Student Notebook-FRO

Hazardous Materials
First Responder OPERATIONS

Student Notebook

Developed Specifically for

UNIVERSITY of CALIFORNIA Riverside
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Hazardous Materials

First Responder Operations

Participant Notebook

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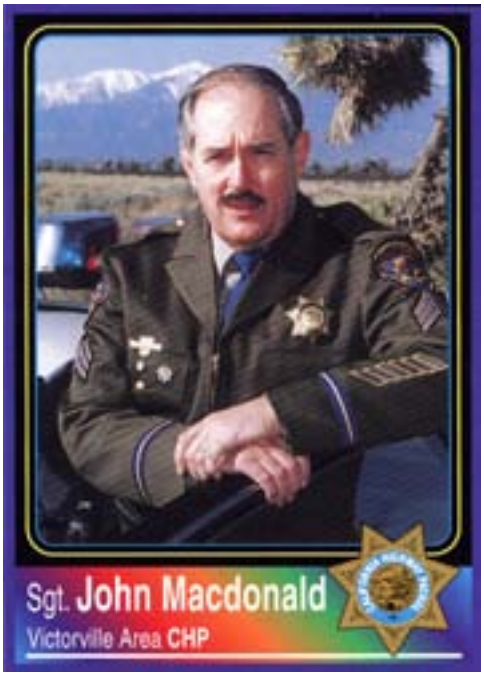

Governor's Office of Emergency Services
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Hazardous Materials First Responder Operations

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Block D

Safety, Isolation and Notifications: (S.I.N.)

Main Points

- ~~Definition of "First Responder" & "SIN"~~
- ~~The First Operational Thought—Safety~~
- The First Operational Priority—Isolation
- ~~The First Operational Alert—Notifications~~

3. The First Operational Priority — ISOLATION

a. The first operational *priority* = **I**solate and deny entry!

1) Responders can safely attempt to isolate and deny entry by establishing Perimeters & Control Zones via ERG.

2) The dilemma of distance. Safety vs. isolation (distance is safety's #1 ally, while it is isolation's #1 enemy).

b. Perimeter and Zones.

1) Purpose: ensure safety and isolation, control the scene, limit contamination spread and allow for safe working areas.

2) Main difference: FRAs can be can establish the Perimeter but only FRO or above can establish the Exclusion Zone.

c. Perimeter and Control Zone terminology:

1) **Perimeter** (Outside security line around all Control Zones).

2) **Exclusion**/Hot **Zone** - Area of isolation (only responders with specific task & proper level of protective clothing in this Zone).

3) **Contamination Reduction**/Warm **Zone** - Used to control areas like Safe Refuge and Decontamination (may use a reduced protective clothing level in this Zone).

4) **Support**/Cold **Zone** - Safe area for Command Post, Media, medical aid, etc. (No protective clothing or SCBA required).

5) Exclusion Zone, Contamination Reduction Zone and Support Zone are all within the Perimeter.

Perimeters and Zones

First Operational Thought — ***Safety***

First Operational Priority — ***Isolate & Deny Entry...***
Via Perimeter and Zones.

Perimeter Security line surrounding control zones to isolate and deny entry to any unnecessary people, usually established by law enforcement.

Zone Zones to ensure safety, limit spread of the hazard, control hazard area, conduct decon and support emergency operations *as established by Haz Mat Group/Team.*

Examples **Exclusion Zone:** Also called Hot Zone, Red Zone, Inner Perimeter.
Contamination Reduction Zone: Also called Warm Zone, Yellow Zone, Secondary Perimeter.
Support Zone: Also called Cold Zone, Green Zone, Outer Perimeter.
Control Zone terms from *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, NIOSH Publication 85-115, October 1985.

3. The First Operational Priority — ISOLATION *(cont.)*

d. Perimeter Control Objectives:

1) Control "**Entry Points**" (secure doors, stairways, gates, intersections, on and off ramps, etc.).
2) Control "**Perimeter**" between all Entry Points.
3) Control "**Access**" inside Perimeter (incl. responders).

e. Perimeter Control Tactics:

1) Determine size and extent of perimeter (per ERG, downwind perimeter will usually be longer),
2) Identify all entry points,
3) Control all entry points,
4) Identify and establish boundaries for perimeter,
   a) Unstaffed barricades usually ineffective,
   b) Be aware of ignition sources from vehicles,
   c) Use existing barriers.
5) Control access to the perimeter,
   a) Deny entry to all unauthorized personnel (incl. responders),
   b) Stage all responders without an immediate mission,
   c) Establish emergency exit procedures for all responders,
   d) Hazmat Group will establish Control Zones,
   e) Watch out for wind shifts!

