Essentials of Fire Fighting 6th Edition

Chapter 24 — Mitigating Haz Mat/WMD Incidents

Learning Objective 1

Summarize first responder roles at haz mat/WMD incidents.

Haz Mat/WMD responder training is governed by different agencies.

OSHA

- U.S. Occupational Safety and Health Administration

EPA

- U.S. Environmental Protection Agency

NFPA®

- National Fire Protection Association®

Canadian Standards

- Ministry of Labour
- WCB—Workers Compensation Board
- NFPA® 472

Awareness-Level personnel may be first to arrive at or witness the incident.

Responsibilities

- Recognize presence of haz mat
- Recognize containers and identify material
- Transmit information
- Identify actions to protect
- Establish scene control

Operations-Level responders assume other duties and may also have mission-specific training.

- Identify haz mat
- Analyze incident
- Protect self, persons, environment, property
- Develop defensive plan of action
- Implement planned response to mitigate/control
- Evaluate progress

Mission-specific competencies

REVIEW QUESTION

What are the basic responsibilities of both Awareness-Level and Operations-Level personnel at haz mat/WMD incidents?

Learning Objective 2

Summarize incident priorities for haz mat/WMD incidents.

There are three incident priorities for haz mat and WMD incidents.

1. Life safety
2. Incident stabilization
3. Protection of property and environment

REVIEW QUESTION

What are the three incident priorities for haz mat/WMD incidents?

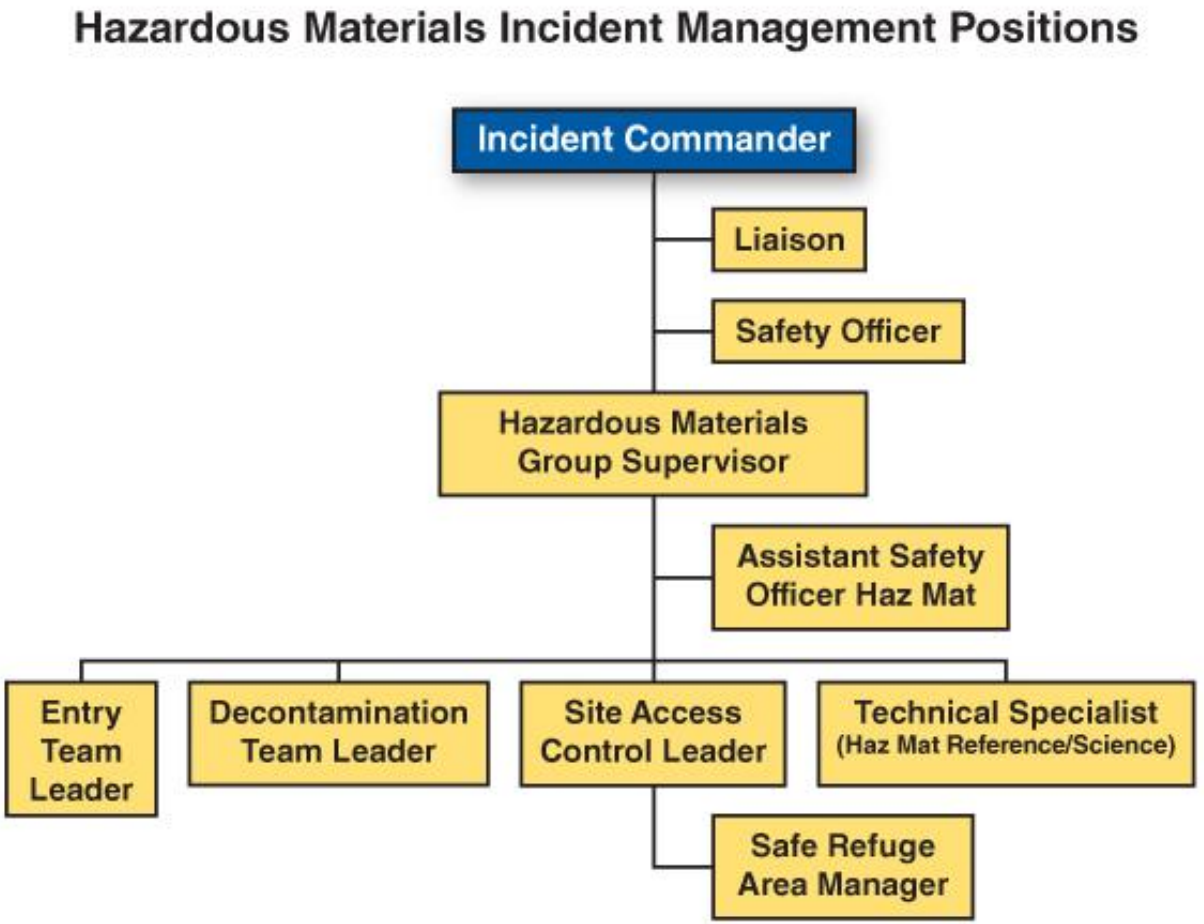
Learning Objective 3

Explain the management structure used for haz mat/WMD incidents.

DISCUSSION QUESTION

How does a haz mat/WMD incident differ from other incidents?

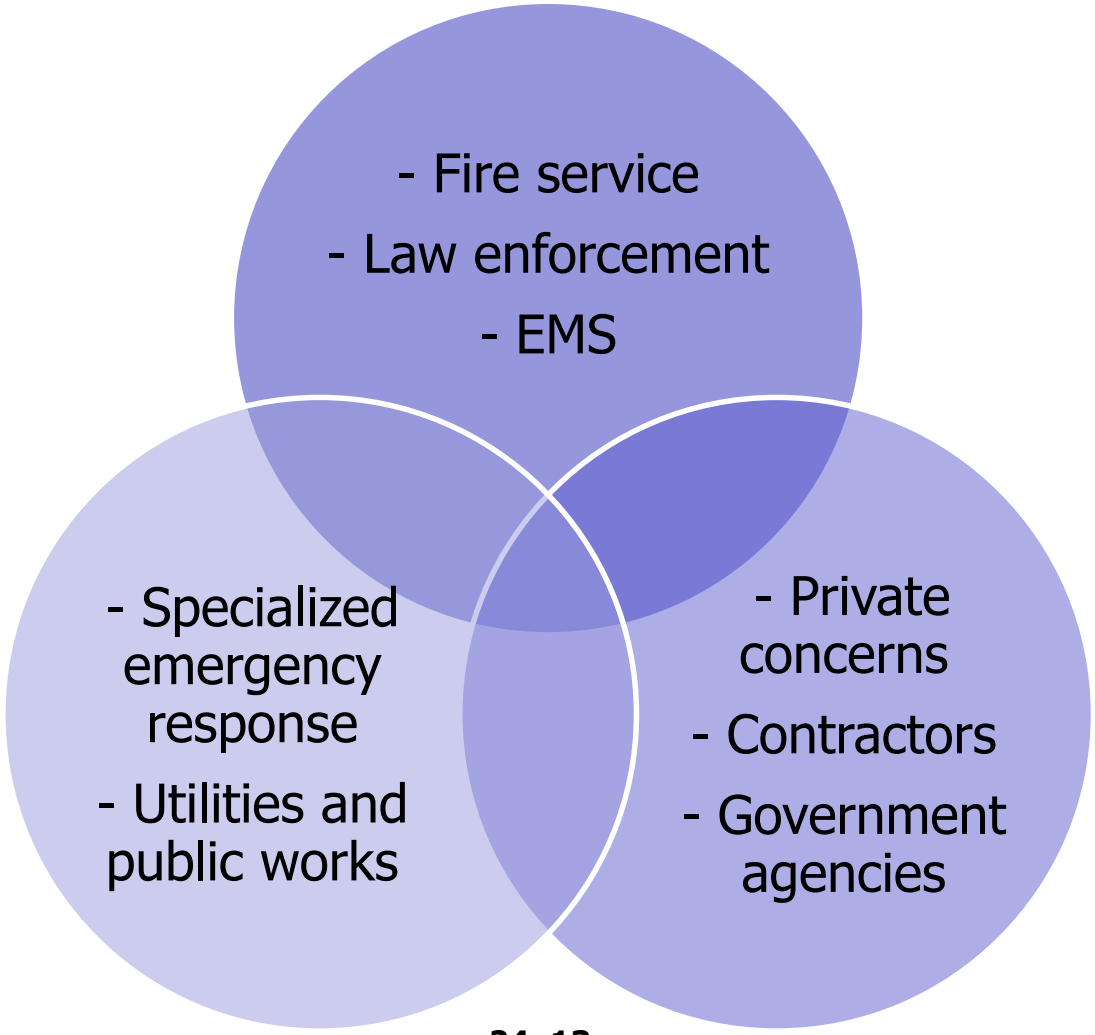
There are several standard ICS positions for to haz mat incidents.



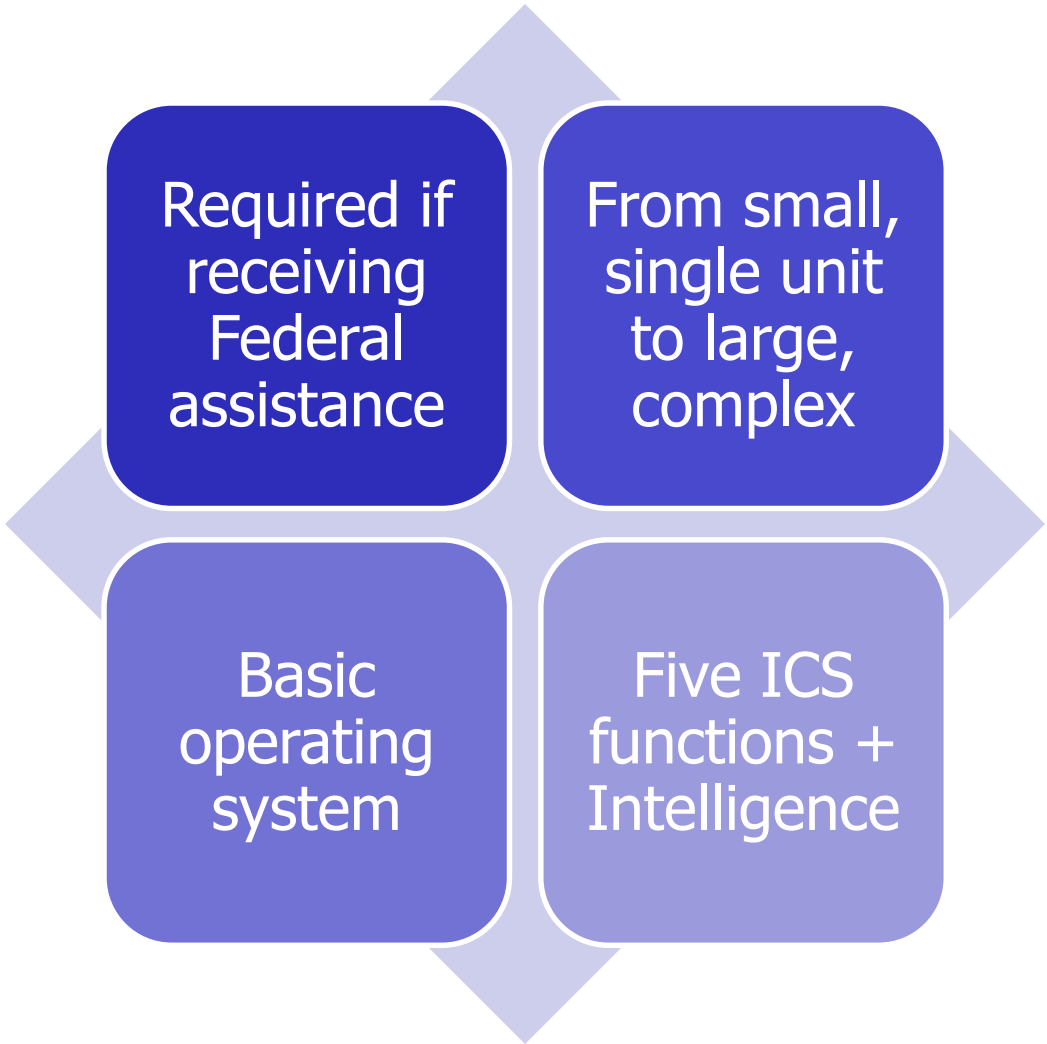
Unified Command ensures control of large-scale incidents to achieve a common purpose.

- Establishing one set of incident objectives
- Selecting strategies
- Accomplishing joint planning
- Insuring integrated tactical operations
- Using resources effectively

Unified Command requires coordination between several agencies/organizations.



NIMS-ICS was designed so U.S. emergency services organizations have common terminology and command structures.



The National Response Framework also establishes resource teams.

WMD-CST	• Weapons of Mass Destruction-Civil Support Teams
DMAT	• Disaster Medical Assistance Teams
DMORT	• Disaster Mortuary Operational Response Teams
NMRT-WMD	• National Medical Response Team-Weapons of Mass Destruction
USAR	• Urban Search and Rescue Task Forces
IMT	• Incident Management Teams

REVIEW QUESTION

What kind of management structure is used for haz mat/WMD incidents?

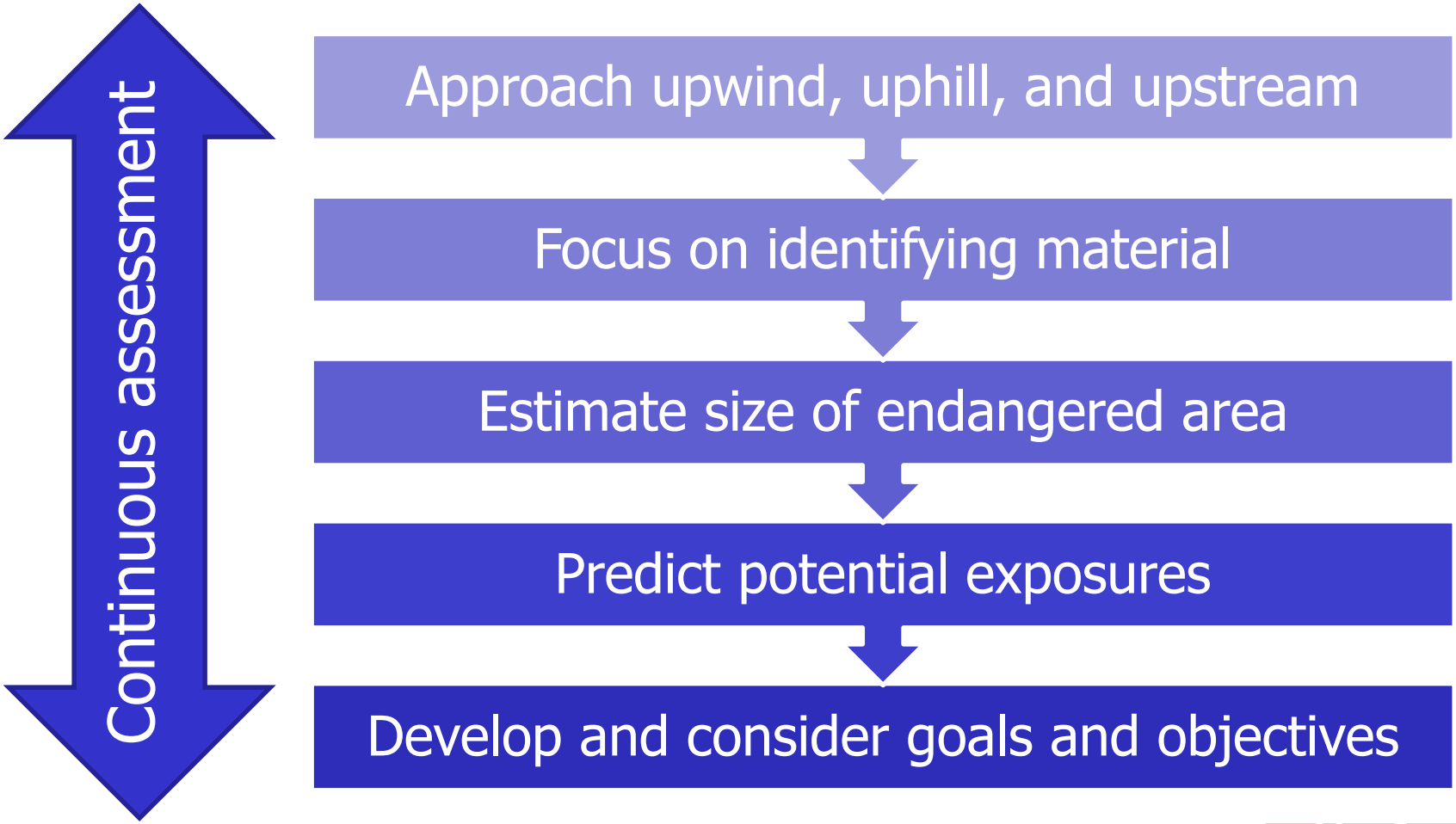
Learning Objective 4

Explain the considerations that must be taken into account during the analysis stage of haz mat/WMD incidents.

