

# Emergency Response to Highly Hazardous Materials: Basic Concepts

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Author: Chad Tameling

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Abstract: The purpose of this presentation is to educate emergency responders to the basic safeguards in responding to highly hazardous materials emergencies.

## Abstract (continued)

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Hazards associated with emergency response to an unsecured scene are multiplied when materials to be managed are shock sensitive, air/moisture sensitive, high-energy compounds, unknowns, or compressed gas cylinders. This presentation will touch on laws governing emergency response, review tactical models (5 step process to managing an incident), as well as organizational models (incident command system) for emergency responders in high hazard situations.

# Emergency Response to Highly Hazardous Materials: Basic Concepts

Chad Taming  
SET Environmental, Inc.

## Presentation Summary

- Tactical Models
  - Five Step Process
  - Incident Command System
- High Hazard Scenarios
  - Shock Sensitive Compounds
  - Explosives
  - Compressed Gas Cylinders
- General Considerations

# Tactical Models

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- The Five Step Process

- 1 Isolate
- 2 Identify
- 3 Notify
- 4 Mitigate
- 5 Terminate

# Isolate

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- Rescue or recovery
- Deny access to the site
- Try to establish safe zones, hot zones and decontamination zone
- Establish staging for additional resources
- Evacuation (in some instances in place sheltering)

## Identify

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- Identify material by placards/labels/MSDS/shipping papers
- Identify material by container specifications
- Identify material by physical characteristics or instrument readings
- If there is harm potential, identify all other exposure hazards

## Notify

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- Notify the party paying the bill
- Transportation - notify the shipper
- Fixed facility - notify the manager
- Outside agencies IE
  - Mutual Aid State Police/IDOT
  - State or Federal EPA
  - Water Reclamation
  - EMS

## Mitigation

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- Defensive approach
  - Most fire departments are defensive
  - Material confinement - keep the problem from growing until properly trained responders arrive to the scene
- Offensive approach
  - Material containment - stop the release, keep material in it's container, or clean up the mess

## Terminate

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- Effectively terminating the incident includes:
  - Response team incident debriefing
  - Multi-agency critique
  - After action report to agencies
  - Record keeping
  - Decontamination or disposal
  - Cost recovery

# Tactical Model - Incident Command System

- Provide a leader for the effort (incident commander or project manager)
- Establish sector officers (or project supervisors) to manage the key elements of the incident
- Determine objectives
- Assign responsibilities

## Incident Command cont'd



## Benefits of Incident Command

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- Organizes the response effort
- All required tasks of the effort are assigned to key personnel
- Manages resources
- Flexible and capable of being modified to adapt to unique situations as incident progresses

## Shock Sensitive Compounds

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# Shock Sensitive Compounds

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## ■ Examples

- Hydrochloric acid + calcium hypochlorite + chlorine dioxide
- Acetylene gas + copper tubing = copper acetylide
- Mercuric oxide + sodium azide = mercurous azide
- Diazocarbonamide

# Shock Sensitive Compounds

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## ■ Tactical Considerations

- 1 Defensive (non-intervention) may be the only safe initial response
  - Let the reactions run their course
  - Isolate and protect exposures
- 2 Ask for Help! Seek assistance from your or other technical experts.

# Shock Sensitive Compounds

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## Tactical Considerations cont'd

- 3 Error on the side of caution
- 4 Distance and shielding
- 5 Stabilize the compound
  - Dilution is the solution
  - Acid/base neutralization
  - Ox/reduction

## Distance and Shielding

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# Explosives

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- Low explosives
  - Deflagrate
  - Reaction rate up to 1312 feet per second
- High explosives
  - Detonate
  - Reaction rate 3280 fps to 27,888 fps

# Explosives

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- Tactical Considerations
  - 1 Most precautions used for shock sensitives are also used for explosives
  - 2 Pay special attention to:
    - poly nitro aromatic compounds ESPECIALLY ASYMETRICAL
    - Metal azides styphnates or fulminates

# Compressed Gas Cylinders

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# Compressed Gas Cylinders

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## ■ Tactical considerations

- 1 Gas/vapor releases can move rapidly and affect a large area
  - Flammable environment
  - Toxic environment
  - Corrosive environment

# Compressed Gas Cylinders

- Tactical considerations cont'd
  - 2 Determine if it is possible to isolate the release
    - Shut off valve on container
    - Shut off ventilation or HVAC systems
    - Close all doors and windows
    - Cylinder containment vessels

# Containment Vessel



## Containment Vessel



## Compressed Gas Cylinders

### ■ Tactical Considerations cont'd

#### 3 Emergency scrubbing systems

- Wet systems
  - sodium hydroxide
  - calcium hydroxide
  - phosphoric acid
  - potassium permanganate
- Dry systems
  - lime
  - activated carbon

## Emergency Scrubbing



## Compressed Gas Cylinders

### ■ Tactical Considerations cont'd

#### 4 If containment is no option:

- Consider evacuation of building or surrounding area
- Vapor suppression can be effective
- Must collect condensed run off in containment area

## Vapor Suppression



## Emergency Decontamination



## General Considerations

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- Good communication is vital to the success of the operation
- Incident pre-planning and preparedness can save time, money and potentially lives
- A successful response must use coordinated teamwork
- Thorough incident termination has positive benefits