Isolation and Deny Entry Objectives

Entry Points

Control Entry Points

•Visually determine isolation distance for Perimeter.
(ERG may often recommend downwind perimeter up to 2-3 times larger distance than crosswind perimeter.)

•Identify closest entry/control points for Perimeter. (e.g. Doorways, Intersections, Gates, etc.) Others: _____

•Start with most obvious and most commonly used Perimeter entry point. (FEMA studies have showed people will evacuate through exits they are accustomed to using.)

•Make early request for sufficient units to secure entry points. (Use Law Enforcement or Auxiliary/Reserve Units. Give incident location and safe routes for ingress.)

•Use all available methods of restricting access (e.g. vehicles, barricades, cones, etc.) Others: _____

•Identify staging areas for responders.

Hazard

Control Area Around Hazard

•Secure the area around the hazard area.

•Use tape, natural barriers, patrols, etc.

•Remember, it's easier to make a perimeter small than bigger after you establish it. Don't be afraid to start big.

Perimeter

Control Access Inside Perimeters.

•Keep public and nonessential responders out.

•Maintain patrol of Perimeter area.

•Provide security for Support Zone work areas.

•Provide traffic control as necessary.

•Maintain communications with security group at all times!

•Have an emergency escape route and watch the wind!!

Block G

Protective Equipment & First Responder Limitations: (P.)

Main Points

- IDHA and Personal Protective Equipment
- Need for PPE
- Typical Hazards On-Scene
- Protective Clothing
- Criteria for Selecting Protective Clothing Level
- Respiratory Protection
- Environmental Monitoring and Sampling Devices
- Risks and Limits of Protective Equipment

Block Outline

1. IDHA and Personal Protective Equipment (PPE).

a. After IDHA, need to determine protective equipment needs.

b. "Personal Protective Equipment" (PPE) includes:
   1) Protective Clothing (at proper level),
   2) Respiratory Protection (SCBA, APR or SAR) and
   3) Monitoring Devices.

c. Level of PPE determined by:
   1) Physical state of material.
   2) Hazards of material.
   3) Route(s) of entry and potential exposure(s).

d. IDHA process will determine type and level of PPE needed.
   1) OSHA regs ***require*** SCBA for inhalation hazards.
   2) FROs normally lack PPE for hazmat.
   3) FROs are limited to defensive actions because they lack PPE that protects against hazardous materials.

e. Bottomline: PPE keeps responders safe!

PPE Requirements.

PPE "Based on the hazardous substances and/or condition present, the individual in charge…shall…assure that the PPE worn is appropriate for the hazards…" Title 8 CCR §5192(q)(3)(C), 29 CFR 1910.120(q)(3)(iii).

SCBA "Employees engaged in emergency response and exposed to hazardous substances presenting an inhalation hazard or potential inhalation hazard shall wear [SCBA]…" Title 8 CCR §5192(q)(3)(D), 29 CFR 1910.120(q)(3)(iv).

Monitoring "The individual in charge…shall identify…all hazardous substances or conditions present…" Title 8 CCR §5192(q)(3)(B), 29 CFR 1910.120(q)(3)(ii).
"Employees engaged in emergency response and exposed to hazardous substances presenting an inhalation hazard or potential inhalation hazard shall wear [SCBA]…until… the individual in charge…determines through the use of air monitoring that a decreased level of respiratory protection will not result in hazardous exposures to employees." Title 8 CCR §5192(q)(3)(D), 29 CFR 1910.120(q)(3)(iv).

Selection Level B is, "…the minimum level recommended for initial site entries until hazards have been further identified." *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities,* NIOSH Publication 85-115.

2. Need for Personal Protective Equipment (PPE).

a. Responders may be exposed via inhalation, ingestion, absorption and/or injection.

b. PPE protects you from the bad stuff by getting between the bad stuff and route(s) of entry.

c. Limits of PPE that first responders usually wear.
   1) Firefighter turnouts are ***not*** chemical protective clothing (read the label!). Even with SCBA they are *Level D*.
   2) Law enforcement equipment (e.g. leather) may actually absorb hazardous materials.
   3) EMS universal precautions won't protect against inhalation of vapors, gases, fumes, etc. Latex gloves may be ineffective against many common hazardous substances (e.g. gasoline, paint thinner and nail polish remover).

3. Typical Hazards On-Scene.

a. First Responders.
   1) Primary hazard is inhalation exposure.
   2) Others: oxygen deficiency, burns (chemical and thermal), toxicity and radioactivity.

b. Technicians and Specialists.
   1) Primary hazard is heat stress from PPE.
   2) Others: damaged containers, slips, trips and falls.

c. Injuries to responders.
   1) Minor injuries are usually from inhalation exposure.
   2) Major injuries are usually chemical burns from exposure to corrosive materials.