REVIEW QUESTION

What are the four problem-solving stages of haz mat/WMD incident mitigation?

During initial size-up, consider all factors and follow a continual process.



Incident levels can be determined after the scope of the incident is established.

Level I

- Within capabilities of first responders

Level II

- Beyond capabilities of first responders

Level III

- Requires outside resources

REVIEW QUESTION

What role does size-up and identifying incident levels play in the analysis stage of haz mat/WMD incidents?

Learning Objective 5

Describe the steps used for planning the appropriate response at haz mat/WMD incidents.

Planning an appropriate response requires both goals and objectives.

Strategic goals

What must be done to resolve incident

Tactical objectives

Specific operations to accomplish goals

Planning a response involves selecting strategies, a mode of operation, and developing an IAP.

Strategies

- Multiple varieties

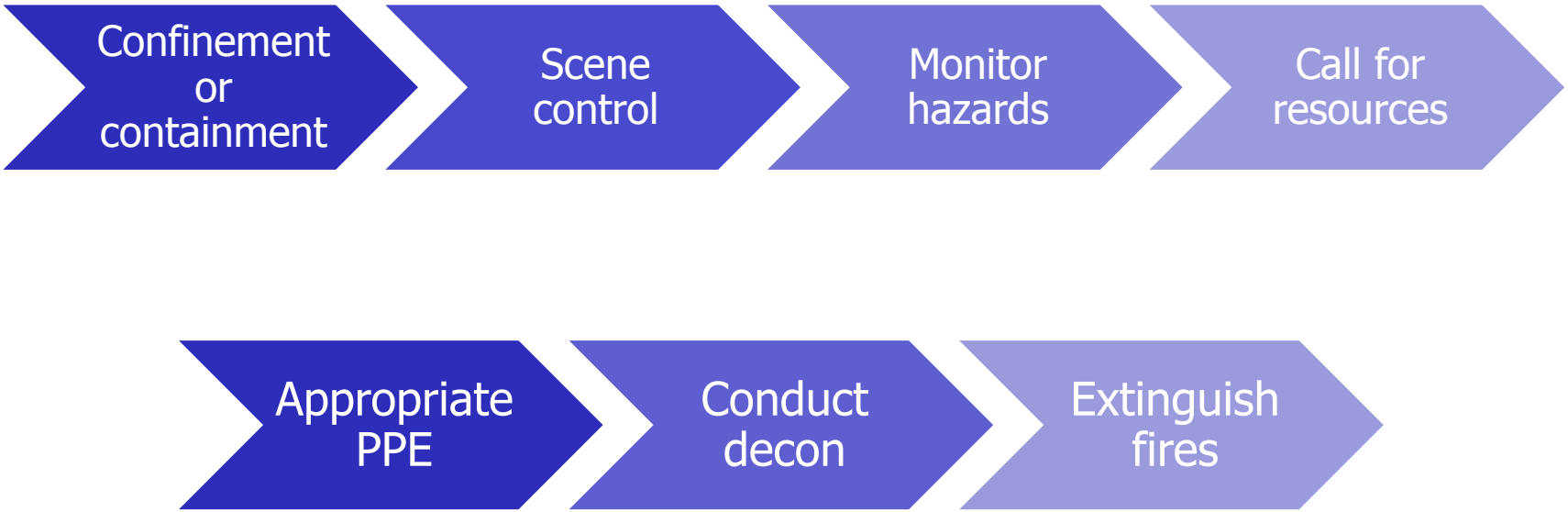
Modes of operation

- Defensive
- Offensive
- Nonintervention

Incident action plans

- Problem-solving process that states what analysis has found, what plan is, and how it will be implemented

The IAP is accomplished through several different types of tactics.



REVIEW QUESTION

What are the different modes of operation that can be used at a haz mat/WMD incident?

Learning Objective 6

Describe the process for evaluating and communicating the progress at haz mat/WMD events.

Evaluating progress is the final part of the problem-solving process.

If successful IAP	• Favorable progress report • Incident stabilization
If efforts failing	• Plan reevaluated and revised

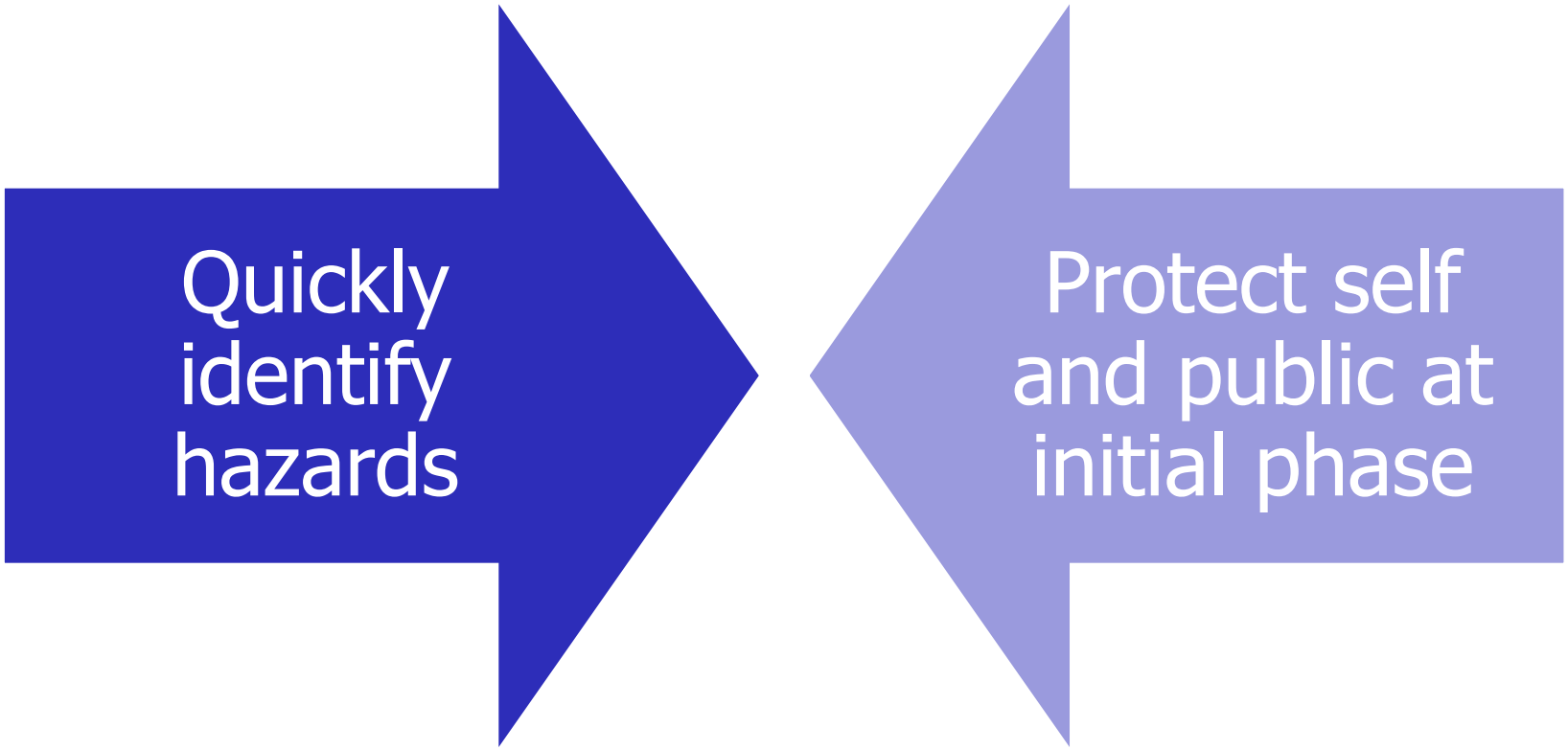
REVIEW QUESTION

When should a plan be reevaluated or revised during haz mat/WMD incidents?

Learning Objective 7

Explain how the *Emergency Response Guidebook (ERG)* is used at haz mat/WMD incidents.

The *Emergency Response Guidebook* (*ERG*) is an aid for responders.



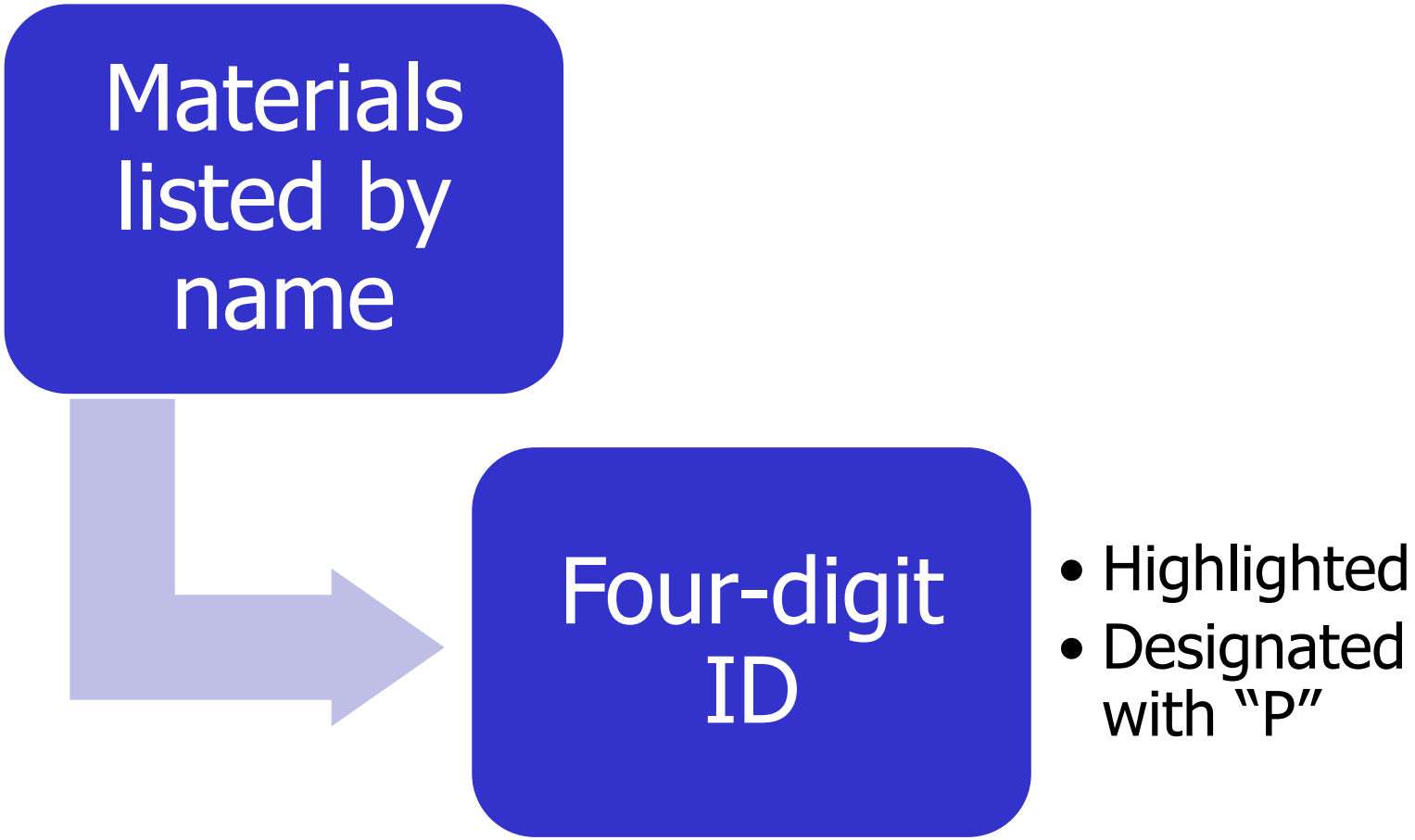
The *ERG* ID number index is found in the yellow-bordered pages.

Four digit UN/NA ID number

Numerical order

- Highlighted
- Designated with "P"

The *ERG* material name index is found in the blue-bordered pages.



The *ERG* initial action guides are found in the orange-bordered pages.

GUIDE 117 GASES - TOXIC - FLAMMABLE (EXTREME HAZARD) ERG2008

POTENTIAL HAZARDS

HEALTH
- **TOXIC; Extremely Hazardous.**
- May be fatal if inhaled or absorbed through skin.
- Initial odor may be irritating or foul and may deaden your sense of smell.
- Contact with gas or liquefied gas may cause burns, severe injury and/or frostbite.
- Fire will produce irritating, corrosive and/or toxic gases.
- Runoff from fire control may cause pollution.

FIRE OR EXPLOSION
- These materials are extremely flammable.
- May form explosive mixtures with air.
- May be ignited by heat, sparks or flames.
- Vapors from liquefied gas are initially heavier than air and spread along ground.
- Vapors may travel to source of ignition and flash back.
- Runoff may create fire or explosion hazard.
- Cylinders exposed to fire may vent and release toxic and flammable gas through pressure relief devices.
- Containers may explode when heated.
- Ruptured cylinders may rocket.

PUBLIC SAFETY
- **CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.**
- As an immediate precautionary measure, isolate spill or leak area for at least 100 meters (330 feet) in all directions.
- Keep unauthorized personnel away.
- Stay upwind.
- Many gases are heavier than air and will spread along ground and collect in low or confined areas (sewers, basements, tanks).
- Keep out of low areas.
- Ventilate closed spaces before entering.

PROTECTIVE CLOTHING
- Wear positive pressure self-contained breathing apparatus (SCBA).
- Wear chemical protective clothing that is specifically recommended by the manufacturer. It may provide little or no thermal protection.
- Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations where direct contact with the substance is possible.

EVACUATION

Spill
- See Table 1 - Initial Isolation and Protective Action Distances.

Fire
- If tank, rail car or tank truck is involved in a fire, ISOLATE for 1600 meters (1 mile) in all directions; also, consider initial evacuation for 1600 meters (1 mile) in all directions.

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The *ERG* initial action guides break information into several sections.

