awareness
- Limit personnel
- Explosion proof equipment
- Aerial reconnaissance
- Avoid complacency
- Refrain from handling, etc
- Check doors and openings
- Avoid turning on and off

If you're the first to discover or detect the presence of an illicit lab, ***DON'T*** *disturb the lab in any way*

Slide 7

REVIEW QUESTIONS

What are some booby traps that may be found at illicit labs?

How can booby traps be avoided?

Slide 8

Variety of Hazards

- Illegally disposed of hazardous waste
- Utilize improper, unapproved processes and locations
- Release hazardous vapors into residential areas
- Pour hazardous waste down sanitary sewers
- Move unmarked hazardous materials in unapproved containers

Slide 9

Drug Labs

Majority of drug labs (80-90%) are set up to produce Methamphetamine (Meth)

- Ecstasy
- Cocaine
- Phenyl-2-proponal (P2P)
- Phencyclidine (PCP)
- LSD
- Amphetamines
- Heroin

Slide 10

Drug Lab Hazards

Flammability is perhaps the most serious hazard associated with meth labs, and many are discovered after a fire or an explosion

Products Used
Highly corrosive acids & bases
Extremely toxic

Byproducts
Phosphine Gas Oxidizers Hydrogen chloride gas Hydrogen iodide gas

Risk of injury or toxicity from chemical exposure varies depending on the toxic properties of the chemicals or byproducts, their quantity and from, their concentrations, the duration of exposure, and route of exposure

Slide 11

Proper PPE

Not wearing appropriate PPE in a meth lab can cause a variety of symptoms

Slide 12

Chemicals & Products typically found in meth labs

- Pseudoephedrine
- Red Phosphorus
- Iodine Crystals
- Sodium Metal or Lithium
- Anhydrous Ammonia
- Starting Fluid or Coleman Fuel
- Ethyl Ether
- Sulfuric Acid or Rock Salt
- Hydrochloric Acid
- Sodium Hydroxide

Slide 13

Some chemicals and products are common to most meth labs

Slide 14

Types of Equipment

- Condenser Tubes
- Filters
- Funnels/Turkey Basters
- Gas Container
- Grinders
- pH Papers
- Tubing

Neck of a propane tank exposed to anhydrous ammonia

Slide 15

Some equipment is also commonly found in meth labs

Slide 16

REVIEW QUESTIONS

What percentage of illegal clandestine labs are set up to produce meth?

What types of chemicals and products are typically found in meth labs?

Slide 17

There are several indicators that can be clues to the presence of a meth lab

- Windows covered → Renters who pay in cash → Unusual security
- Excessive trash → Increased activity → Unusual structures
- Discoloration → Strong odors, smell of ammonia, etc → Iodine- or chemical-stained fixtures

Slide 18

Hazardous Waste Generated

For every pound (0.5 kg) of meth produced there are six pounds (3 kg) of hazardous waste generated

Slide 19

REVIEW QUESTIONS

What types of equipment may be found in meth labs?

What are some other clues to the presence of meth labs in structures?

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Slide 22

Chemical Agent Labs

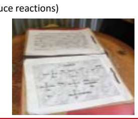
- Produce chemical warfare agents
- Recipes may be easy to find, materials necessary may not
- Some ingredients are common, others are restricted

School chemistry lab

Slide 23

Indicators of a Chemical Lab

- Military manuals
- Underground "cookbooks"
- Organophosphate pesticides (not normally used to make meth)
- Methyl iodide & phosphorus trichloride (attempts to make sarin)
- Sophisticated lab equipment (to produce reactions)
- Presence of cyanides or acids



Slide 24

Explosive Labs

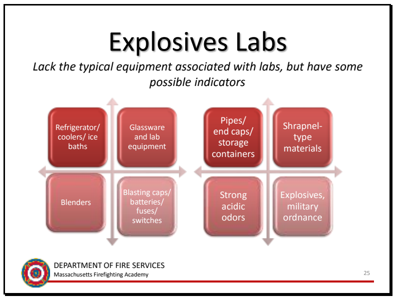
Explosive labs are the second most common type of lab discovered, after drug labs

Types of explosive labs

- Custom Fireworks
- Explosive chemical mixtures
- Peroxide base explosives

Improvised explosives lab

Slide 25



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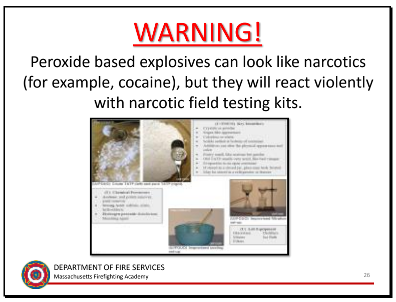

Slide 27

Slide 28

WARNING!

Do not touch white crystals or powder found in a clandestine laboratory! They may be extremely sensitive to heat, friction, and shock.

Bottle Rocket Bomb

Acetone Peroxide Explosive

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Slide 29

REVIEW QUESTION

What are some indicators of a possible explosives lab?

