

# FIRE COMMAND 1B

Approved by the Statewide Training and Education Advisory Committee



Adopted by the State Board of Fire Services



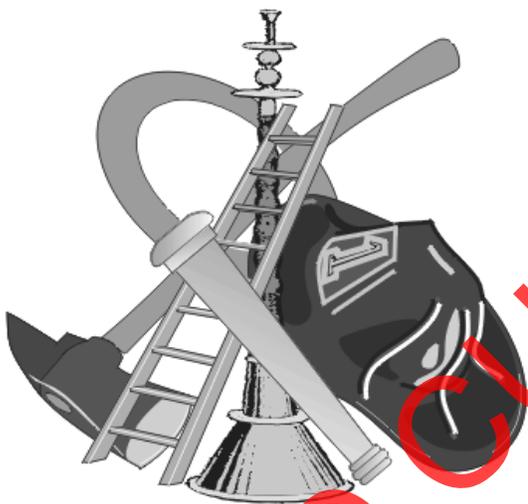
**STUDENT  
MANUAL**  
1998 Edition



# FIRE COMMAND 1B

INCIDENT MANAGEMENT FOR COMPANY OFFICERS

## STUDENT MANUAL



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RETIRED CURRICULUM

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## State Fire Training

### Mission Statement

The mission of State Fire Training is to enable the California fire service to safely protect life and property through education, training, and certification.

### California Fire Service Training and Education System

The California Fire Service Training and Education System (CFSTES) was established to provide a single statewide focus for fire service training in California. CFSTES is a composite of all the elements that contribute to the development, delivery, and administration of training for the California Fire Service. The authority for the central coordination of this effort is vested in the Training Division of the California State Fire Marshal's Office with oversight provided by the State Board of Fire Services.

The role of CFSTES is one of facilitating, coordinating, and assisting in the development and implementation of standards and certification for the California fire service. CFSTES manages the California Fire Academy System by providing standardized curriculum and tests; accredited courses leading to certification; approved standardized training programs for local and regional delivery; administering the certification system; and publishing Career Development Guides, Instructors Guides, Student Manuals, Student Supplements, and other related support materials.

This system is as successful and effective as the people involved in it are. It is a fire service system developed by the fire service, for the fire service, and we believe it is the best one in the country.

### Acknowledgments

The State Fire Training Curriculum Development Division coordinated the development of the material contained in this guide. Before its publication, the Statewide Training and Education Advisory Committee (STEAC) and the State Board of Fire Services (SBFS) approved this guide. This guide is appropriate for fire service personnel and for personnel in related occupations that are pursuing State Fire Training certification.

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Special acknowledgement and thanks are extended to the following members of CDF/State Fire Training Curriculum Development Division for their diligent efforts and contributions that made the final publication of this document possible.

The material contained in this document was compiled and organized through the cooperative effort of numerous professionals within, and associated with, the California fire service. We gratefully acknowledge these individuals who served as principal developers for this document.

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<b>Geoff Miller</b> Sacramento County Fire Protection District
<b>Jim Ott</b> Anaheim Fire Department
<b>Nick Pavone</b> Rancho Santa Fe Fire Department

The September 1998 edition of Fire Command 1B student manual was developed under a new type of "living" system. Unlike past curriculum, this student manual will become a viable document within the system. Here's how it works.

Each registered Command 1B instructor, and for that matter every Fire Command 1B student, will have the ability to critique this document on a continual basis. At the conclusion of each course taught, the instructor should comment on the material presented, as should the student. The Fire Command 1B Curriculum Team will meet on an as-needed basis and review each instructor's and student's comments and suggestions.

At the conclusion of each meeting, approved revisions will be submitted to the CDF/State Fire Training Curriculum Development Division for inclusion into the master document. Pages are numbered for easy replacement. This system allows newer information and concepts to continually replace older, outdated ones and the curriculum will evolve as technology grows and changes. Fire Command 1B will not become obsolete as time passes.

Dennis Childress, Team Leader  
Orange County Fire Authority

## Introduction to the Manual

This publication is intended to serve as a student manual and includes information for a complete understanding of the topic, applicable activities, and copies of every slide developed by the original cadre printed three to a page with a space for taking notes. Appendices may be added as necessary to meet minimum course requirements.

State Fire Training gladly accepts your comments and suggestions for future enhancements or revisions to this document. Please forward to:

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## Course Outline

**Course Objectives:** To provide the student with...

- a) Information in which to direct the initial operations of a multi-casualty incident
- b) Information in which to direct the initial operations of a hazardous materials incident
- c) Information in which to direct the initial operations of a wildland fire incident
- d) The opportunity to demonstrate the knowledge and skills learned in handling initial operations at hazardous materials, wildland fire, and multi-casualty incidents through simulation and class activities

**COURSE CONTENT:**..... 40:00

### Unit 1: Course Overview and ICS Review

1-1 Orientation And Administration.....	1:00
1-2 Course Overview.....	1:00
1-3 Fire Command 1A Review.....	2:00
1-4 Concepts Of ICS Organization.....	3:00

### Unit 2: Multi-Casualty Incidents

2-1 Components Of Triage And START.....	2:00
2-2 ICS And EMS Multi-Casualty.....	1:30
2-3 ICS-MCI Implementation Overview.....	1:30

### Unit 3: Hazardous Materials Incidents

3-1 Hazardous Materials Overview.....	0:30
3-2 Properties Of Hazardous Materials.....	1:00
3-3 Toxicology.....	0:30
3-4 Site Control/Work Zones.....	0:30
3-5 Evacuation Considerations.....	1:00
3-6 Decision-Making Process.....	0:30
3-7 ICS And The Hazardous Materials Incident.....	1:30

### Unit 4: Wildland Fire Incidents

4-1 Factors Affecting Wildland Fires.....	2:00
4-2 Defensive And Offensive Strategies In Wildland Fire Fighting.....	0:30
4-3 Use Of Direct And Indirect Attack Methods On Wildland Fires.....	1:00
4-4 Structure Protection And Triage In Wildland Fires.....	2:00
4-5 Wildland Fire Safety.....	1:00



# FIRE COMMAND 1B

Incident Management for Company Officers



Course Outline

Simulation Exercises.....	14:00
Review and Certification Exam.....	2:00

## Texts and References

- Field Operations Guide ICS 420-1, FIRESCOPE, 1994
- Firefighting Tactics, Lloyd Layman
- Ground Cover Practices, IFSTA, Second Edition
- Hazardous Materials 1A-1G Student Manual, SFT
- ICS 200, NWCG, 1994
- "START – The Race Against Time" video, Newport Beach Fire Department and Hoag Memorial Hospital, 1994
- The Dose Makes the Poison, M. Alice Ottoboni, 1984
- Wildland Firefighting, Clayton, Day, and McFadden, 1987
- Wildland Firefighting, Fire Behavior, Tactics, and Command, Perry, 1987

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### Topic 1-1: Orientation and Administration

Slide 1

**STUDENT INTRODUCTIONS**

- ◆ Name
- ◆ Department
- ◆ Rank
- ◆ Years of experience
- ◆ Current assignment
- ◆ Reason for taking Fire Command 1B

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Slide 2

**FACILITIES ORIENTATION**

- ◆ Classroom location(s)
- ◆ Restrooms
- ◆ Food locations
- ◆ Smoking
- ◆ Breaks
- ◆ Telephones
- ◆ Parking

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Slide 3

**CERTIFICATION TRACKS**

INVESTIGATOR II	INSTRUCTOR III	CHIEF OFFICER	PREVENTION OFFICER III	PUBLIC EDUCATION OFFICER I
INVESTIGATOR I Investigation 1A Investigation 1B	INSTRUCTOR II	FIRE OFFICER Command 1A Command 1B	PREVENTION OFFICER II	
	INSTRUCTOR I Instructor 1A Instructor 1B	Instructor 1A Instructor 1B Investigation 1A Management 1 Prevention 1A Prevention 1B	PREVENTION OFFICER I Prevention 1A Prevention 1B Prevention 1C	

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As with any course of instruction, there are certain expectations to be anticipated. There are three major components to this course and those are the curriculum, the instructor, and you, the student.