Potential hazards

Potential health and fire/explosion hazards

Public safety

General information on isolation of site, recommended PPE, isolation distance and zone

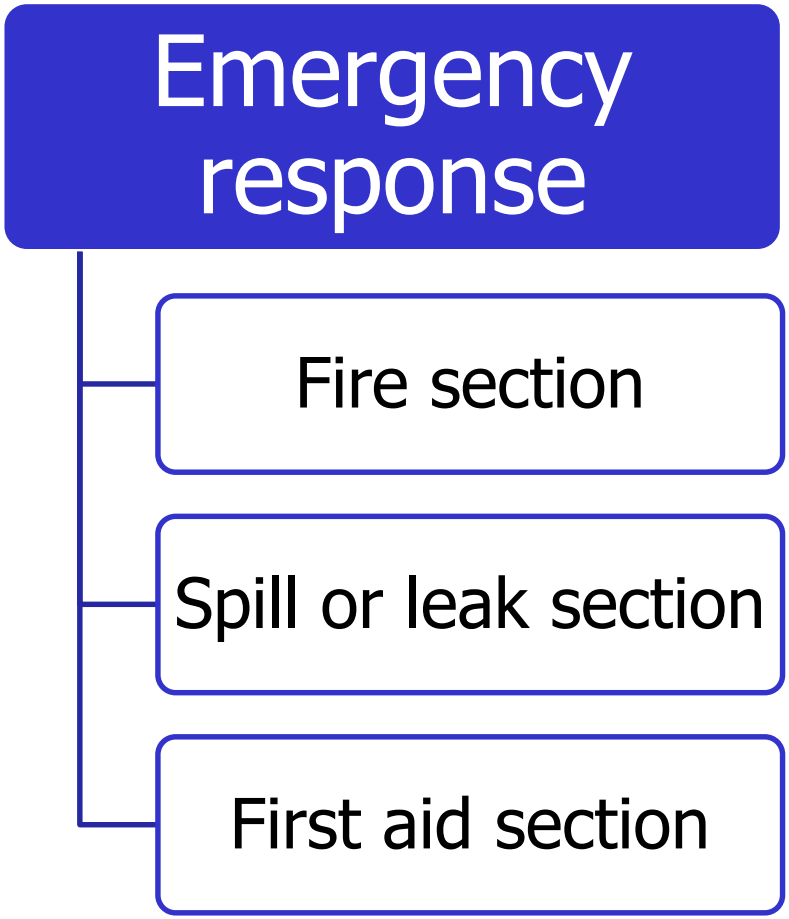
- Protective clothing section
- Evacuation section

(Cont.)

CAUTION

You must be properly trained and equipped before attempting the actions recommended in the *ERG*.

The *ERG* initial action guides break information in several sections.



The *ERG* table of initial isolation and protective action distances are found in the green-bordered pages.

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TABLE 1 - INITIAL ISOLATION AND PROTECTIVE ACTION DISTANCES

ID No.	NAME OF MATERIAL	SMALL SPILLS (From a small package or small leak from a large package) First ISOLATE in all Directions		Then PROTECT persons Downwind during- DAY		NIGHT		LARGE SPILLS (From a large package or from many small packages) First ISOLATE in all Directions		Then PROTECT persons Downwind during- DAY		NIGHT	
		Meters	(Feet)	Kilometers	(Miles)	Kilometers	(Miles)	Meters	(Feet)	Kilometers	(Miles)	Kilometers	(Miles)
1005 1005	Ammonia, anhydrous Anhydrous ammonia	30 m	(100 ft)	0.1 km	(0.1 mi)	0.2 km	(0.1 mi)	150 m	(500 ft)	0.8 km	(0.5 mi)	2.3 km	(1.4 mi)
1008 1008	Boron trifluoride Boron trifluoride, compressed	30 m	(100 ft)	0.1 km	(0.1 mi)	0.6 km	(0.4 mi)	300 m	(1000 ft)	1.9 km	(1.2 mi)	4.8 km	(3.0 mi)
1016 1016	Carbon monoxide Carbon monoxide, compressed	30 m	(100 ft)	0.1 km	(0.1 mi)	0.1 km	(0.1 mi)	150 m	(500 ft)	0.7 km	(0.5 mi)	2.7 km	(1.7 mi)
1017	Chlorine	60 m	(200 ft)	0.4 km	(0.3 mi)	1.6 km	(1.0 mi)	600 m	(2000 ft)	3.5 km	(2.2 mi)	8.0 km	(5.0 mi)
1023 1023	Coal gas Coal gas, compressed	30 m	(100 ft)	0.1 km	(0.1 mi)	0.1 km	(0.1 mi)	60 m	(200 ft)	0.3 km	(0.2 mi)	0.4 km	(0.3 mi)
1026 1026	Cyanogen Cyanogen gas	30 m	(100 ft)	0.2 km	(0.1 mi)	0.9 km	(0.5 mi)	150 m	(500 ft)	1.0 km	(0.7 mi)	3.5 km	(2.2 mi)
1040 1040	Ethylene oxide Ethylene oxide with Nitrogen	30 m	(100 ft)	0.1 km	(0.1 mi)	0.2 km	(0.1 mi)	150 m	(500 ft)	0.8 km	(0.5 mi)	2.5 km	(1.6 mi)
1045 1045	Fluorine Fluorine, compressed	30 m	(100 ft)	0.1 km	(0.1 mi)	0.3 km	(0.2 mi)	150 m	(500 ft)	0.8 km	(0.5 mi)	3.1 km	(1.9 mi)
1048	Hydrogen bromide, anhydrous	30 m	(100 ft)	0.1 km	(0.1 mi)	0.4 km	(0.3 mi)	300 m	(1000 ft)	1.5 km	(1.0 mi)	4.5 km	(2.8 mi)
1050	Hydrogen chloride, anhydrous	30 m	(100 ft)	0.1 km	(0.1 mi)	0.4 km	(0.2 mi)	60 m	(200 ft)	0.3 km	(0.2 mi)	1.4 km	(0.9 mi)
1051	AC (when used as a weapon)	100 m	(300 ft)	0.3 km	(0.2 mi)	1.1 km	(0.7 mi)	1000 m	(3000 ft)	3.8 km	(2.4 mi)	7.2 km	(4.5 mi)
1051 1051 1051	Hydrocyanic acid, aqueous solutions, with more than 20% Hydrogen cyanide Hydrogen cyanide, anhydrous, stabilized Hydrogen cyanide, stabilized	60 m	(200 ft)	0.2 km	(0.1 mi)	0.6 km	(0.4 mi)	400 m	(1250 ft)	1.6 km	(1.0 mi)	4.1 km	(2.5 mi)
1052	Hydrogen fluoride, anhydrous	30 m	(100 ft)	0.1 km	(0.1 mi)	0.5 km	(0.3 mi)	300 m	(1000 ft)	1.7 km	(1.1 mi)	3.6 km	(2.2 mi)

REVIEW QUESTION

What are the three ways a firefighter can identify a hazardous material or WMD using the *Emergency Response Guidebook (ERG)*?

Learning Objective 8

Summarize the role of emergency response centers during haz mat/WMD incidents.

Contact information for emergency response centers is included in the white pages of the *ERG*.

U.S.

- **CHEMTREC®** Chemical Transportation Emergency Center

Canada

- **CANUTEC** Canadian Transport Emergency Centre

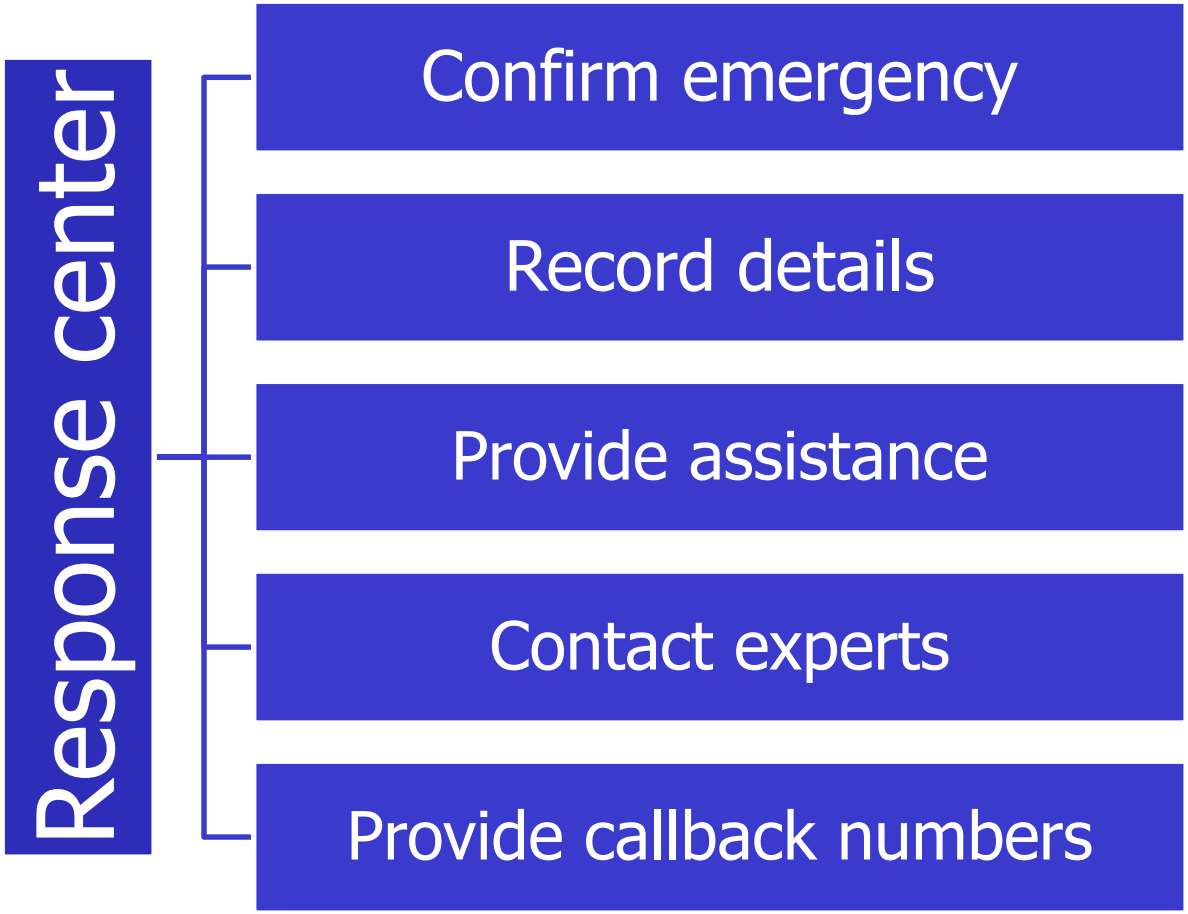
Mexico

- **CENACOM** National Center for Communications of the Civil Protection Agency
- **SETIQ** Emergency Transporation System for the Chemical Industry

Be prepared with as much information as safely possible before calling.

- ✓ Name, callback number
- ✓ Location, nature of problem
- ✓ Name, ID number of material
- ✓ Shipper/consignee/point of origin
- ✓ Carrier name, railroad marks, truck number
- ✓ Container type, size
- ✓ Quantity of material
- ✓ Local conditions
- ✓ Injuries, exposures, current conditions
- ✓ Local emergency services notified

Response centers will take action after gathering information.



REVIEW QUESTION

What can an emergency response center offer to responders during haz mat/WMD incidents?

Learning Objective 9

Explain the considerations that must be taken when choosing personal protective equipment at haz mat/WMD incidents.

Respiratory protection can be provided by a variety of methods.

SCBA with NIOSH certification label

SAR

(Cont.)

Respiratory protection can be provided by a variety of methods.

Courtesy of FEMA News Photos, photo by Jocelyn Augustino

APRs

Courtesy of New South Wales Fire Brigades

PAPRs

(Cont.)

Respiratory protection can be provided by a variety of methods.

Courtesy of U.S. Air Force, photo by Airman 1st class Bradley A. Lail.

Supplied-air hoods

Courtesy of MSA

Escape respirator

Protective clothing can also be provided in several forms.

Structural

- Limitations
- Conditions for use with haz mat
- Provides some protection

(Cont.)

Protective clothing can also be provided in several forms.

Courtesy of William D. Stewart

- **High-temp**
  - Proximity suits
  - Fire-entry suits
  - Limitations

(Cont.)

Protective clothing can also be provided in several forms.

Courtesy of U. S. Air Force, photo by A1C Jason Epley

Chemical-protective

- Purpose
- Selection process
- Mechanical and fire hazards

(Cont.)

WARNING!

No single type of CPC protects against all chemical hazards.

Protective clothing can also be provided in several forms.

Courtesy of U. S. Air Force, photo by A1C Jason Epley

Chemical-protective

- Specific design
- Can contribute to heat disorders
- Must be decontaminated

(Cont.)

WARNING!

Responders must have sufficient training to operate in conditions requiring the use of chemical-protective clothing.

Protective clothing can also be provided in several forms.

- Liquid-splash
  - Splashes, not vapor or gases
  - Encapsulating
  - Nonencapsulating

(Cont.)

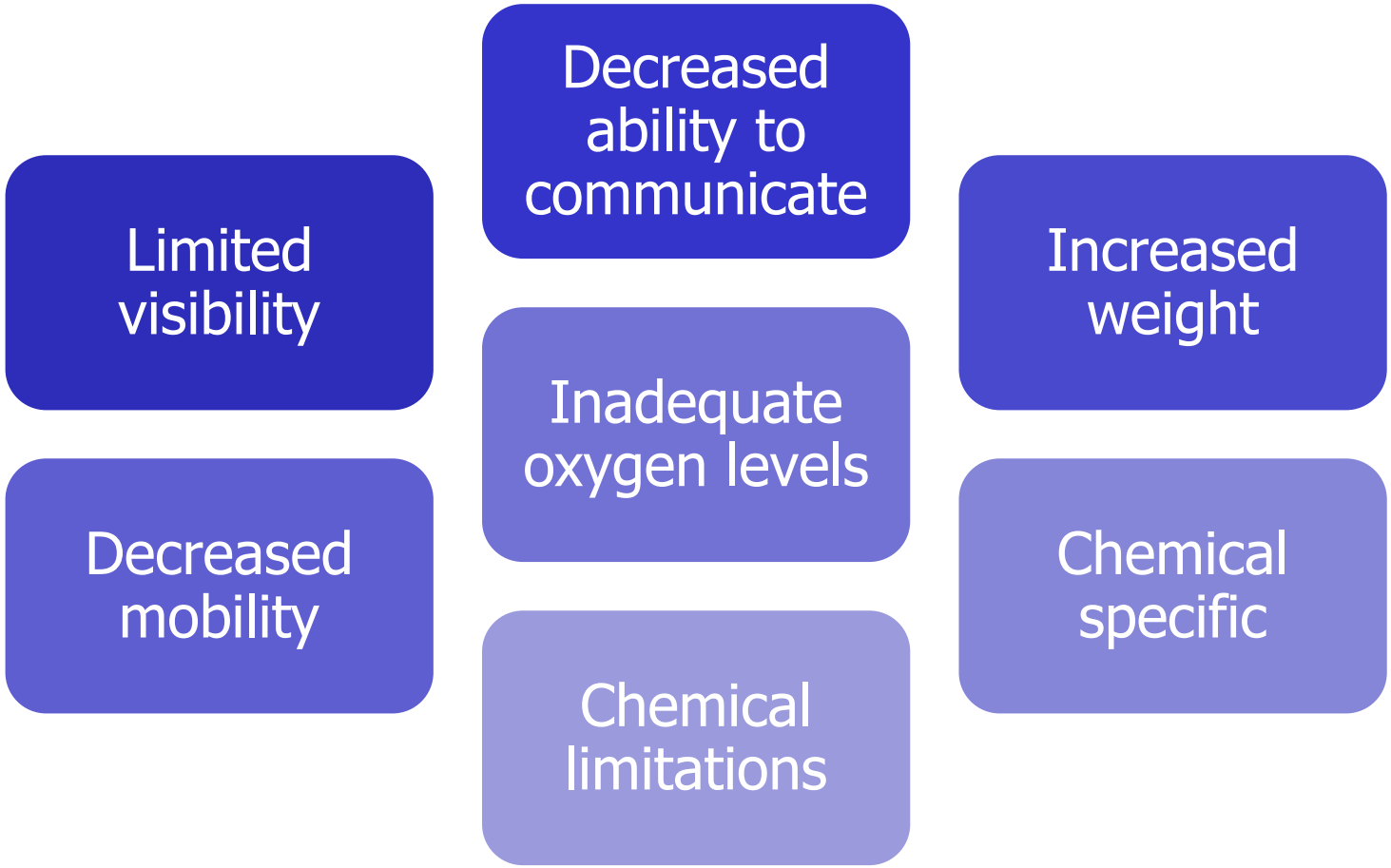
Protective clothing can also be provided in several forms.