Examples of Level "D" PPE.

Hazard to Responders

FROs

Inhalation

Technicians and Specialists

Heat Stress

4. Protective Clothing.

a. Levels of Protective Clothing (PC) include:
   1) Level A — Best respiratory and skin protection.
      a) Positive pressure SCBA and
      b) *Fully encapsulated, vapor tight* chemical protective suit.
   2) Level B — High level of respiratory protection but less for skin
      a) Positive pressure SCBA and
      b) Hooded chemical resistive clothing.
   3) Level C — Air purifying respirators and modest skin protection
      a) Full or half-mask APR and
      b) Hooded chemical resistive clothing.
   4) Level D — Ordinary work uniform, *Minimal protection*.
      a) No respiratory protection.
      b) Minimal splash and vapor protection.
      c) May actually absorb vapors, gases and liquids.

b. Limitations of PPE levels.
   1) Levels A and B: limited mobility, restricted vision, finite air supply and heat stress.
   2) Level C: limited mobility, restricted vision, difficulty breathing and heat stress.

c. Number 1 responder limitation is lack of Protective Clothing. (i.e. FROs don't usually have *any* PPE.)
   1) First Responders are usually in *Level D*.
   2) Level D provides no respiratory protection and only limited chemical resistance.

Levels of Protective Clothing.

Level A When greatest level of skin, respiratory and eye protection is required; site operations and work functions involve a high potential for splash, immersion or exposure to unexpected vapors, gases or particulates that are harmful to skin or capable of being absorbed through the skin; substances with high degree of hazard to the skin are present; operations being conducted in confined, poorly ventilated areas in the absence of conditions requiring Level A haven't yet been determined.

Level B When highest level of respiratory protection is needed, but a lesser level of skin protection is needed; atmosphere contains less than 19.5% oxygen; presence of vapors indicated but vapors aren't harmful to skin or capable of being absorbed through the skin; no confined space.

Level C When atmospheric contaminants, liquid splashes or direct contact won't adversely affect or be absorbed through any exposed skin; concentrations and types of airborne substances have been identified and measured; appropriate air purifying respirators (APRs) are available. *These criteria make Level C impractical for emergency response.*

Level D When the atmosphere contains no known hazard; work functions preclude splashes, immersion or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals. A work uniform affording minimal protection, used for nuisance contamination only.

NOTE: **Work uniforms and firefighter turnouts are Level D protection! Firefighter turnouts and police uniforms often contain materials that may absorb hazardous materials.**

5. Criteria for Selecting Protective Clothing Level.

a. Selection of Protective Clothing level based on solid IDHA and,
   1) Physical form of material (e.g. vapor or splash potential),
   2) Degree of hazard (e.g. length of exposure, dermal hazard),
   3) Other (Oxygen level, PC chemical compatibility, work activity, uncertain/unknown hazards, etc).

b. Criteria for each level:
   1) Level A: Unknown and/or skin absorptive material, high splash hazard, confined space.
   2) Level B: Less than 19.5% O_2, incompletely ID'd gas or vapor.
   3) Level C: No skin hazard, no unknowns, sufficient O_2.
   4) Level D: No Hazard.

c. Control Zones and PPE.
   1) Exclusion Zone: Level A-C.
      a) No PPE? Then stay our of Exclusion Zone!
   2) Contamination Reduction Zone: Level A-C.
   3) Support Zone: None required (no hazard!).

d. The Safety Officer *approves* proper level of PC and submits recommendation to IC for final approval.

Control Zones and Protective Clothing

Exclusion Zone

Requires proper level of protective clothing, including Level A, B or C. (Also called Hot Zone, Red Zone, Inner Perimeter, etc.)

Contamination Reduction Zone

Requires proper level of protective clothing, **usually one level down** from that required in the Exclusion Zone (e.g. Entry to Exclusion Zone requires Level A, entry to CRZ will require at least Level B.) (Also called Warm Zone, Yellow Zone, Secondary Perimeter, etc.)

Support Zone

No special protective clothing required. Level D is acceptable. (Also called Cold Zone, Green Zone, Outer Perimeter, etc.)