The curriculum will consist of three areas. The first is the identification of those factors which affect fire department related emergency incidents. Then, you will be introduced to the managerial techniques necessary to control fire department related operations. Lastly, you will be given the opportunity to employ those techniques in simulated fire-related activities.

The instructor is the next component of this course. The instructor will guide you through the curriculum. It will, in most cases, be a learning experience for all involved. No instructor has seen everything or done it all. There is always room for growth. Your experience will be a valuable component of this course and can benefit all involved. We learn from experience. Both good and bad experiences teach us lessons. There are exercises and chances for sharing our experience built into this class just for the purpose of that growth.

The student is the next component. You will be expected to attend all sessions from start to finish. The material is designed to build upon itself as the course progresses and missing part of the information would jeopardize your ability to acquire the information necessary to pass the certification exam, as well as function on the fireground.

You will also be expected to put some out-of-class time into this course. Read the material provided and prepare for the quizzes, simulation, and certification exam. As with most classes, you will only get out as much as you put in. In this course, what you get out of it could save lives and property.

There will be opportunities to work in group exercises as well as on individual activities. You will be asked to contribute in all of these activities. Learning from the curriculum, instructor, and each other is our goal in this course.

To be eligible to take the state certification exam, you must pass the course with an 80% minimum on quizzes and student activities. The certification exam requires a minimum 70% passing rate.

## Topic 1-2: Course Overview

The Fire Command 1B course was first offered on a regional basis in 1978, and became part of the Certified Fire Officer program in 1981. The course has had revisions since its inception, but this most recent revision in 1998 was a complete change in course content. The content has been significantly expanded to keep pace with the changing roles in the fire service, as well as those operations that are necessary for the management of emergency incidents.

The objectives of this course are:

- To satisfy portions of the NFPA 1021 command standards for Fire Officer I, II, and III.
- To satisfy one of the educational requirements for Certified Fire Officer.
- To satisfy the prerequisites for the Level 2 Command series offered by State Fire Training.
- To maintain compatibility with other courses offered in the Fire Officer series by State Fire Training.

The contents of this course are designed around the responsibilities of the "first-in" officer at incidents. Emphasis is on the development of management and decision-making practices required for the successful command of various incidents.

Basic concepts will be addressed, however, that will not be the emphasis of this course as it is felt that the future or practicing fire officer attending the course will have already mastered those basic concepts. The information you learned in Fire Command 1A will be reviewed before moving into new areas challenging the use of these skills. You should, therefore, have the skills, knowledge, and abilities equal to the Certified Fire Fighter II before attending this course.

The specific methods of field evolutions will not be addressed here, as this course is the management of people and strategies in the successful mitigation of several different types of emergencies.

Topics include commanding, using the Incident Command System (ICS), a number of possible incidents such as:

- Hazardous materials
- Multi-casualty emergencies
- Wildland fires
- Major disasters

Individual courses taught in greater detail for many of these areas are available through State Fire Training. For information, see your instructor or department training officer.

Fire Command 1B is designed as a continuation of Fire Command 1A by utilizing the concepts and skills acquired in the course. In addition to satisfying command portions of NFPA 1021, Fire Command 1B prepares the first-in officer with the basic tools necessary to set-up and maintain command at a variety of emergency incidents.

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**Topic 1-3: Fire Command 1A Review**

Slide 1

**SIZE-UP DEFINED**

The mental evaluation made by an officer in charge of a fire or other emergency which enables him or her to determine the best course of action

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Slide 2

**Layman's System of Size Up**

1. Facts
2. Probabilities
3. Own situation (resources)
4. Decisions
5. Plan of operation

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Slide 3

**FACTS**

- ◆ Number can be enormous
- ◆ Not all are relevant or immediately important
- ◆ Must be filtered and screened
- ◆ Pertinent considerations
  - ◆ Time of emergency
  - ◆ Location
  - ◆ Type or nature

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Slide 4

**PROBABILITIES**

- ◆ Large number may exist
- ◆ Filtering is required
- ◆ Probabilities versus remote possibilities
- ◆ Given initial attention
- ◆ Considerations
  - ◆ Life hazards
  - ◆ Construction type and reaction to fire
  - ◆ Rate of fire growth

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Slide 5

**OWN SITUATION**

- ◆ Think big
- ◆ Resources extension
- ◆ Reference resources
  - ◆ Prefire plans, maps, building guides
- ◆ Considerations
  - ◆ Immediate needs
  - ◆ Eventual resources available
  - ◆ Water supply

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Slide 6

**DECISIONS**

- ◆ Obtain all pertinent material first
- ◆ Not cast in concrete
- ◆ Correct and modify as necessary
- ◆ Maintain flexibility
- ◆ Constantly review and assess
- ◆ Considerations
  - ◆ Strategic mode
  - ◆ Initial and supplemental

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Slide 7

**PLAN OF OPERATION**

- ◆ May be modified or changed
- ◆ Constantly monitor and evaluate
  - ◆ For effectiveness
- ◆ Requires issuing orders and instructions
- ◆ Management and supervision must be exercised

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Slide 8

**DIVISIONS OF FIRE FIGHTING**

R escue  
E xposures  
C onfinement  
E xtinguishment  
O verhaul  
S alvage  
V entilation

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Slide 9

**TACTICAL PRIORITIES**

- R - first priority in all emergencies
- E - keep fire from extending
- C - smallest possible area
- E - attack and halt
- O - check and investigate
- V - remove heat, smoke, fire gases
- S - minimize damage

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Slide 10

**Strategy, Tactics, & Methods**

- ◆ Strategy identifies goals and prioritizes objectives based on mode of attack
  - ◆ *Offensive or defensive*
- ◆ Tactics are objectives that must be completed to achieve strategy
  - ◆ *Search, rescue, exposure protection*
- ◆ Methods are evolutions to accomplish tactics
  - ◆ *Hose lay, ladder raise, medical aid*

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Slide 11

**COMMAND DEFINED**

The systematic management of resources to reduce the impact of an emergency

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Slide 12

**COMMAND ACTIVITIES**

- ◆ Collecting and analyzing facts
- ◆ Identifying and assessing of probabilities
- ◆ Determining resource capabilities
- ◆ Making decisions
- ◆ Implementing the plan

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Slide 13

**THE HUMAN ELEMENT**

- ◆ The “perfect” commander does not exist
- ◆ Subject to human variables and flaws
- ◆ No two individuals will handle an emergency in the same way
  - ◆ Perceptions differ
  - ◆ Difference in experience and training
  - ◆ Priorities may vary

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RETIRED CURRICULUM

All levels of emergencies require that the fire department perform numerous activities or operations. The size and complexity of these operations will be based upon the size and complexity of the emergency. Utilizing the basic divisions of fire fighting as a guide, the fire officer can make operational decisions in a systematic, prioritized manner. This lesson will review the basic concepts that must be mastered in order to be a more successful fire ground officer.