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

Vapor-protective

- Higher level than liquid-splash
- Worn with positive pressure SCBA or combination SCBA/SAR
- Limitations

Be aware of the physical limitations present when wearing PPE.



REVIEW QUESTION

What considerations must be taken when choosing personal protective equipment at haz mat/WMD incidents?

Learning Objective 10

Distinguish among the four levels of EPA defined protection.

PPE ensembles are identified in the U.S. by EPA levels of protection.

Level A

Level B

(Cont.)

PPE ensembles are identified in the U.S. by EPA levels of protection.

Level C

Level D

REVIEW QUESTION

In what situations are each level of EPA defined protection used?

Learning Objective 11

Describe Mission-Oriented Protective Posture (MOPP) ensembles.

Mission-Oriented Protective Posture ensembles are used by the U.S. military.

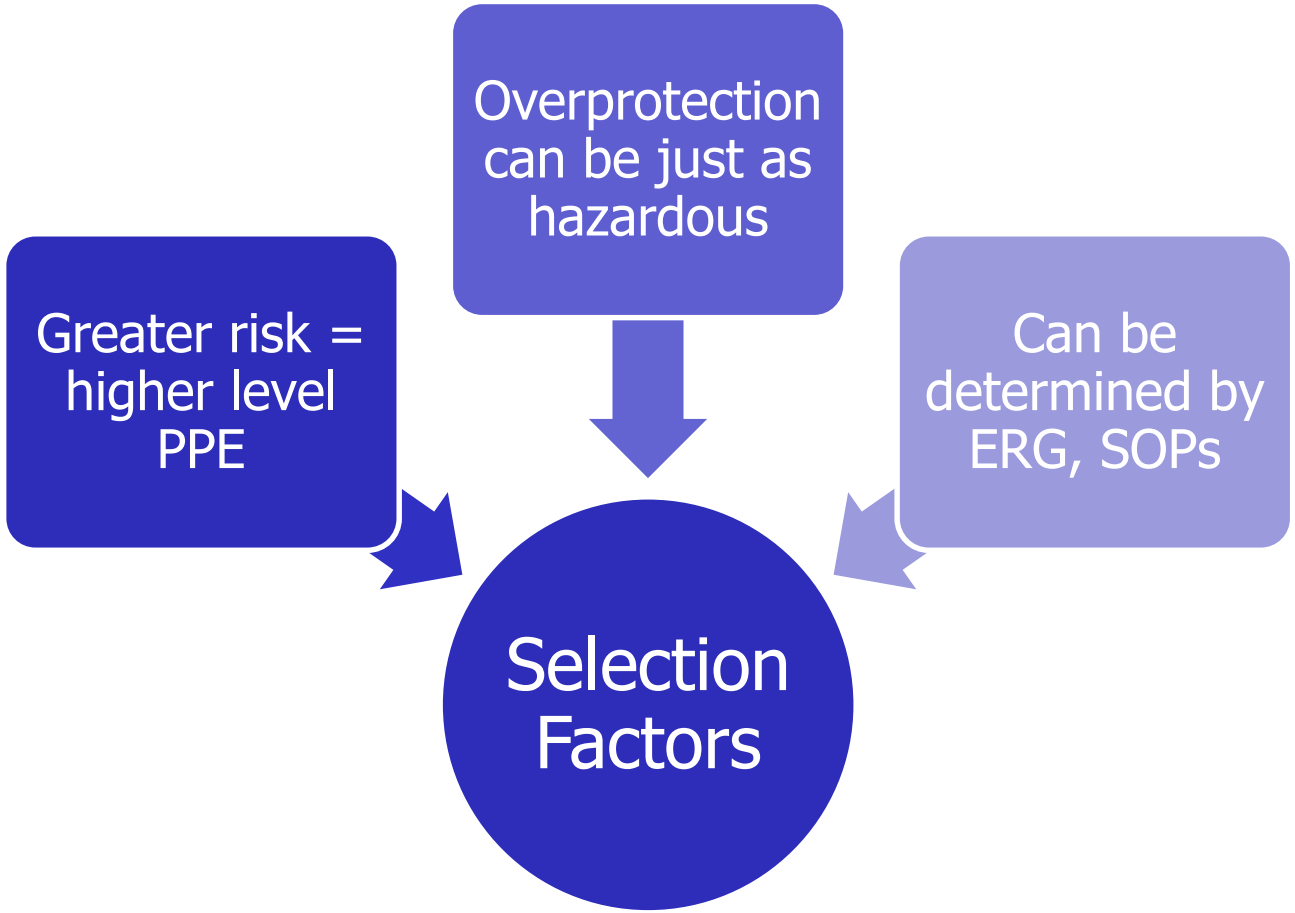
REVIEW QUESTION

What are Mission-Oriented Protective Posture (MOPP) ensembles?

Learning Objective 12

Describe the selection factors that must be considered when selecting personal protective equipment at haz mat/WMD incidents.

PPE selection is based on several factors and information from different sources.



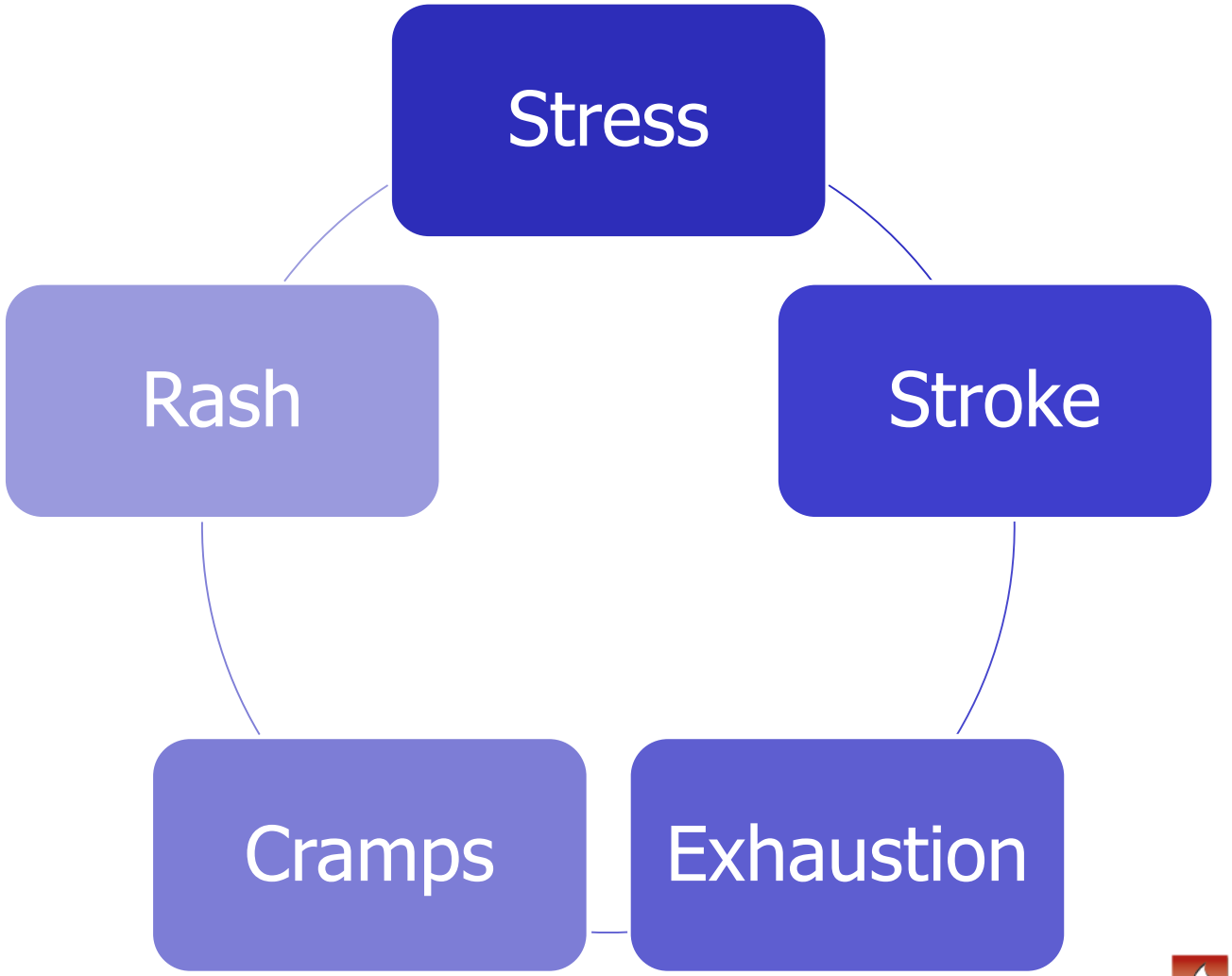
REVIEW QUESTION

What factors must be considered when selecting personal protective equipment for use at haz mat/WMD incidents?

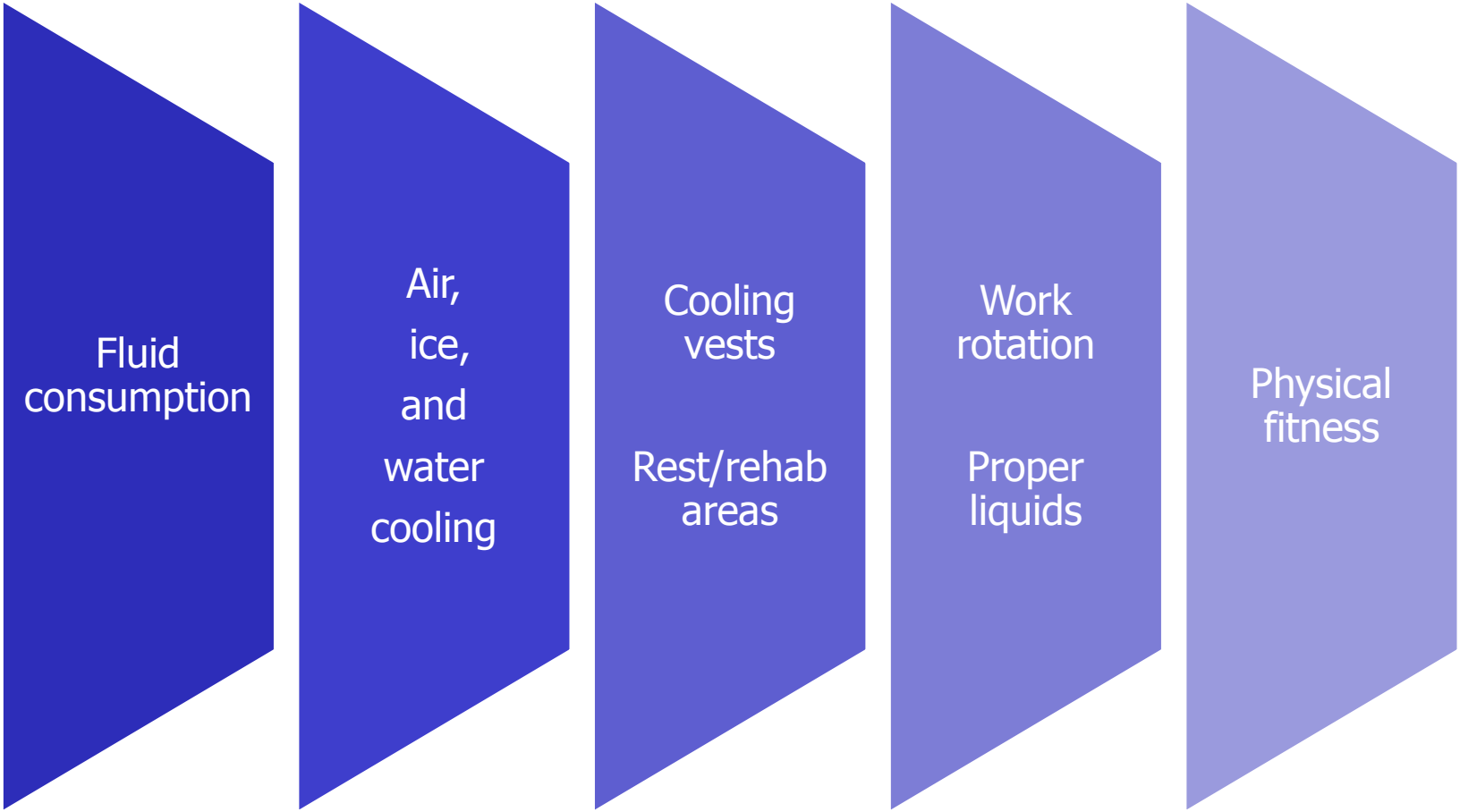
Learning Objective 13

Explain safety and emergency procedures used for personnel wearing protective clothing.

Heat disorders can be caused by wearing full-body protective clothing.



There are several methods that can be used to prevent heat exposure.