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Slide 30

Biological Labs

Biological labs are used to produce agents such as

- Bacteria
- Toxins
- Viruses

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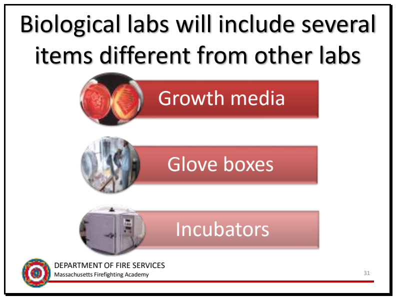

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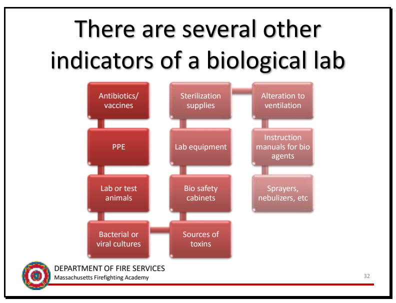

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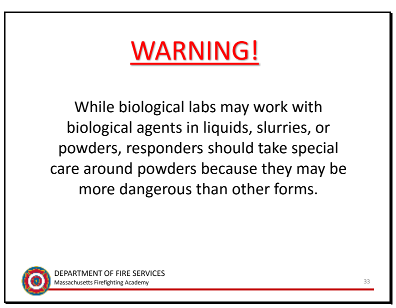

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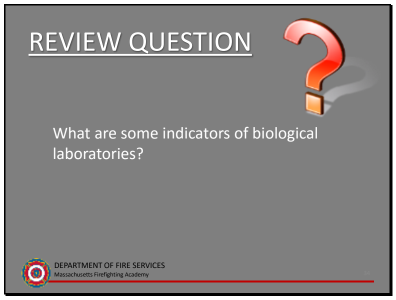

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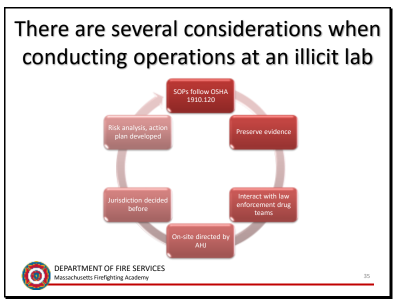

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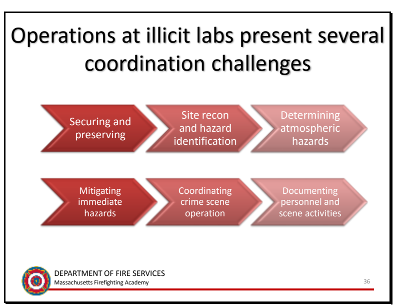

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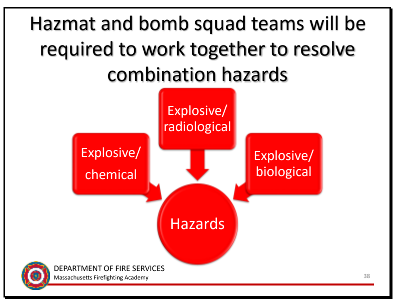

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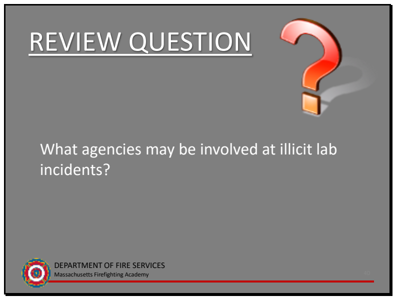

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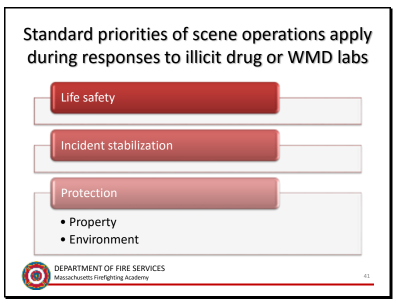

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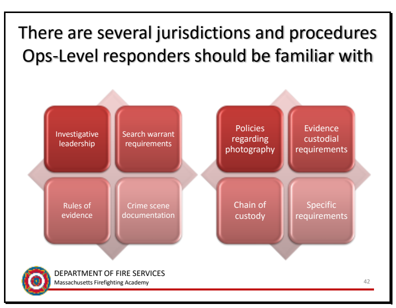

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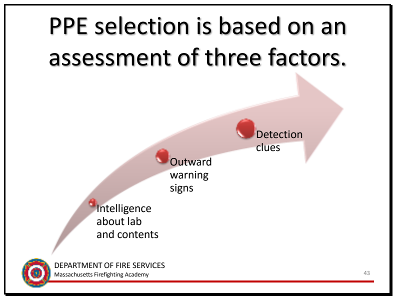

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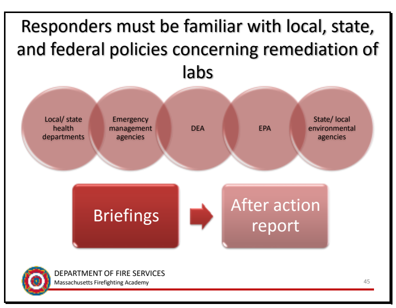
Slide 45



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Summary

- Responders should be familiar with each type of illicit lab.
- When a suspected lab is discovered, responders must withdraw and notify law enforcement.

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Summary

- Responders should follow all appropriate safety procedures when operating in illicit labs.
- When in the hot zone, responders should not disturb the scene in any way.