Lloyd Layman, in his book "Fire Fighting Tactics," first described a process of evaluating an incident in order to determine a logical course of action to pursue. He developed a system of "size-up." Size-up is a mental evaluation made by the officer in charge of a fire or other emergency that enables him or her to determine the best course of action. Size-up begins with the initial receipt of the alarm and continues until control of the incident is achieved.

The responsibility is not only that of the overall commander but also the responsibility of each person on the incident throughout that incident. The first-in officer begins the process upon receipt of the alarm, and at the same time, the rest of the crew begins the process with the pre-incident knowledge and experiences they have acquired over time. The process continues as the company goes on scene and other units arrive. If command is passed on, the process continues with the new officer in charge. Each company or division will continue the process throughout the incident.

The process of size-up must be systematic and thorough. There are a number of specific factors that must be addressed when sizing up an incident. To miss any one of these factors may be to overlook critical information that is essential to the safety of personnel on scene or to successful control of the emergency. It is said that the size up process is the basis for all strategy, tactics, and methods employed on the fire ground.

Several techniques have been developed for the process of conducting a size-up. The one most widely recognized is Lloyd Layman's. Layman has broken size-up into five distinct components.

### **Major Components of Size-Up**

- ❶ Facts
- ❷ Probabilities
- ❸ Own Situation
- ❹ Decision
- ❺ Plan of Operation

Within each of these major components are numerous factors that must be considered. For example, the fire officer is presented with several facts from the outset including time, location, and the type of emergency. He or she must consider various probabilities such as rescue and life hazards, construction type and how it impacts fire spread, the rate of fire spread, and the rate of fire growth. In other words, what changes might be anticipated over the duration of the incident? The fire officer must take into account resources currently available on scene and those that can be summoned to the scene quickly. These resources include personnel, equipment, water supplies, etc.

Once the fire officer has examined the facts, probabilities and his/her own situation, it is possible to begin making decisions. Initial decisions will be made based on current and anticipated conditions and resources. Supplemental decisions may be made later in response to the results obtained. Finally, the officer must determine and implement a plan of action encompassing strategy, tactics, methods, and leadership or supervision style(s).

### **Mental Discipline**

Knowledge of these components and factors alone will not ensure an adequate size up. It takes mental discipline to know what information is important and how to use that information in the decision making process that follows.

### **Dealing with Facts**

The number of facts observed or available to the Incident Commander can be enormous. Not all of them are relevant or immediately important. They must be filtered and screened so that only the most relevant are dealt with initially. The individual facts must be evaluated in terms of how they fit into the overall "big picture."

### **The Probabilities**

The Incident Commander must look ahead at probable hazards or concerns. Once again, there can be a large number of them. In order to focus on the most important, the distinction must be made between those that are probable and those that are remote possibilities. Initial attention must be devoted to those that are most likely and those that present a high degree of risk to personnel on scene.

### **Own Situation (Resources)**

The fire officer must never hesitate to "think big." Turning back units will always be easier than requesting them when you have run out of resources and the enemy surrounds you. It is important to remember that your resources extend beyond your initial response. It is also important to remember that your resources include reference items such as prefire plans, maps, and building guides.

### **Decisions**

A good fire officer will try not to make decisions before obtaining pertinent facts, just as a successful football quarterback will not throw the ball before knowing who is open. Use all of your senses and those of your fellow fire fighters in gathering as much pertinent information as possible before committing your resources. Then after committing your resources, remember that your decisions are not cast in concrete. Stay flexible and receptive to continual input. Constantly review and assess the effectiveness of your decisions.

### **Plan of Operation**

The original plan of operation may require modification or change on occasion. The fire officer must constantly monitor and evaluate the effectiveness of the plan. Management and supervision must be continually exercised. Issuing orders and instructions will be an important aspect of the plan's operation.

## **Size-Up and Divisions of Fire Fighting**

As soon as possible, the process of sizing-up an incident should be applied to the divisions of fire fighting. It will assist the officer in identifying both problems and solutions/objectives. This process can take the form of questions such as:

- What are the facts concerning rescue?
- What is the probability of rescue being needed?
- What resources are available to conduct the rescue?
- What decisions must be reached regarding rescue?
- What will the rescue plan entail?

Each of the examples above is geared specifically towards rescue. However, the process is repeated for each of the other fire divisions (exposures, confinement, extinguishment, overhaul, ventilation, and salvage). The process can be interrupted or modified as the situation dictates. For example, if the facts and probabilities concerning rescue indicate that rescue operations are not needed, there is no point assessing your resource capabilities or establishing a rescue plan.

## **Tactical Priorities: RECEO**

Lloyd Layman, in his book entitled "Firefighting Tactics" uses the acronym RECEO to help fire officers remember the essential fire ground divisions or priorities. Those divisions include rescue, exposure, confinement, extinguishment, and overhaul. They are listed in their order of importance, and are generally performed in this order. Two additional divisions, ventilation and salvage, are incorporated into the fireground operations where appropriate.

It is important to recognize that these tactical priorities often overlap. And, although they are listed in order of their *general importance*, they may need to be accomplished in a different order depending on the situation and the resources available.

### **Rescue**

Rescue, or life safety, is the first priority at all emergencies. Rescue operations consist of those activities that are required to remove the threat to lives at an emergency scene.

### **Exposure Protection**

The next priority is exposure protection to keep the fire from extending within buildings or areas not yet involved in the fire, but likely to be in the path of the fire's growth.

### **Confinement**

At this point, efforts should be directed towards confining the fire to the smallest possible area. All avenues of fire spread must be secured to keep fire and products of combustion from extending either horizontally or vertically.

## **Extinguishment**

Once the fire has been confined, it can then be extinguished. Extinguishment consists of attacking the seat of the fire and halting combustion.

## **Overhaul**

Overhaul is that phase of the operation where fire fighters carefully check the fire area to make sure that everything is completely extinguished so that the fire will not rekindle after the fire department has left the scene. Overhaul also includes conducting an investigation to determine the cause of the fire and making the structure as safe as possible.

## **Ventilation**

Ventilation includes those operations aimed at removing heat, smoke, and fire gases from the structure. Although ventilation appears as an individual objective low on the priority list, it is actually a vital component of almost all the other tactical priorities. For example, it may be necessary to ventilate the structure in order to perform rescue operations.

## **Salvage**

Salvage operations are done to minimize damage from the fire, smoke, and water or other extinguishing agents used. Salvage efforts may be started as soon as hose lines are brought into the structure.

## **Strategy, Tactics, and Methods**

It must be remembered that fire ground decisions are made on three different levels consisting of strategy, tactics, and methods.

A strategy is a basic plan that identifies major goals and prioritizes objectives. A part of this plan is based on the decision as to the mode of attack. There will be offensive and defensive strategies based on information acquired by the fire ground officer.

An offensive strategy is utilized when resources are in sufficient form to aggressively attack the incident. The purpose of this attack is to completely control the entire incident. Offensive strategy is close-up, aggressive and followed up with other forces completing support functions.

A defensive strategy is utilized when the incident is such that the resources are not in enough mass to accomplish complete control of the incident. A true defensive strategy involves attacking only a part of the incident and holding until more resources arrive.

Tactics are specific individual objectives that must be completed to accomplish the overall goal or strategy. They are based on tactical priorities such as search, rescue, or exposure protection, etc.