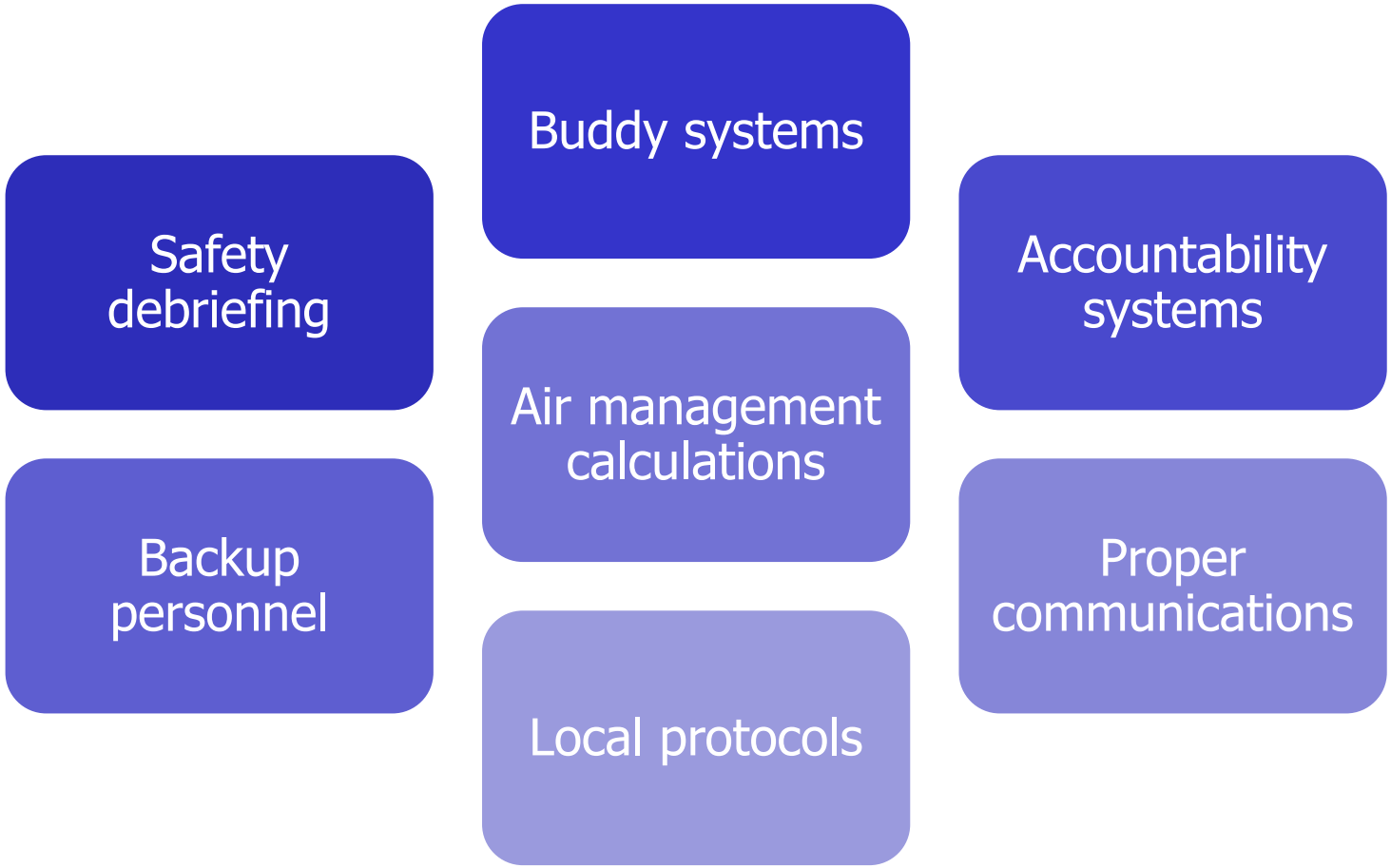


There are several cold disorders that may be present at incidents.

- Trench foot
- Frostbite
- Hypothermia
- Environmental conditions cause stress

Medical monitoring is required for several different reasons on scene.

There are several safety and emergency procedures that can be used.



REVIEW QUESTION

What safety and emergency procedures can be implemented when personnel are wearing protective clothing?

Learning Objective 14

Explain proper procedures for PPE inspection, storage, testing, and maintenance.

PPE inspection, storage, testing, and maintenance ensures ensembles will perform as expected during an incident.

REVIEW QUESTION

What type of information should be included in inspection records for PPE?

Learning Objective 15

Describe the techniques used for isolation and scene control.

Isolation and scene control are important aspects of haz mat incidents.

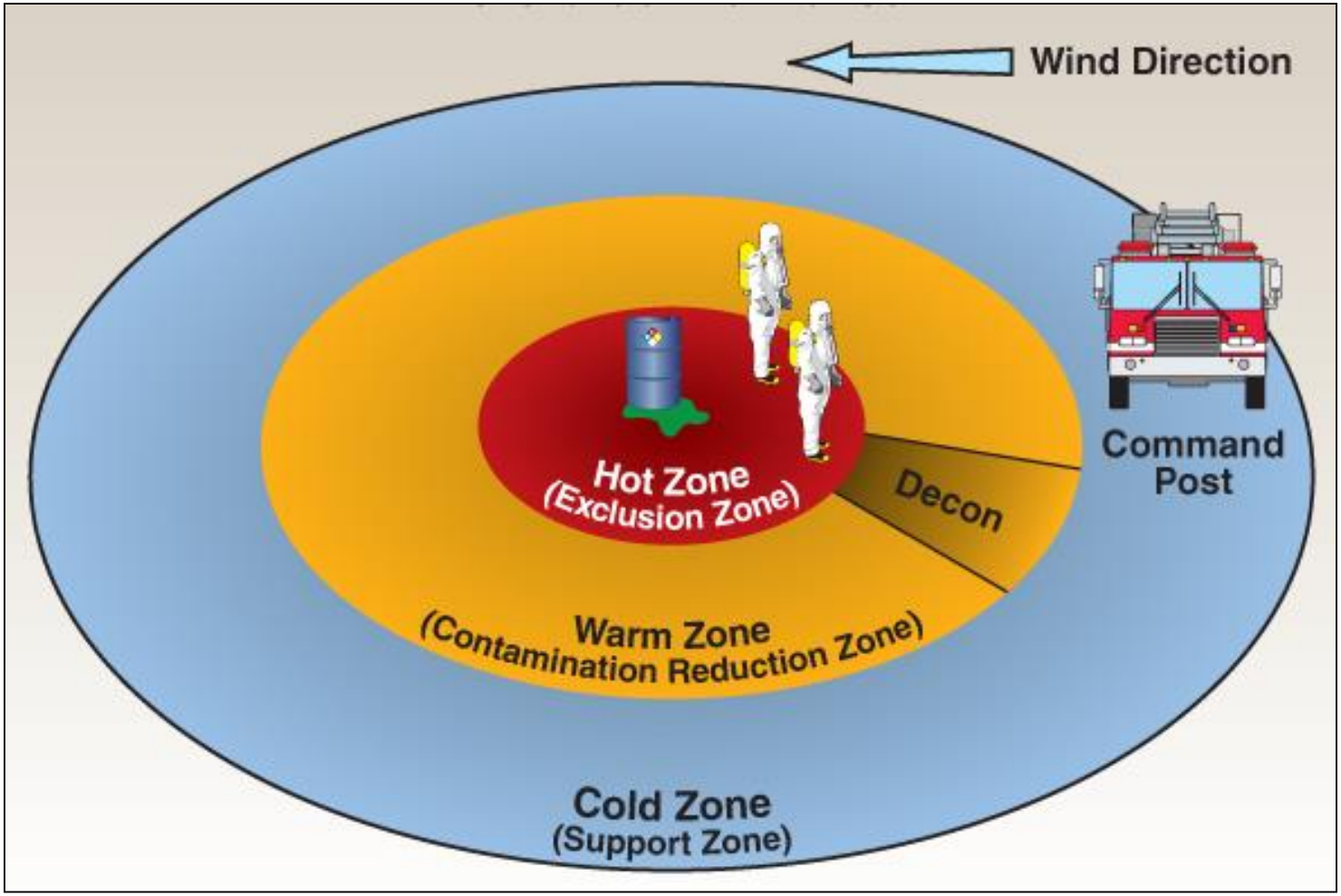
The isolation perimeter prevents access by unauthorized persons.

DISCUSSION QUESTION

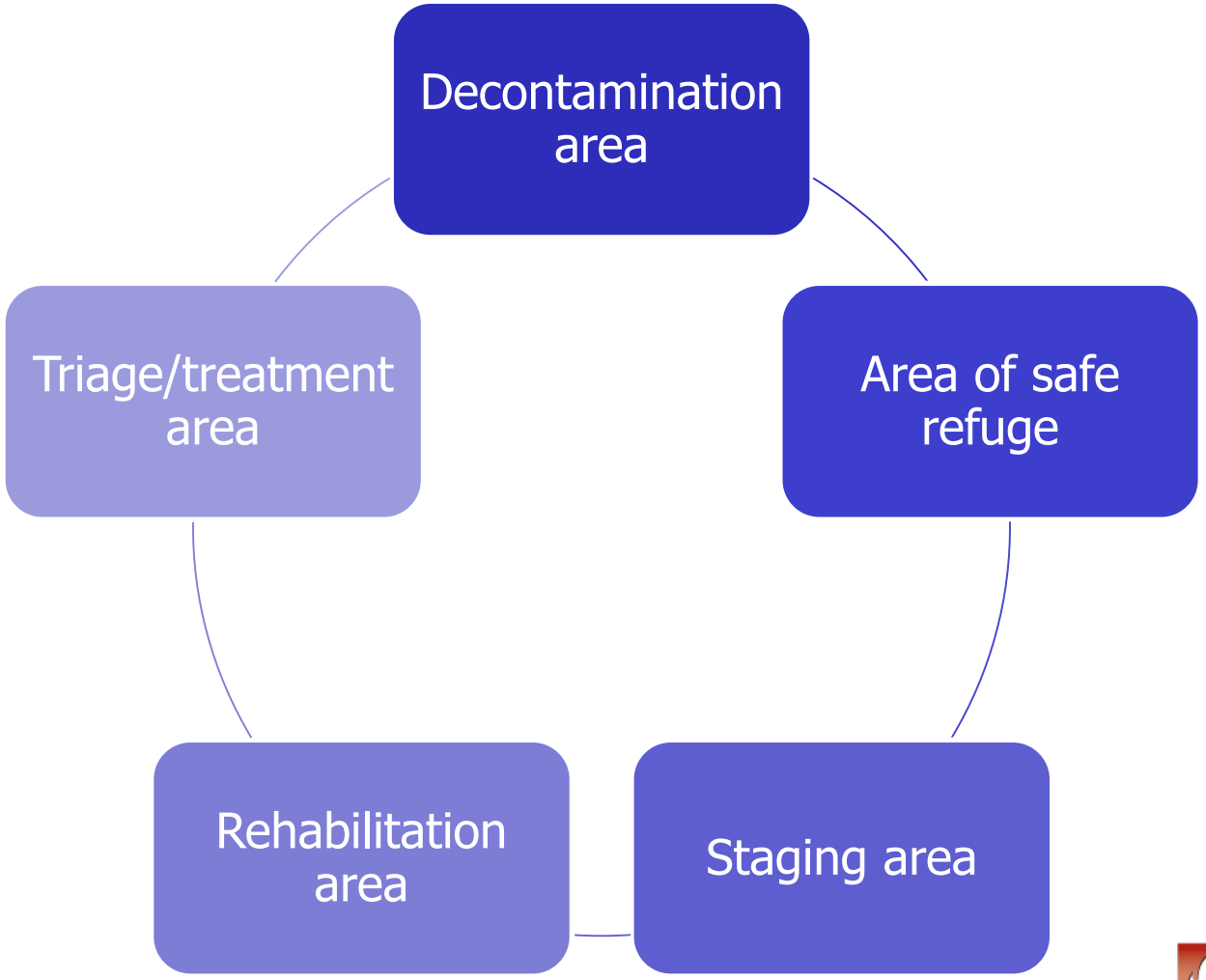
Where is an isolation perimeter set at an indoor incident? Outdoor?

Hazard control zones accomplish several goals.

There may be multiple hazard-control zones within the incident perimeter.



There are several additional zones that may also be establish at an incident.



REVIEW QUESTION

How do isolation and scene control help mitigate the impact of haz mat/WMD incidents?

Learning Objective 16

Identify basic notification considerations at haz mat/WMD incidents.

There are several possible notification methods used to report an incident.

The National Response Plan spells out the notification process for the U.S.

REVIEW QUESTION

What agencies may need to be notified in the event of haz mat/WMD incidents?

Learning Objective 17

Describe methods that help ensure the protection of responders during haz mat/WMD incidents.

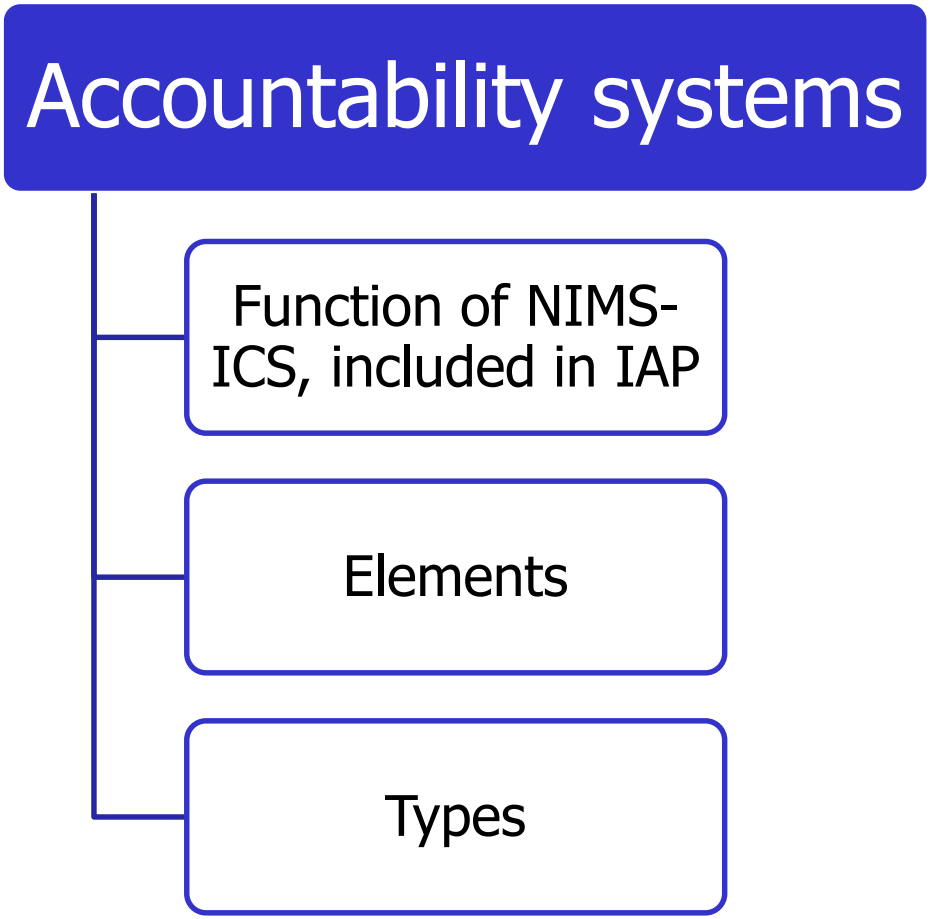
Protection, the overall goal of safety, is accomplished through several tactics.

- Identify and control
- Use and wear PPE
- Conduct rescues
- Shoring and stabilizing
- Emergency decon and medical care
- Other measures

Several measures can be taken to achieve protection of responders.

Stay uphill, upstream, upwind	Decontaminate responders	Work in team or buddy system
Wear PPE	Ensure accountability	Assign safety officers
Protect with time, distance, shielding	Track and identify all personnel	Have evacuation and escape procedures

Specific measures are used to increase protection of responders.