6. Respiratory Protection.

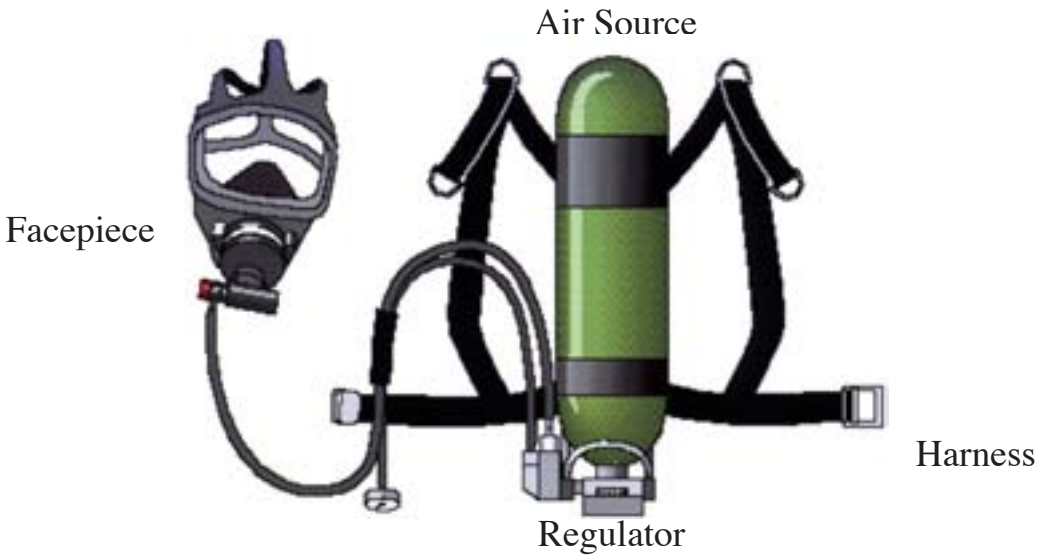
a. Respiratory protection helps to prevent you from inhaling dangerous substances.

b. Basic types of respiratory protection:
   1) SCBA (Self-contained breathing apparatus).
   2) APR (Air purifying respirator).
   3) SAR (Supplied Air Respirator. Rarely used in emergency response due to practical limitations.)

c. Components of respiratory protection:
   1) Self-Contained Breathing Apparatus.
      a) Facepiece,
      b) Harness,
      c) Regulator,
      d) Air source.
   2) Air-Purifying Respirators.
      a) Facepiece,
      b) Air-purifying device (hazard-specific).

d. Limitations of respiratory protection.
   1) SCBA: finite supply of air.
   2) SAR: length of hose limited.
   3) ARP: filter life limited.
   4) All will eventually fail.

Components of SCBA.



OSHA "Employees engaged in emergency response and exposed to hazardous substances presenting an inhalation hazard or potential inhalation hazard shall wear [SCBA]…" Title 8 CCR §5192(q)(3)(D), 29 CFR 1910.120(q)(3)(iv).

7. Environmental Monitoring and Sampling Devices.

a. Purpose: Detect Haz Mat presence & concentration, aid in IDHA & PPE selection, assist in documentation, help investigations, etc.

b. Common types FROs use:
   1) Combustible Gas Indicators and Oxygen Meters.
   2) Radiation survey instruments.

b. Common types technicians and specialists use:
   1) Photoionization Detector (PID).
   2) Flame Ionization Detector (FID).
   3) Direct Reading Colormetric Indicator Tubes.
   4) Other: Radiation Meters; CO and H_2S Meters; etc.

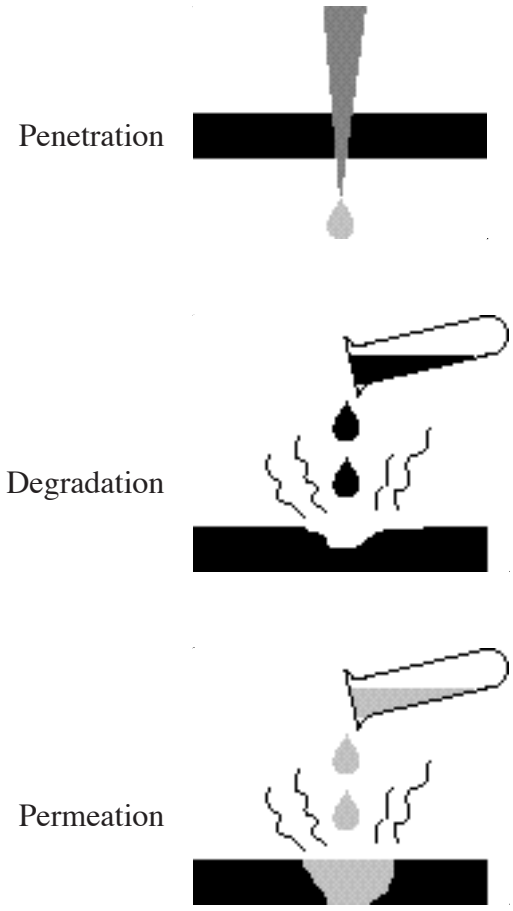
8. Risks and Limits of Protective Equipment.

a. "Penetration", "Degradation" and "Permeation".

b. Even Level A protection has limitations (heat stress, impaired vision and mobility, impaired communications, no one suit protects for all Hazmats, etc.).

c. Thermal influences (seal-a-meal, cryogenic hazards, effect of temperature extremes on shelf-life).