Methods are the individual evolutions conducted to accomplish the tactical objectives. They involve the actual physical work and appropriate movements needed in order to get the work done. An example would be the particular hose evolution or medical treatment.

## **Command Overview**

To many fire fighters, serving in a command position in a working incident is the high point of their careers. They find it exciting, challenging, and demanding. Others are reluctant to assume command due to lack of training, lack of experience, fear of failure, or the stress involved. Regardless of an officer's personal feelings, the command function is a basic responsibility of all fire officers.

### **Human Element of Command**

The term "fire command" implies different things to each fire fighter. The most generic definition is that it is the systematic management of resources to reduce the impact of an emergency. Using this definition, we see that the primary function of command is, therefore, the management of resources.

To successfully discharge the primary function of command, the fire officer must engage in a number of general activities at every emergency. These are most usually:

- The collection and analysis of facts
- The identification and assessment of probabilities
- The determination of our resource capabilities
- The making of decisions
- The implementation of a plan

Occasionally expressed in different terms, these remain the basic activities of command. They do not change with the type of emergency or the rank of the officer in command.

Defining command and identifying common functions is necessary, but it is essential that we remember that command is an endeavor involving human behavior. Command is therefore subject to all the variables and flaws typical of the human being.

There are two "givens" in command. First, no two individuals are likely to handle an emergency in the same manner. Each person's perception will be a little bit different. Each may size up the situation differently. They will have different levels of training and experience. They may prioritize things differently, even when guided by set parameters or standard operating procedures (SOPs). Rarely is there "one right answer."

The second "given" is that there is no such thing as the "perfect" fireground officer. At one time or another all commanders will get excited or flustered, make mistakes or judgment errors, forget things, or doubt their abilities. They will often look back at an incident and think of things they could have done differently or better.

These are two important concepts. Acceptance of these two facts will better equip any officer to study the responsibilities and techniques of fire command.

## Summary

Lloyd Layman describes size-up as the process of evaluating an incident in order to determine which course of action to pursue. It is an on-going process that is done throughout the duration of the incident. Size-up can be broken into five distinct components: facts, probabilities, own situation, decision, and plan of operation. Each of these components involves several different factors. It also takes mental discipline to know what information is important and how to use that information in the decision making process that follows.

Lloyd Layman uses the acronym RECEO to help fire officers remember the essential fireground divisions or priorities. Those divisions include rescue, exposure, confinement, extinguishment, and overhaul. They are listed in their order of importance, and are generally performed in this order. Two additional divisions, ventilation and salvage, are incorporated into the fireground operations where appropriate.

Strategy, tactics, and methods are fireground concepts that can be applied to any emergency activity. The terms describe the plan of action, the objectives needed to accomplish the plan, and the evolutions needed to achieve the objectives.

It is important to remember also that the human behavior traits of individuals will be a part of their fire ground behavior. They will make mistakes as well as heroic judgments. Each person's perception of the "facts" may differ causing a different emphasis on the size-up and its application.

## Chapter Review Questions

1. Define "size-up" as described by Lloyd Layman.

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2. Explain the time parameters for the size-up of an incident. When does it begin and end?

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3. The acronym "RECEO" is missing two very important components that can appear anywhere in the operational sequence. What are these components and where do they fit in the sequence?

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4. What must be present in order for the officer to ask for an "offensive strategy?"

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5. To successfully discharge the primary function of command, the fire officer must engage in what type of activities on the fireground?

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RETIRED CURRICULUM

**Activity 1-3-1**

**TITLE:** Terminology and Concepts of Command

**MATERIALS NEEDED:** • Pen or pencil

**INTRODUCTION:** Understanding terminology and concepts of command is important for the fireground commander. To be successful, the fireground commander must be able to quickly relate to appropriate actions on the scene of an emergency.

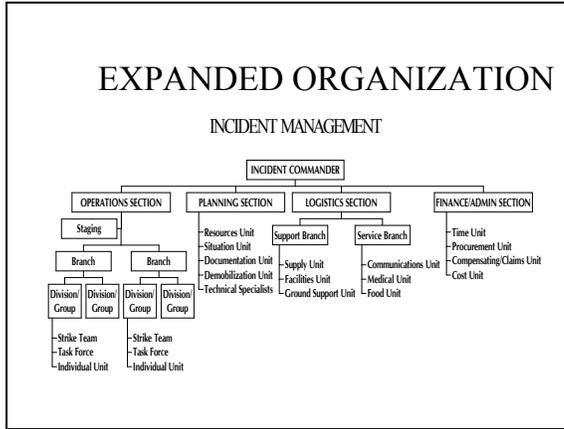
**DIRECTIONS:** 1. Match the terms in the left-hand column with the appropriate descriptor in the right-hand column to see how well you remember the concepts presented in Fire Command 1A. (Note: Some descriptors in the right-hand column may be used more than once.)

Term	Descriptor
1. _____ Fire Load	A Demands/stress
2. _____ RECEO	B Convection heat transfer
3. _____ Knowledge/Reinforcement	C Problem solving
4. _____ Concept of Alternatives	D Ignition to control
5. _____ Systems Overload	E Amount of fuel per square foot
6. _____ Decision Model	F Branching decisions
7. _____ Thermal Balance	G Synergistic effect
8. _____ Priorities	H Fire tactics division
9. _____ Reflex Timing	I Fireground objectives
10. _____ Offensive	J Mode of operation
11. _____ Defensive	K Things to be done first
12. _____ Command	L Information as the problem changes
13. _____ 952	M One person - one supervisor
14. _____ Disclosure Effect	N Allowing subordinates to act
15. _____ Unit of Command	O Report of authority
16. _____ Chain of Command	P Transfer of authority
17. _____ Delegation of Authority	Q Amount of water needed