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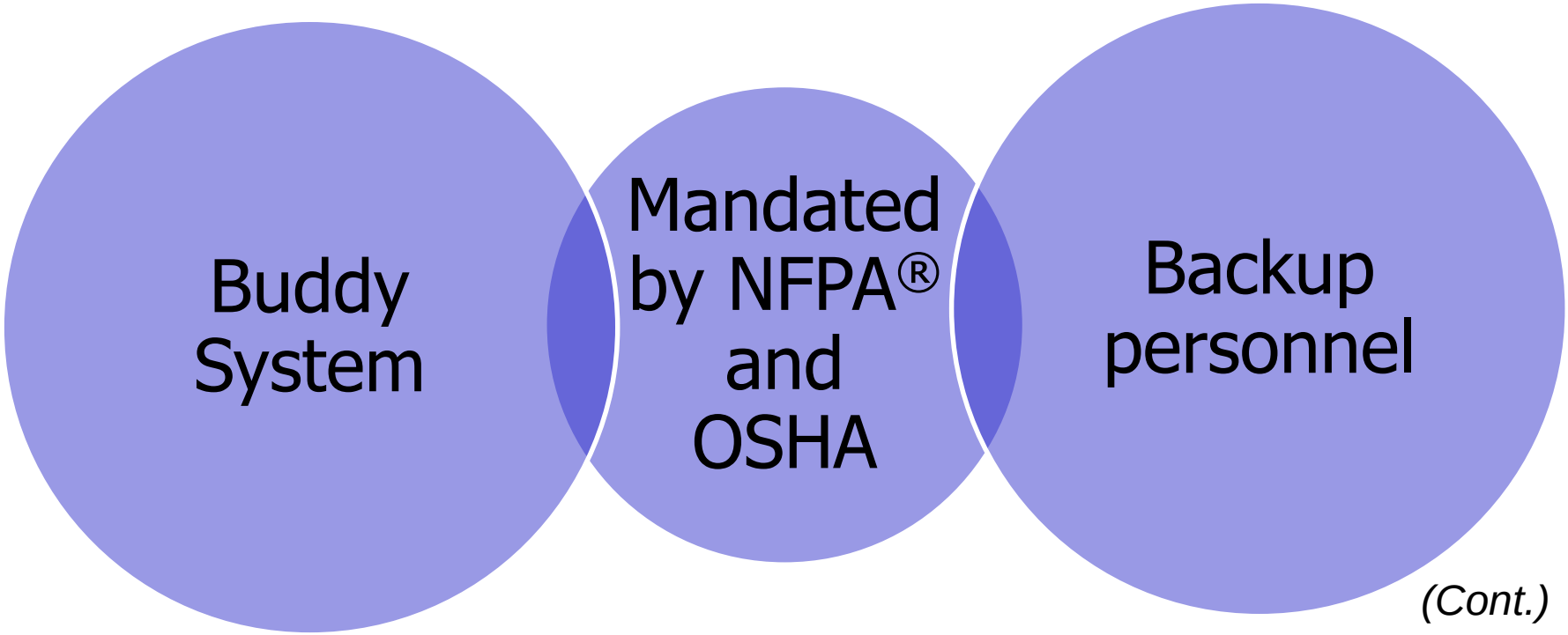

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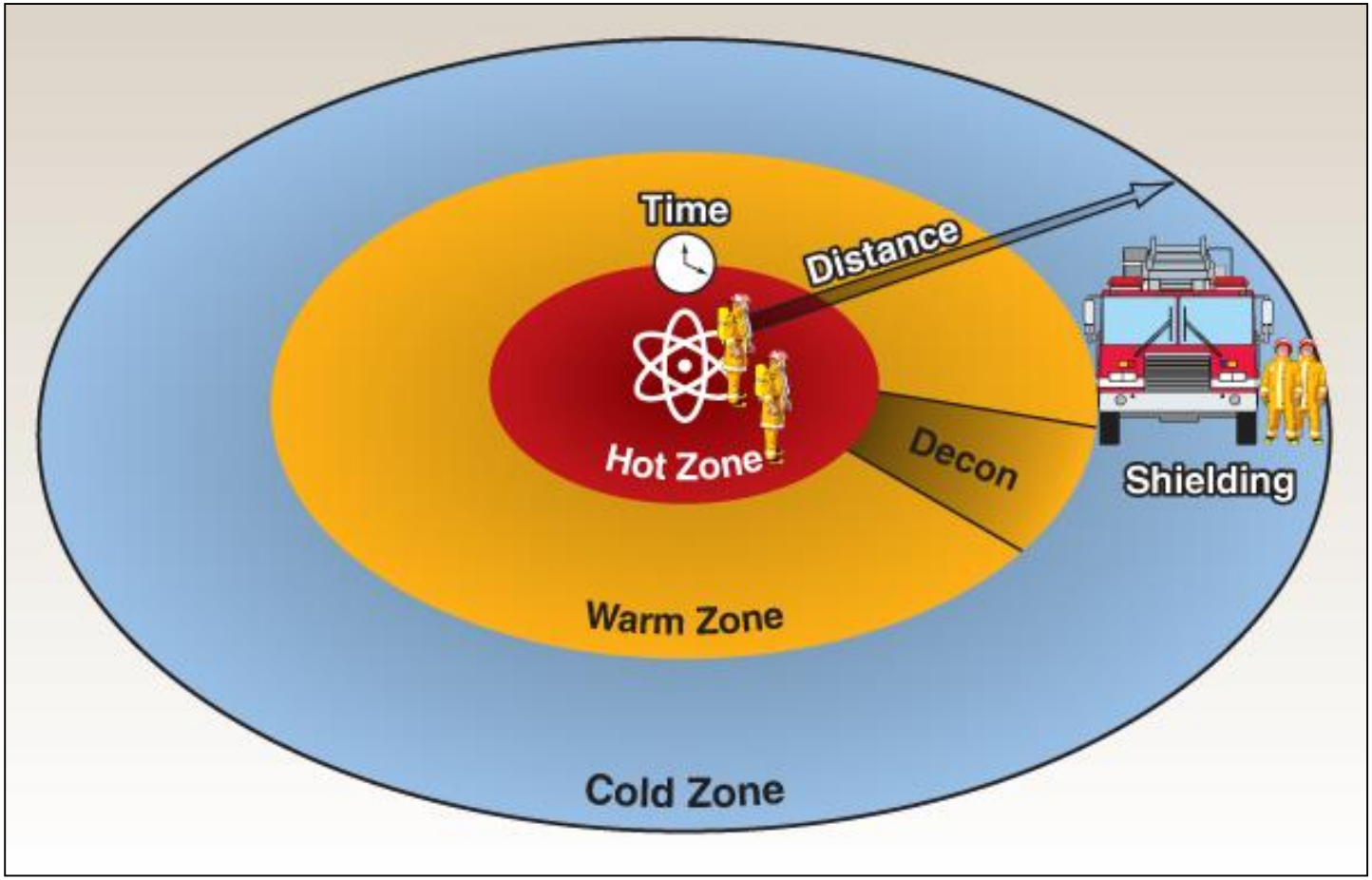

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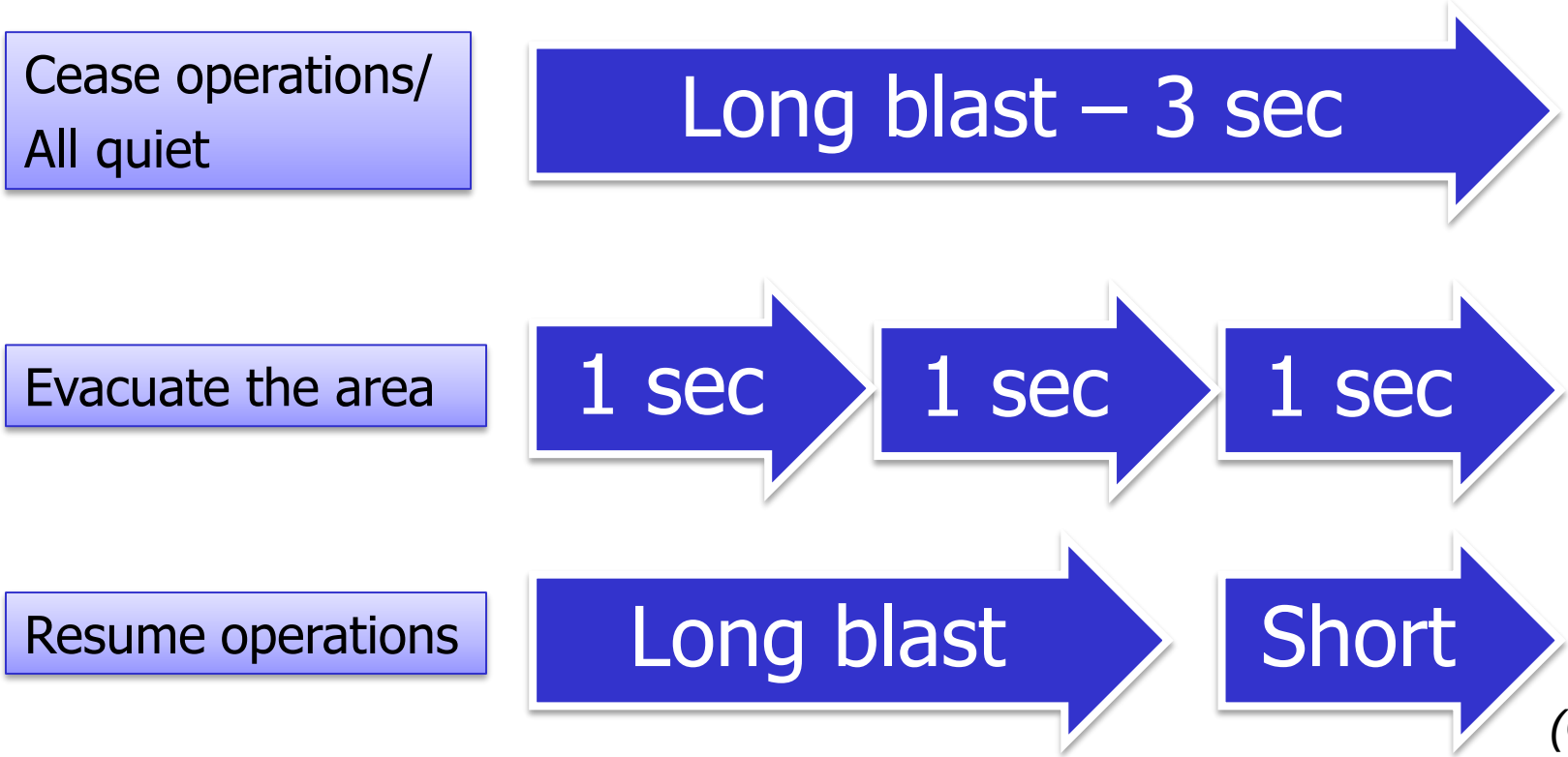
Withdrawal/Escape Procedures



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Specific measures are used to increase protection of responders.

Safety Officers

- Responsibilities
- Duties
- Briefings

REVIEW QUESTION

What methods are used to help ensure the protection of responders during haz mat/WMD incidents?

Learning Objective 18

Describe methods that help ensure the protection of the public during haz mat/WMD incidents.

Evacuation moves all people from a threatened area to a safer place.

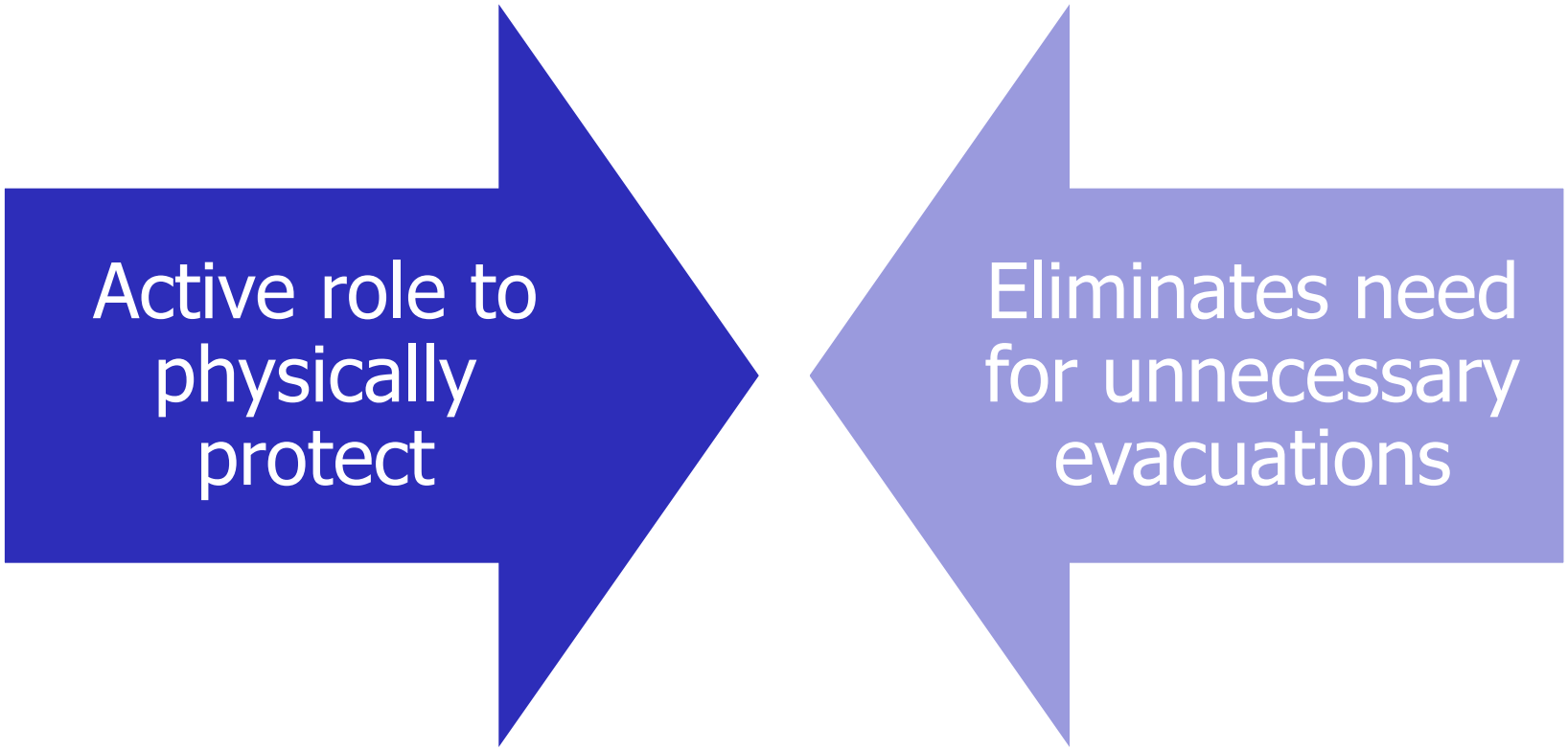
Courtesy of FEMA News Photos, photo by Win Henderson

- Notification
- Transportation
- Relocation facilities, temporary shelters
- Prevention of looting

Sheltering-in-place directs people to go inside a building and remain there until danger passes.

- More effective in certain conditions
- Closed to airflow
- Not optimal for explosive gases
- More effective when public educated
- Tape and polyethylene sheets

Protecting/defending-in-place is an offensive role to protect the public.



REVIEW QUESTION

What means of protecting the public during haz mat/WMD incidents do responders have to choose from?