Limits of Protective Clothing Material.



Penetration The movement of chemicals through zippers, stitched seams or imperfections (e.g. holes) in the clothing material.

Degradation The loss of or change in the fabric's chemical resistance or physical properties due to exposure to chemicals, use (or misuse) or ambient conditions (e.g. sunlight).

Permeation The process by which a chemical dissolves in and/or moves through a protective clothing material on a molecular level.

29 CFR 1910.120 & CCR 5192 (Excerpts)

General Description and Discussion of the Recommended Levels of Protection & Protective Equipment

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

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

The following constitutes Level "A" equipment; it may be used as appropriate: [1]= Optional, as applicable

1. Positive pressure, full face-piece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape BA, approved by the National Institute for Occupational Safety and Health (NIOSH).
2. Totally-encapsulating vapor tight chemical protective suit.
3. Coveralls [1].
4. Long underwear [1].
5. Gloves, outer, chemical-resistant.
6. Gloves, inner, chemical-resistant.
7. Boots, chemical-resistant, steel toe and shank.
8. Hard hat (under Suit) [1].
9. Disposable protective suit, gloves and boots (depending on suit construction, may be worn over totally-encapsulating suit).
10. Flashover protection.

General Description and Discussion of the Recommended Levels of Protection & Protective Equipment *(continued)*

II. Level B

The highest level of respirator protection is necessary but a lesser level of skin protection is needed.

The following constitutes Level "B" equipment; it may be used as appropriate:

1. Positive pressure, full face-piece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA (NIOSH approved).
2. Hooded chemical resistant clothing (overalls and long-sleeved jacket; coveralls; one or two-piece chemical-splash suit; disposable chemical-resistant overalls).
3. Overalls [1].
4. Gloves, outer, chemical-resistant.
5. Gloves, inner, chemical-resistant.
6. Boots, outer, chemical-resistant steel toe and shank.
7. Boots, outer, chemical-resistant (disposable) [1].
8. Hard hat [1].
9. [Reserved].
10. Face shield [1]. [1]= Optional, as applicable

General Description and Discussion of the Recommended Levels of Protection & Protective Equipment *(continued)*

III. Level C The concentration(s) and type(s) of airborne substance(s) is known and the criteria for using air purifying respirators is met. The following constitutes Level "C" equipment; it may be used as appropriate:

1. Full-face or half-face air purifying respirator (NIOSH approved).
2. Hooded chemical-resistant clothing (overalls; two-piece chemical-splash suit; disposable chemical-resistant overalls).
3. Coveralls [1].
4. Gloves, outer, chemical-resistant.
5. Gloves, inner, chemical-resistant.
6. Boots, (outer), chemical-resistant steel toe and shank [1].
7. Boot-covers, outer, chemical-resistant (disposable) [1].
8. Hard hat [1].
9. Escape mask [1].
10. Face shield [1]. [1]= Optional, as applicable

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

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

1. Coveralls.
2. Gloves. [1]
3. Boots/shoes, chemical-resistant steel toe and shank.
4. Boots, outer, chemical-resistant (disposable). [1]
5. Safety glasses or chemical splash goggles .
6. Hard hat. [1]
7. Escape mask. [1]
8. Face shield. [1] [1]= Optional, as applicable

29 CFR 1910.120 & CCR 5192 (Excerpts)

General Description & Discussion of the Levels of Protection & Protective Gear

Part B The *type of hazards* for which Levels A, B, C, and D protection are appropriate are described below:

I. Level A **Level "A" protection should be used when:**

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

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

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

General Description & Discussion of the Levels of Protection & Protective Gear *(continued)*

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

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

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

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

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

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

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

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

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

General Description & Discussion of the Levels of Protection & Protective Gear *(continued)*

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

1. The atmosphere contains no known hazard; and

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

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

Remember: Typically, FROs have Level "**D**" protective clothing,

D = Defensive!

Participant Worksheet

1. In your own words, explain the need for "Protective Equipment":

2. Why does Level **D** PPE limit you to **d**efensive actions?

3. Which route of entry is the most dangerous to you?

4. Of the hazardous materials in your workplace, would any of them require Level A?