**RETIRED CURRICULUM**

### Topic 1-4: Concepts of the ICS Organization

Slide 1




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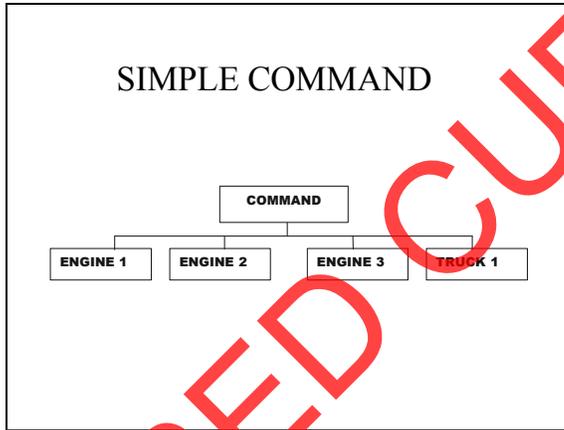
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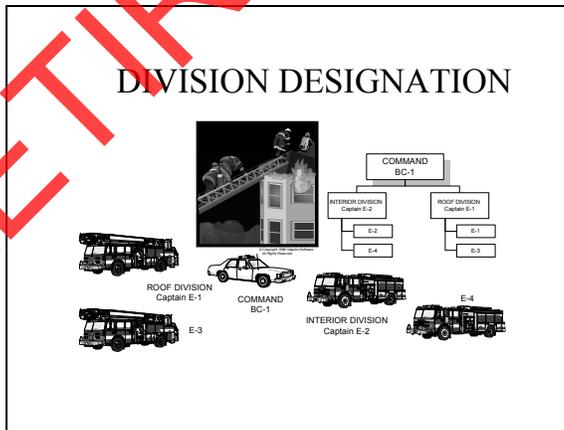
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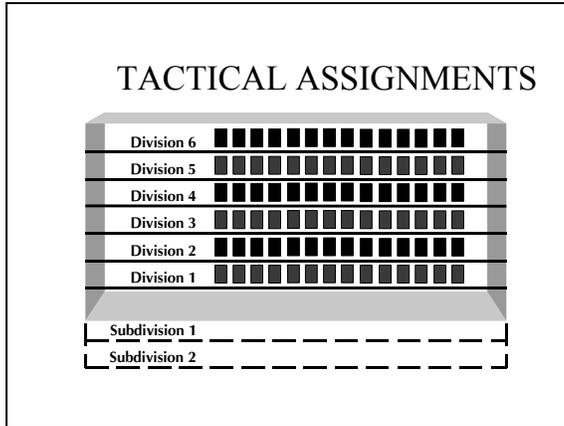
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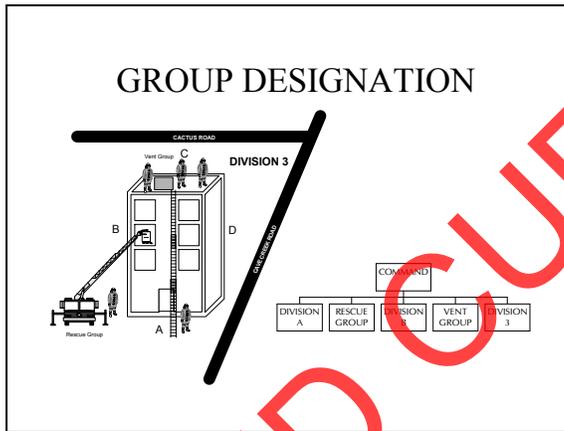
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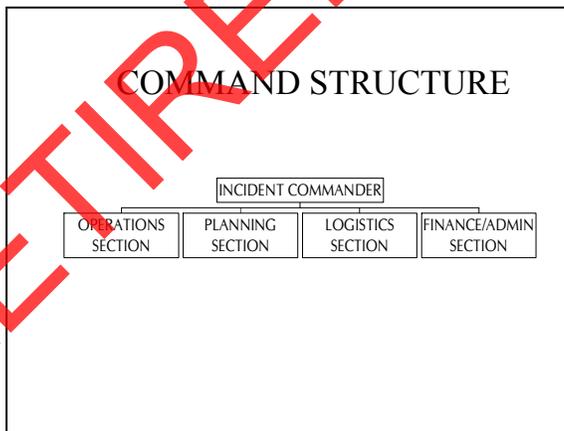
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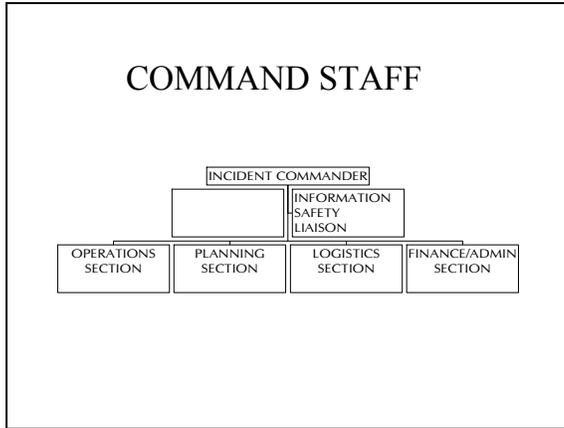
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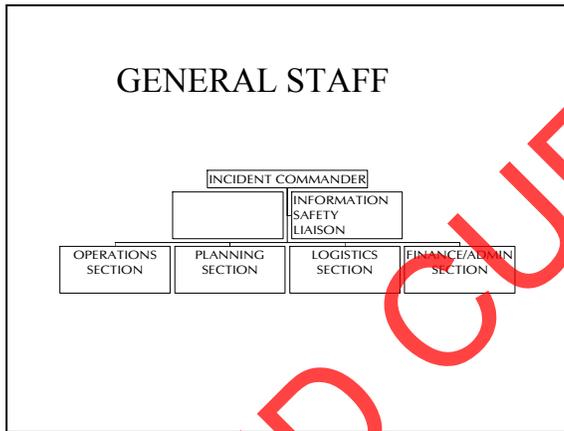
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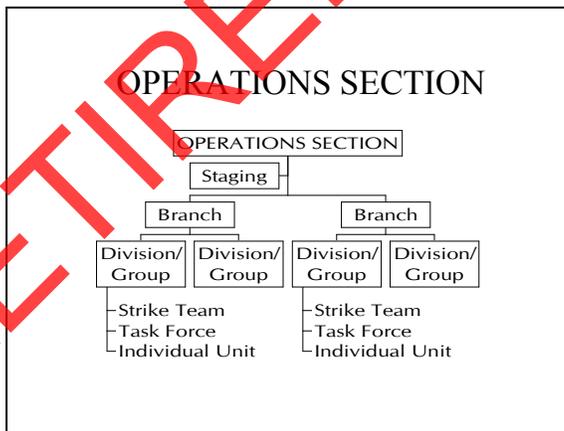
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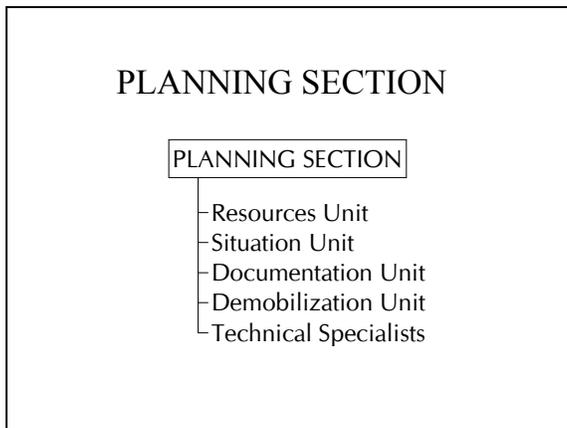
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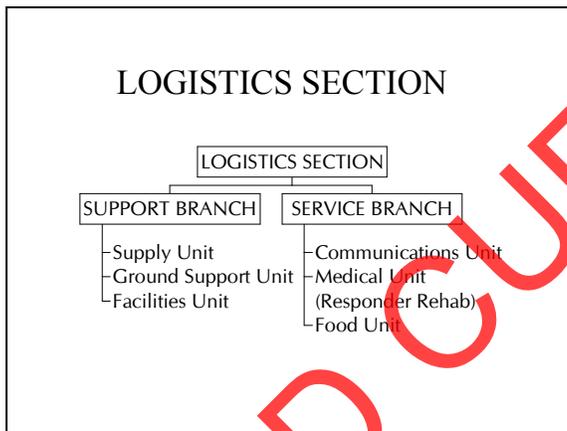
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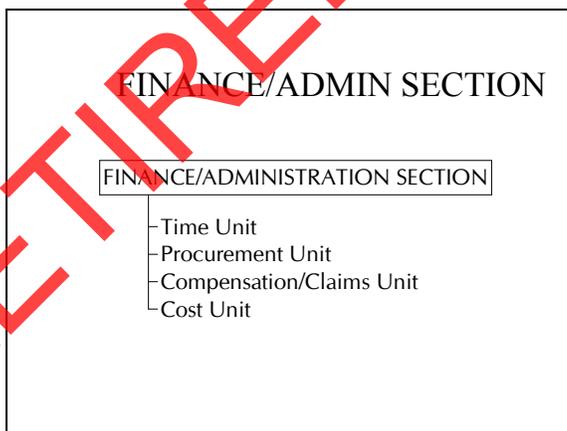
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RETIRED CURRICULUM

Fighting fire is a very dangerous occupation. Fighting a large fire compounds the dangers. The success or failure of fire fighters combating large fires, as well as other emergencies, is based on the development and utilization of an appropriate command system or organization. This chapter will identify the basic concepts and principles for developing an organizational system for managing resources on major incidents. These principles are the foundation for coping with and managing "all risk" type incidents, no matter what classification, size, or type.