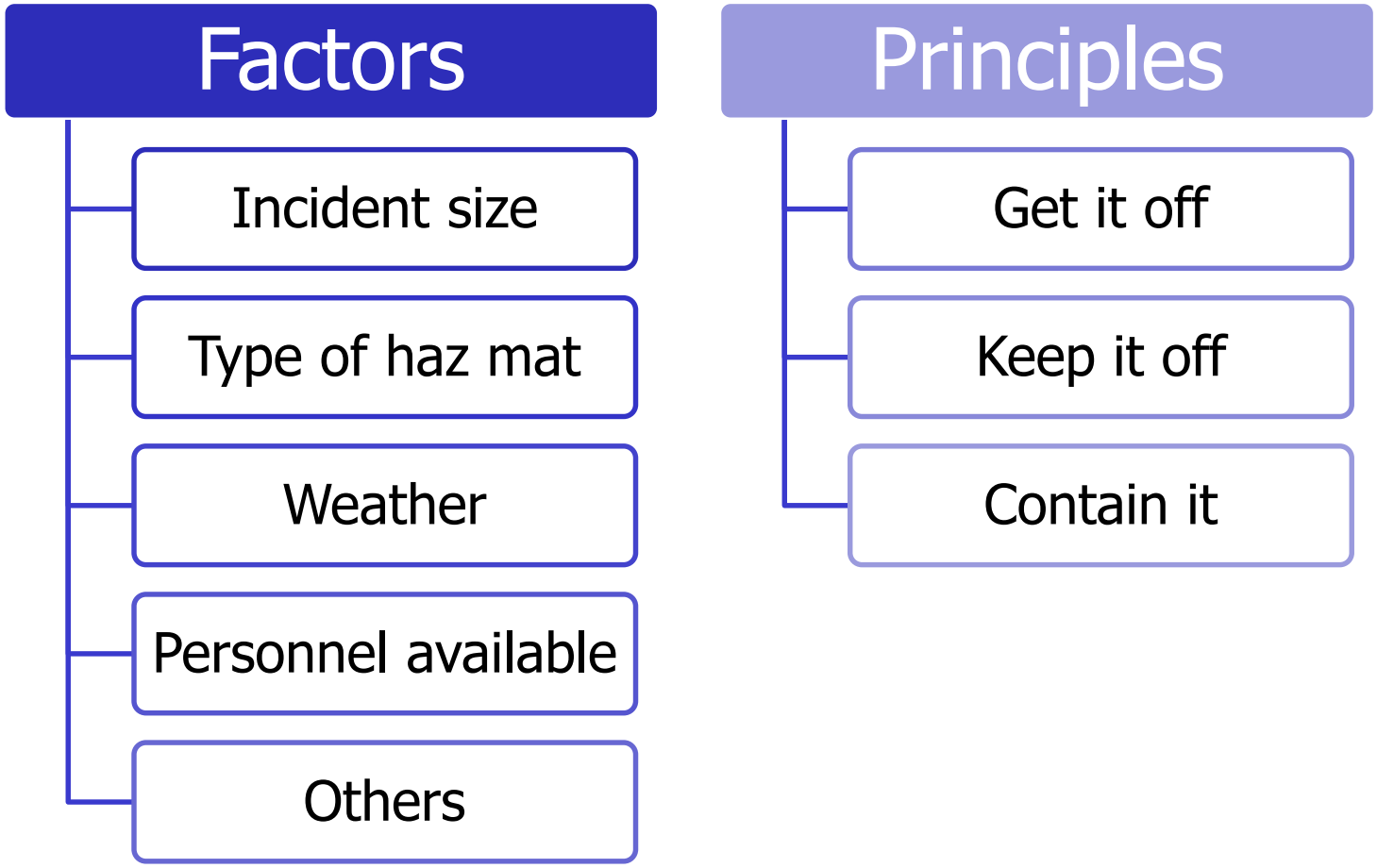
Learning Objective 19

Describe the considerations and limitations of emergency and technical decontamination.

Decontamination is performed to remove hazardous materials from anything that has been contaminated.

Courtesy of Boca Raton (FL) Fire Rescue

Decontamination type is determined by several factors, but will always follow three basic principles.



Emergency decon removes the contaminant without regard for the environment or property.

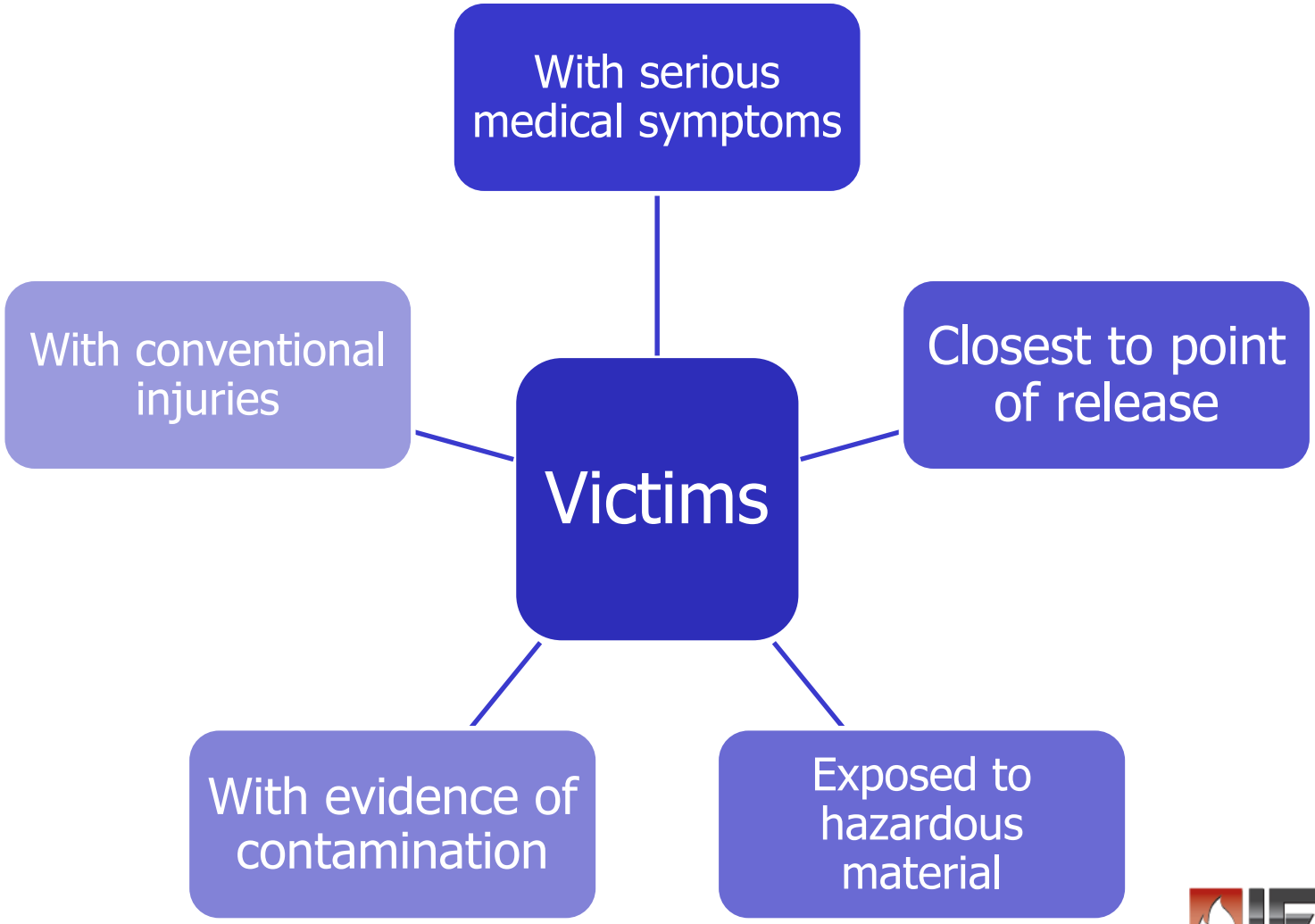
Limitations

- Quick fix
- Requires thorough decon later
- Can harm environment

There are several general guidelines for decon operations.

- ✓ Start decon as quickly as possible
- ✓ Always wear appropriate PPE
- ✓ Avoid contact, including contaminated victims
- ✓ Decontaminate anyone moving from hot to cold
- ✓ Decon responders and victims separately
- ✓ Remove as much clothing as possible
- ✓ Communicate using a variety of methods to direct victims
- ✓ Provide privacy when possible
- ✓ Use warm water if possible

There are several factors that influence patient priority during triage.



Technical decon uses chemical/physical methods to remove contaminants.

Courtesy of U. S. Air Force, photo by Chiaki Iramina

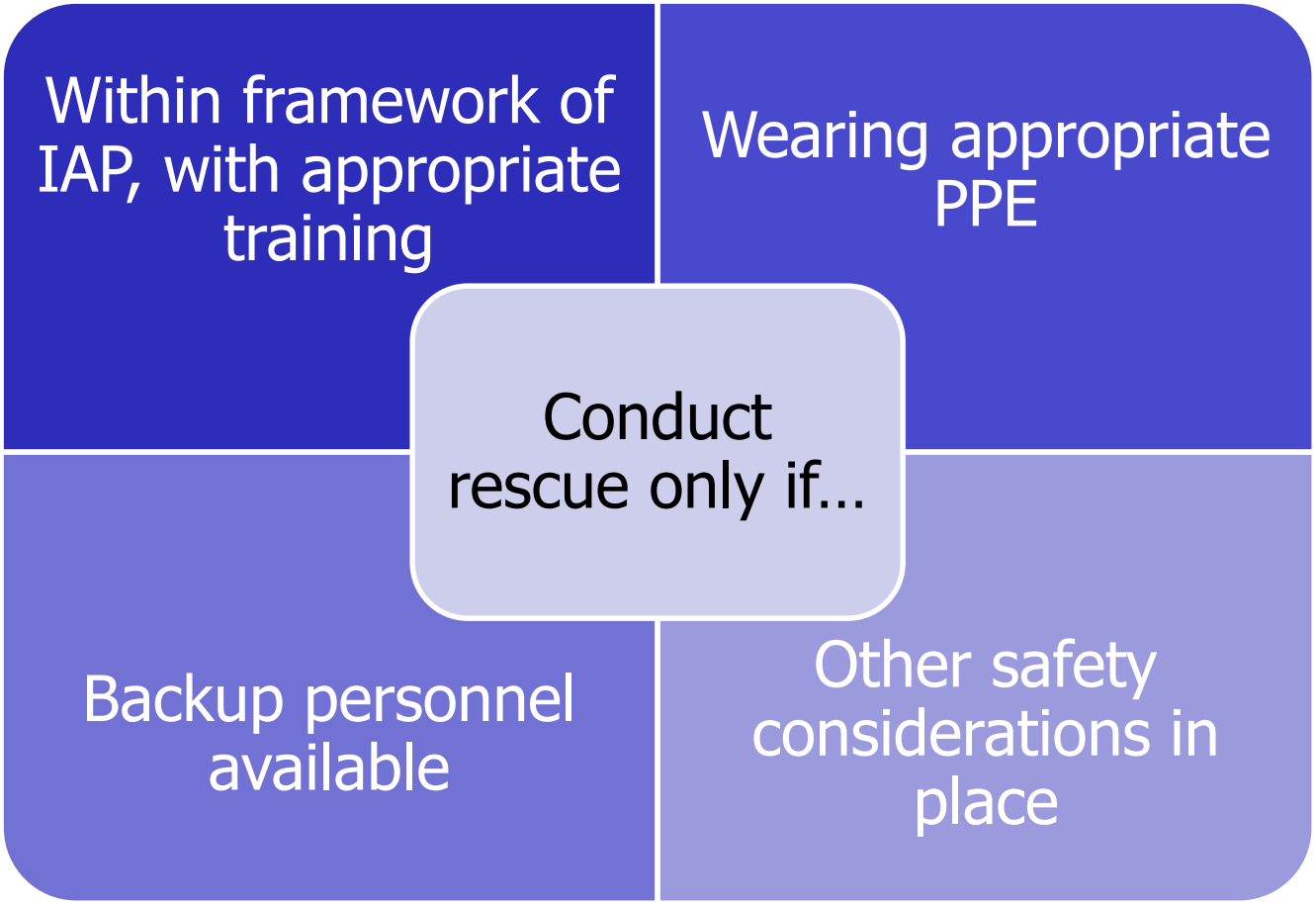
REVIEW QUESTION

When is it best to use emergency decontamination instead of technical decontamination?

Learning Objective 20

Tell what rescue actions can be taken at haz mat/WMD incidents by personnel without specialized training.

Rescue is a difficult strategy to implement at a haz mat incident.



There are several actions safe for those without training to perform.

- Direct to safe place within hot zone
- Instruct victims to less dangerous area
- Direct contaminated victims to decon
- Give directions to large group during mass decon
- Conduct searches during reconnaissance
- Conduct searches on edge of hot zone

REVIEW QUESTION

What rescue actions can a firefighter take without additional training in hazardous materials rescue?

Learning Objective 21

Explain the strategic goal of spill control and confinement.

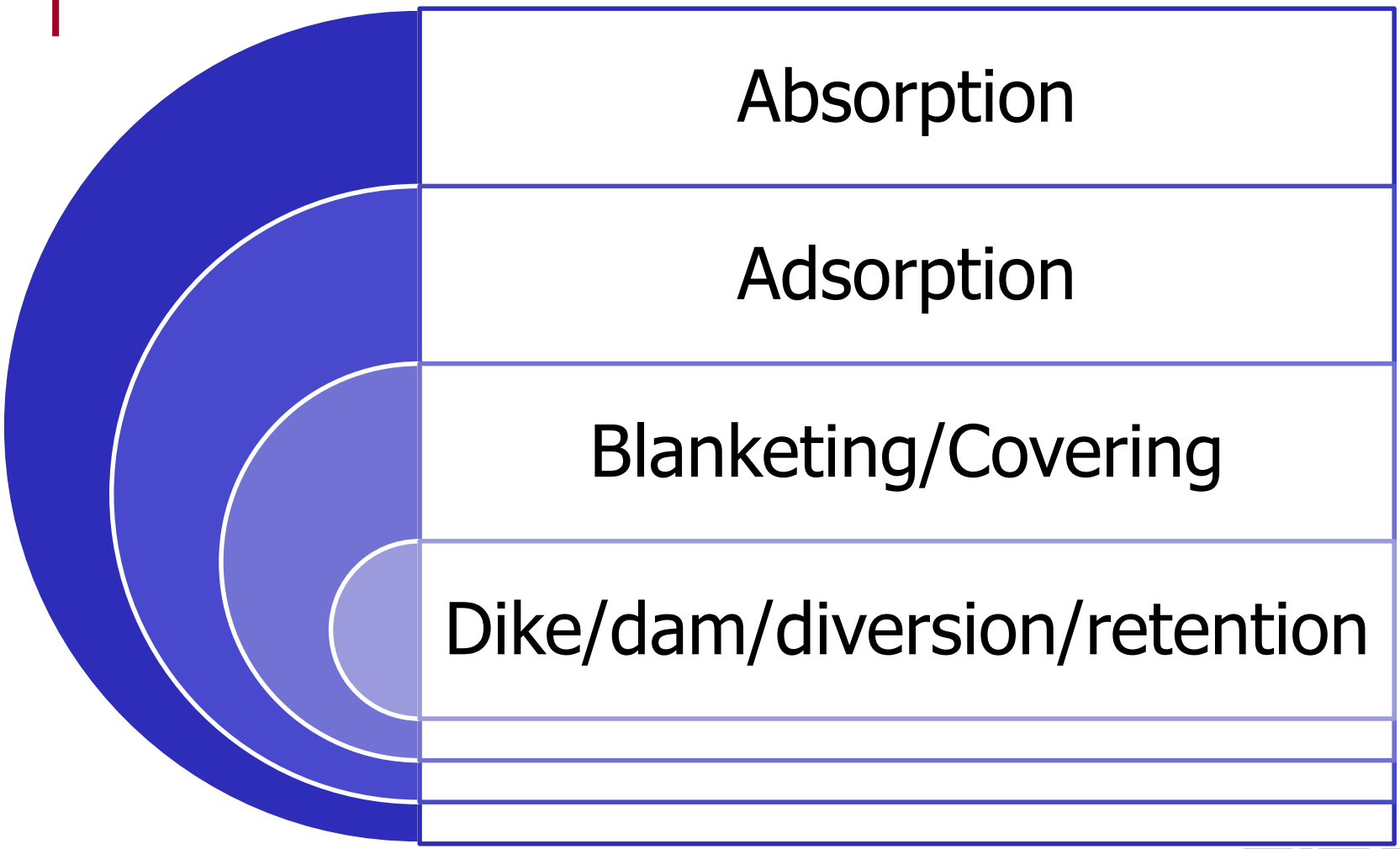
The goal of spill control is to limit dispersion of released materials.

Defensive spill-control

CAUTION

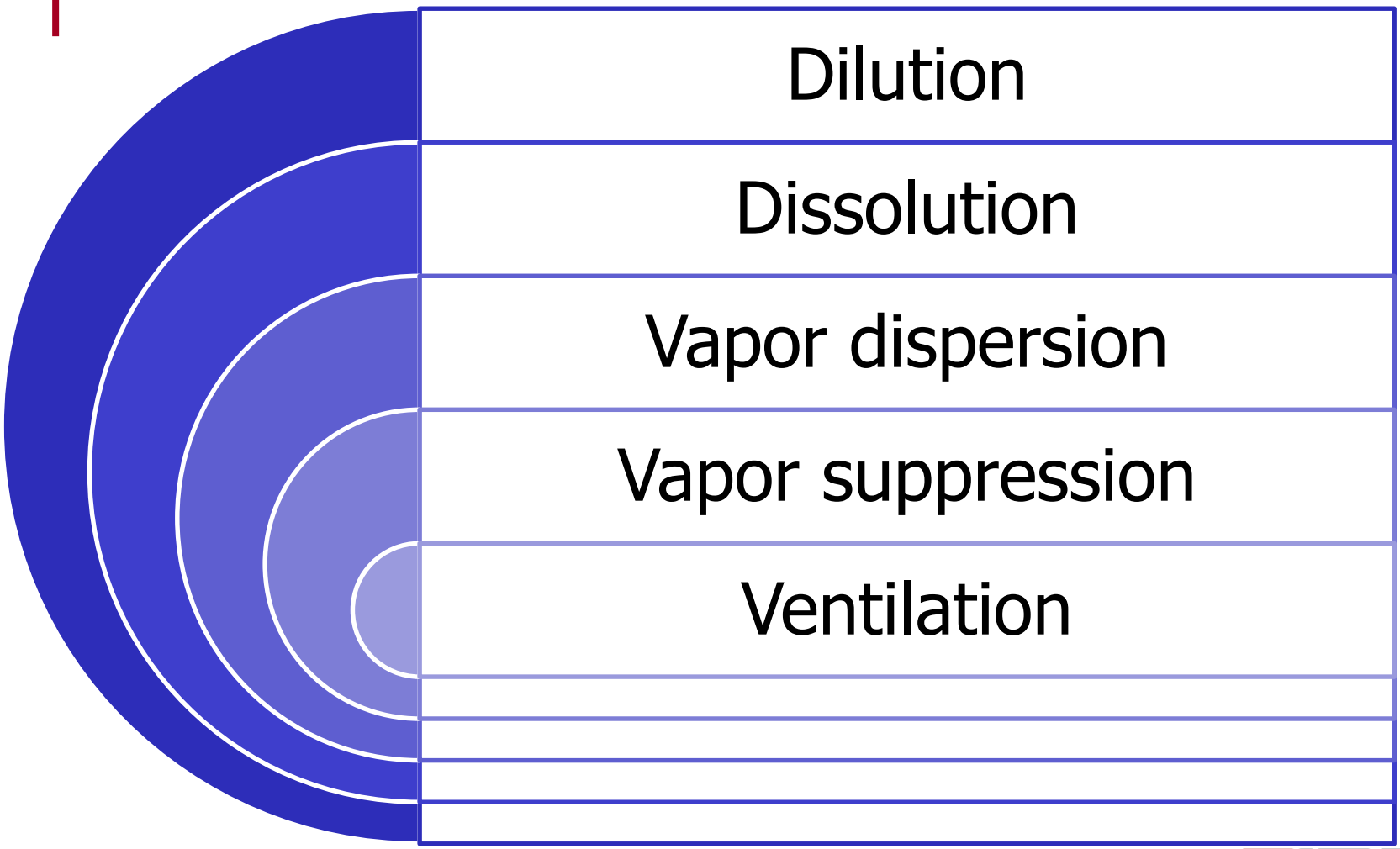
Do not attempt confinement actions unless you are reasonably certain that you will not contact or be exposed to the hazardous material.

There are several spill control and confinement tactics that may be used.



(Cont.)

There are several spill control and confinement tactics that may be used.



REVIEW QUESTION

What tactics can be used to implement the strategic goal of spill control and confinement?

Learning Objective 22

Describe methods used to complete the strategic goal of leak control and containment.

Leak control and containment is intended to prevent material from escaping or to contain a release.

- Tactics determined by type
- Offensive action
- Operations Level can perform in certain situations
- Operation of emergency remote shutoff valves

REVIEW QUESTION

What type of strategy is leak control and containment?

Learning Objective 23

Summarize the actions necessary when an incident is suspected to involve terrorist activity.

There are several guidelines to follow at terrorist and criminal incidents.

(Cont.)

There are several guidelines to follow at terrorist and criminal incidents.

REVIEW QUESTION

What are the guidelines to use when an incident is suspected to involve terrorist activity?

Learning Objective 24

Explain how to preserve crime scene evidence.

Crime scene preservation is also a consideration at haz mat incidents.

Courtesy of FEMA News Photos, photo by Jocelyn Augustino

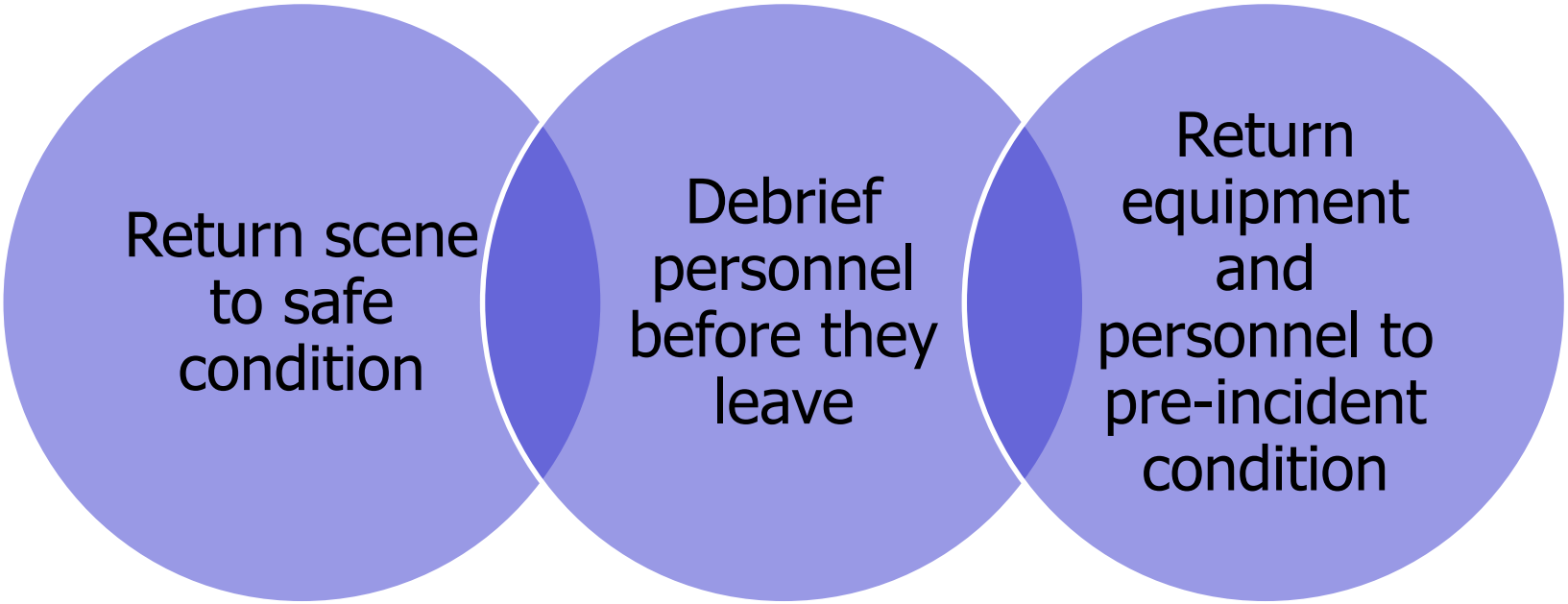
REVIEW QUESTION

What other agency will need to be involved during a response to a terrorist or criminal incident?

Learning Objective 25

Explain the goals for the recovery and termination phases of haz mat/WMD incidents.

There are three major goals to accomplish in the recovery phase.



The efforts of on-scene recovery are directed toward returning the scene to a safe condition.

May require coordinated effort

Fire and emergency services organizations

If no imminent threats, do not provide cleanup	Provide control and safety oversight

On-scene debriefing includes two types of discussions.

Group discussion

- Important observations
- Actions taken
- Timeline of actions

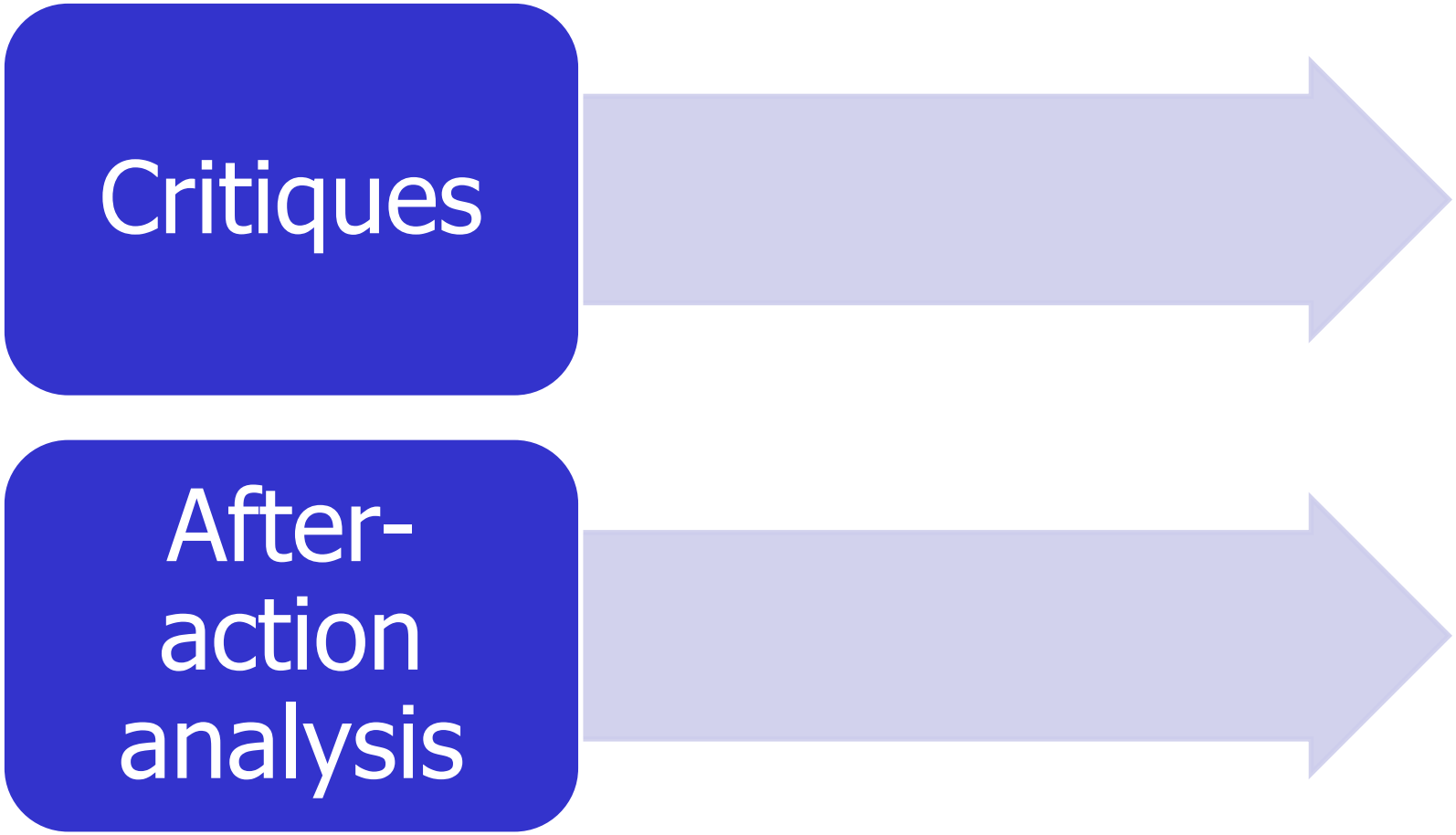
Hazardous communication briefing – OSHA

- Identify material
- Potential effects of exposure
- Actions for further decon
- Signs and symptoms of exposure
- Mechanism for medical evaluation and treatment
- Exposure documentation procedures

Operational recovery involves actions needed to return responders to level of pre-incident readiness.

- Release of units
- Resupply materials and equipment
- Decon of equipment and PPE
- Preliminary actions for financial restitution

Incident termination involves two procedural actions.



REVIEW QUESTION

What are the goals during recovery and termination of haz mat/WMD incidents?

Summary

- Hazardous materials incidents are similar in many ways to other emergencies: the incident management system is required, and the same incident priorities apply.

(Cont.)

Summary

- While there are similarities, there are also important differences. Size-up may have to be performed from a considerable distance, personnel can be at risk even far from the point of release, and there is an increased need for environmental protection.

(Cont.)

Summary

- Hazardous materials also pose extreme health risks, so many personnel may not be properly trained or equipped to mitigate the incident. In these cases, haz mat specialists should be notified and be supported.

Learning Objective 26

Obtain information about a hazardous material using the *Emergency Response Guidebook (ERG).*

This objective is measured in Skill Sheet 24-I-1.

Learning Objective 27

Perform emergency decontamination.

This objective is measured in Skill Sheet 24-I-2.

Learning Objective 28

Perform defensive control functions – Absorption.

This objective is measured in Skill Sheet 24-I-3.

Learning Objective 29

Perform defensive control functions – Adsorption.

This objective is measured in Skill Sheet 24-I-4.

Learning Objective 30

Perform defensive control functions – Diking.

This objective is measured in Skill Sheet 24-I-5.

Learning Objective 31

Perform defensive control functions – Damming.

This objective is measured in Skill Sheet 24-I-6.

Learning Objective 32

Perform defensive control functions – Diversion.

This objective is measured in Skill Sheet 24-I-7.

Learning Objective 33

Perform defensive control functions – Retention.

This objective is measured in Skill Sheet 24-I-8.

Learning Objective 34

Perform defensive control functions – Dilution.

This objective is measured in Skill Sheet 24-I-9.

Learning Objective 35

Perform defensive control functions – Vapor dispersion.

This objective is measured in Skill Sheet 24-I-10.

Learning Objective 36

Perform defensive control functions – Remote valve shutoff.

This objective is measured in Skill Sheet 24-I-11.