## **History**

The ICS is quite probably a very old concept. Any organization or country involved in any kind of political or physical struggle with another entity that has gone to battle or war, in order to be successful, had to be organized. Its forces had to have a leader who delegated authority to other leaders in some kind of orderly fashion. If they did not, they were usually unorganized and unsuccessful. Thus, was born a form of command system.

The fire service is not much different from those warriors of old. We must be organized and orderly in our fight against our enemies of fire and other disasters. Our first documented effort at organization in emergency operations took place in the early seventies.

After the disastrous wildland fires in 1970, and with Congressional support, a cooperative effort between the US Forest Service, California Department of Forestry and Fire Protection, California Office of Emergency Services, Los Angeles County Fire Department, Los Angeles City Fire Department, Ventura County Fire Department, Santa Barbara County Fire Department, and the Orange County Fire Department resulted in the establishment of the FIRESCOPE program (Fire Fighting Resources of Southern California Organized for Potential Emergencies).

These agencies committed themselves to the massive effort of addressing the problems of 1970 and to creating and implementing new applications in fire service management, technologies and coordination, with high emphasis on incident command and multi-agency coordination.

Among its many accomplishments between 1970 and 1987, the FIRESCOPE Program's Incident Command System was developed, tested and implemented, and has demonstrated its value and credibility not only to the fire service, but to any "all-risk" emergency application. The FIRESCOPE Incident Command System is of such success and value that it is accepted and implemented on a statewide, national and in some cases, international basis.

## **Today's Incident Command System**

As California developed FIRESCOPE, a few other agencies were beginning to also develop systems that would eventually parallel the California system.

The Phoenix Fire Department, under the leadership of Chief Alan Brunacini, began work on "Fire Command." "Fire Command" is extremely similar to FIRESCOPE ICS with the exception of a few position terms. Soon after this system was developed, the Phoenix Fire Dept. began a campaign of sharing this system with other agencies across the US.

Also, around this time the federal government began working on another very similar system to the California program. Eventually the National Interagency Information System (NIIMS) took shape and another competing system was created. This system was closer to the FIRESCOPE process than the Phoenix system, but still had a number of subtle differences.

In all, the FIRESCOPE ICS is the dominant system in California and most of the US. As a result of the 1991 East Bay Hills Fire in Oakland, California, Senate Bill 1841 was created and passed in 1993, taking affect in September of 1994. The intent of this law is to improve the coordination of state and local emergency response in California. The Standardized Emergency Management System (SEMS) incorporates the use of ICS (FIRESCOPE version) into a much larger practice than before. This new version's purpose is to create a more responsive, coordinated, multi-agency, and multi-jurisdictional emergency plan.

It is not the direction of this course (Command 1B) to teach SEMS. The direction of this course will be to focus on ICS in the California fire service and bring it into a field of understanding to show its compatibility with our emergency response protocols. SEMS training is available through the California State Fire Marshal's Office as well as many local fire agencies. See your Training Officer for more details in that area.

### **Purpose of the ICS**

The purpose of the ICS is to provide for a systematic development of a complete, functional command organization, designed to allow for single or multi-agency use, which increases the effectiveness of command and fire fighting safety.

This system combines command strategy with organizational procedures and is designed to be applicable to all types of emergency incidents.

### **Key Elements of the System**

- The systematic development of a complete, functional organization with the major functions being Command, Operations, Planning, Logistics, and Finance/Administration.
- Designed to allow for multi-agency adoption in federal, state, and local fire agencies. Therefore, organizational terminology used in the ICS is designed to be acceptable to all levels of government.
- Designed to be the basic, everyday operating system for all incidents within each agency. Therefore, the transition to a large and/or multi-agency operation requires a minimum of adjustment for any of the agencies involved.
- The organization builds from the ground up, with the management of all major functions initially being the responsibility of one or just a few persons. Functional units are designed to handle the most important incident activities. As the incident grows in size and/or complexity, functional unit management is assigned to additional individuals in order to maintain a reasonable span of control and efficiency.
- Designed on the premise that the jurisdictional authority of the involved agencies will not be compromised. Each agency having legal responsibility within its jurisdiction is assumed to have

full command authority within its jurisdiction at all times. Assisting agencies will normally function under the direction of the Incident Commander appointed by the jurisdiction within which the incident occurs.

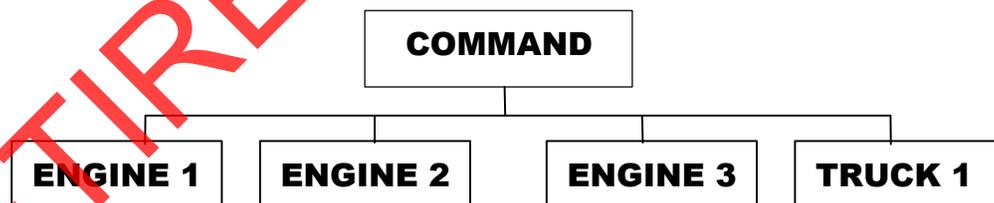
- ❑ Multi-jurisdictional incidents will normally be managed under a Unified Command management structure involving a single incident Command Post and incident.
- ❑ The system is intended to be staffed and operated by qualified personnel from any agency, and a typical incident could involve the use of personnel from a variety of agencies, working in many different parts of the organization.
- ❑ The system expands and contracts organizationally based upon the needs of the incident. Span-of-control recommendations are followed closely; therefore, the organizational structure is never larger than required.

### **Command Structure – Basic Organization**

The Incident Command System structure is very much like an organizational chart. A common organization chart will show the Company President or Fire Chief at the top and each level beneath that person in a pyramid design. The assembly-line person or fire fighter position will usually be at the bottom of the structure, supporting all of the elements above.

On the most basic emergency, this structure still exists. If two people respond, one is usually given the responsibility of being in charge. If an engine company responds to an emergency, the rank of the personnel usually dictates the structure of the command system. In continuing this building of the incident response, we find that if more than one unit responds, department protocol will dictate who is the most responsible or "in charge"

The basic organizational structure in an emergency will show the person most responsible or in charge at the top of the pyramid.



Simple Command

As the size of an incident escalates, the person in charge (Incident Commander) will need to keep as "organized" as possible so he/she does not lose control of the resources under his/her authority. Management literature tells us that "span of control" must be maintained in order to remain in control of a situation. This management concept (span of control) says that a single person can best control up to five people and that if the number of people under the manager's control should grow beyond this figure, control can be lost easily.

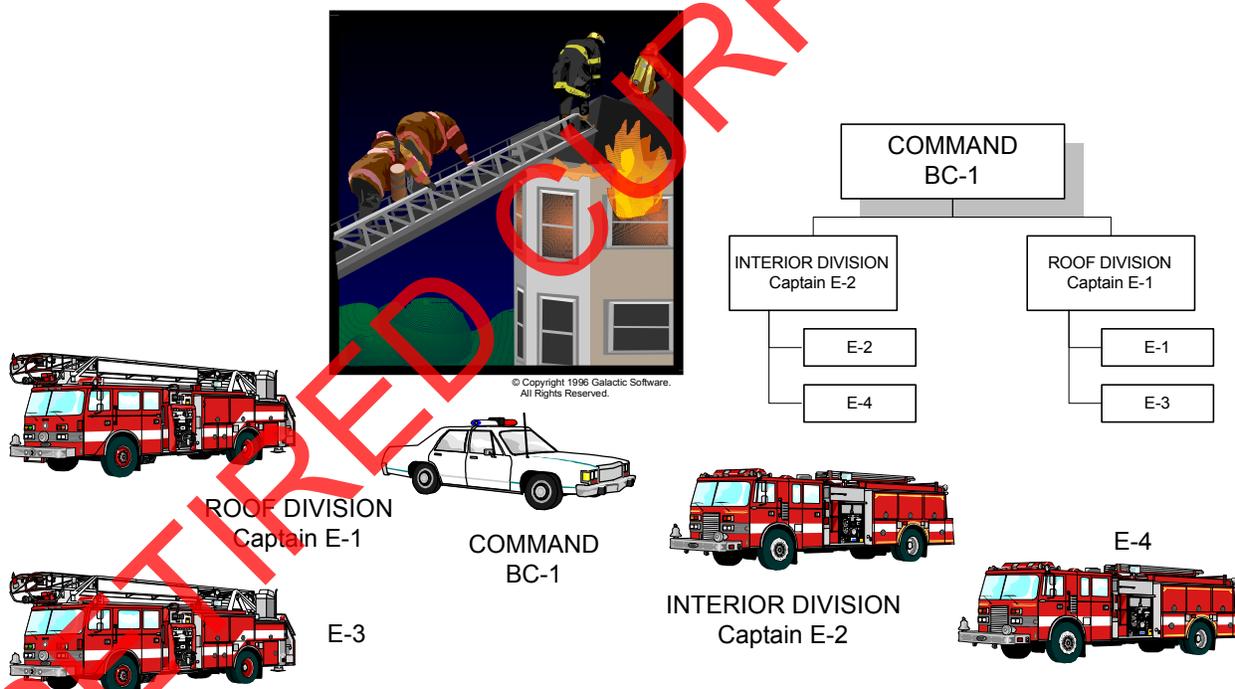
In order to maintain span of control, the commander will have to begin "grouping" his resources when they begin to number more than four or five units. Creating divisions or groups of resources does this best.

### Division/Groups

The ICS is organized into "units" of work. Each work category is then separated by both function and by responsibility. This grouping in a basic fire ground operation gives us the terms, divisions, and groups.

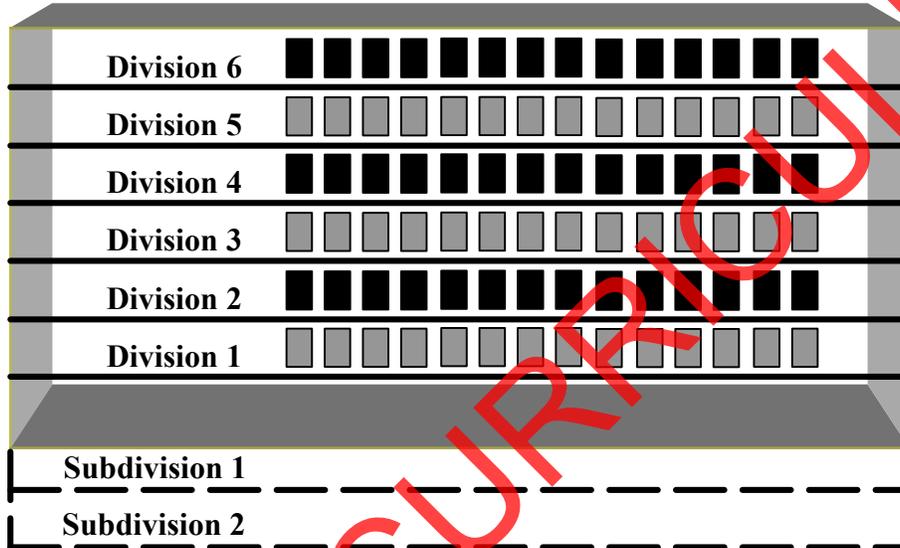
A division is the organizational level having responsibility for operations within a defined geographical area. To effectively use the division terminology, a department must have a designated method of dividing an incident scene. Figures below represent typical division designation systems on the fire ground.

### Division Designations

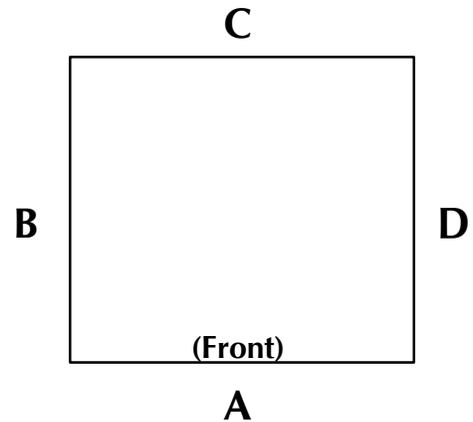


***Tactical Assignments for a Multi-Story Incident***

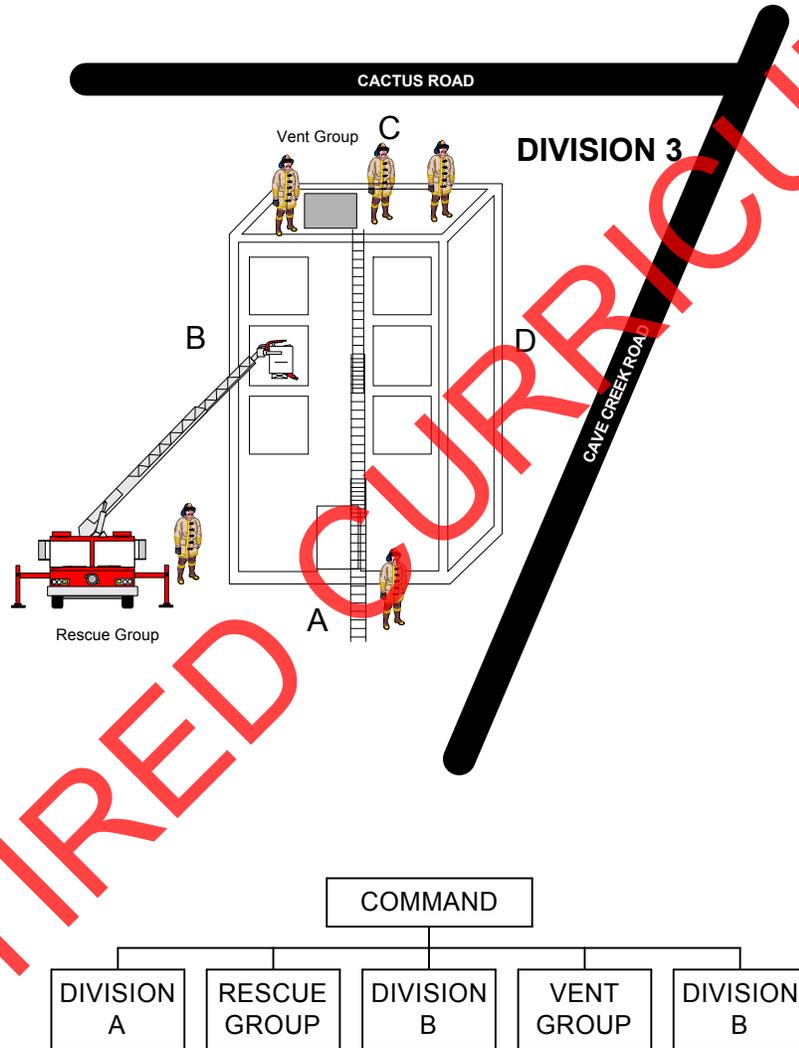
In multi-story occupancies, divisions will usually be indicated by floor number (Division 6 indicates 6<sup>th</sup> floor). When operating in levels below grade such as basements, the use of subdivisions is appropriate.



Alpha letters identify exterior designations. Starting at the front of a building and progressing clockwise around the building as illustrated.



Groups are organized on the fireground in functional capacities. Below is a typical group designation system in the fireground combined with a divisional system. You will notice that the divisions are location or geographic in nature and the groups are functional in nature.



Divisions/Groups reduce the overall amount of radio communications. Most routine communications within a Division/Group should be conducted in a face-to-face manner between Company Officers and their Division/Group. This process reduces unnecessary radio traffic and increases the ability to transmit critical radio communications.

The safety of fire fighting personnel represents the major reason for establishing Divisions/Groups. Each Division/Group must maintain communication with assigned companies to control both their position and function. The Division/Group must constantly monitor all hazardous situations and risks to personnel. The Division/Group must take appropriate action to ensure that companies are operating in a safe and effective manner.

### ***Assigning Divisions/Groups***

The Incident Commander should begin to assign divisions/groups based on the following factors:

- Situations that will eventually involve a number of companies or functions beyond the capability of Command to directly control. Command should initially assign Division/Group responsibilities to the first companies assigned to a geographic area or function until Chief Officers are available.
- When Command can no longer effectively cope with (or manage) the number of companies currently involved in the operation.
- When companies are involved in complex operations. (Large interior or geographic area, hazardous materials, technical rescues, etc.)
- When companies are operating from tactical positions, which command has little or no direct control over (i.e., out of sight).
- When the situation presents special hazards and close control is required over operating companies (i.e., unstable structural conditions, hazardous materials, heavy fire load, marginal offensive situations, etc.).

When establishing a Division/Group, the Incident Commander will assign each Division/Group:

1. Tactical objectives
2. A radio designation (Roof Division, Division A)
3. The identity of resources assigned to the Division/Group

### **Command Structure – Expanding the Organization**

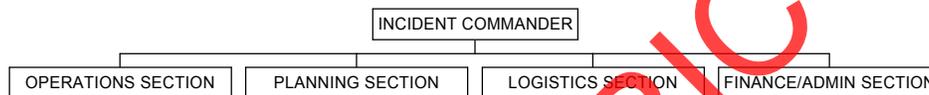
As a small incident escalates into a major incident, additional organizational support will be required. The Incident Commander can quickly become overwhelmed and overloaded with information management: 1) assigning companies, 2) completing and updating the tactical worksheets, 3) planning, forecasting, and requesting additional resources, 4) talking on the radio, 5) and fulfilling all the other functions of Command. The immediate need of the Incident Commander is support. As additional ranking officers arrive on the scene, the command organization may be expanded through the involvement of officers and staff personnel to fill Command and General Staff positions.

The transition from the initial response to a major incident organization will be evolutionary and positions will be filled, as the corresponding tasks are required.

During the initial phases of the incident, the Incident Commander normally carries out these four functions.

1. OPERATIONS
2. PLANNING
3. LOGISTICS
4. FINANCE/ADMINISTRATION

During the growing incident, each of these tasks will grow in responsibility. Eventually, the Incident Commander (IC) will have to get help in maintaining these growing areas of need. When the IC delegates each of these responsibilities, a new position is created within the ICS organization. The newer organizational chart (ICS) structure plan will eventually begin to look like the following, as the positions are filled.



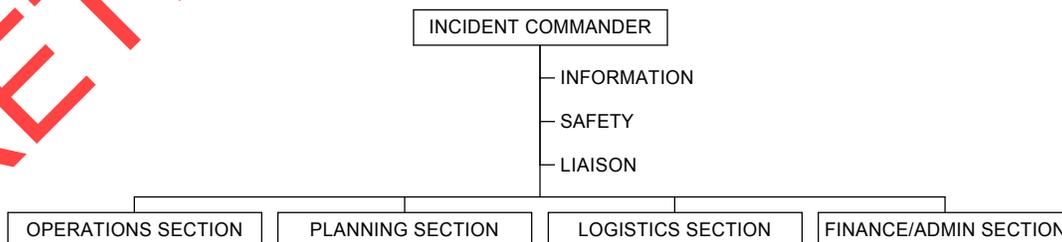
### **Command and General Staff**

As the organizational structure expands, a number of positions begin to take shape. We now have an incident in need of a PIO, a Safety Officer, and a Liaison to coordinate police, fire, and city or municipality functions. As these positions are filled, they take positions in the command structure or organizational chart.

Looking back at the preceding figure, you will notice that the structure is now beginning to take the shape of a pyramid. The structure will eventually begin to separate itself into functions or areas of staff and line. The previous figure is all staff functions.

### **Command Staff**

The Command Staff consists of the IC, PIO, Safety Officer, and the Liaison. The IC being in charge of all positions under him/her. The reason for setting these three positions directly under the IC are many. The primary reason is that they each must have direct access to the IC at all times in order to operate in their capacities. Each reports directly to the IC and assists him/her in the role as the IC.



### ***The Incident Commander***

Once the Operations Section is in place and functioning, the Incident Commander's focus should be on the strategic issues, overall strategic planning, and other components of the incident. This focus is to look at the "big picture" and the impact of the incident from a broad perspective. The Incident Commander should provide direction, advice, and guidance to the Command and General Staff in directing the tactical aspects of the incident.

#### ***Roles and Responsibilities***

- Review and evaluate the plan, and initiate any needed changes.
- Provide on-going review of the overall incident (the big picture).
- Select priorities.
- Provide direction to the Command and General Staff officer.
- Review the organizational structure and initiate change or expansion to meet incident needs.
- Stage Command and General Staff functions as necessary.
- Establish liaison with other internal agencies and officials, outside agencies, property owner, and/or tenants.

Command staff positions are established to assume responsibility for key activities, which are not a part of the line organization. Three specific staff positions are identified:

- Information Officer
- Safety Officer
- Liaison Officer

Additional positions might be required, depending upon the nature and location of the incident, or requirements established by Incident Command.

#### ***Information Officer***

The Information Officer's function is to develop accurate and complete information regarding incident cause, size, current situation, resources committed, and other matter of general interest. The Information Officer will normally be the point of contact for the media and other governmental agencies that desire information directly from the incident. In either a single or unified command structure, only one Information Officer would be designated. Assistants may be assigned from other agencies or departments involved.

#### ***Safety Officer***

The Safety Officer's function at the incident is to assess hazardous and unsafe situations and develop measures for assuring personnel safety. The Safety Officer has emergency authority to stop and/or prevent unsafe acts. In a Unified Command structure, a single Safety Officer would be designated. Assistants may be required and may be assigned from other agencies or departments making up the Unified Command including the need for Responder Rehabilitation assessment.

**Liaison Officer**

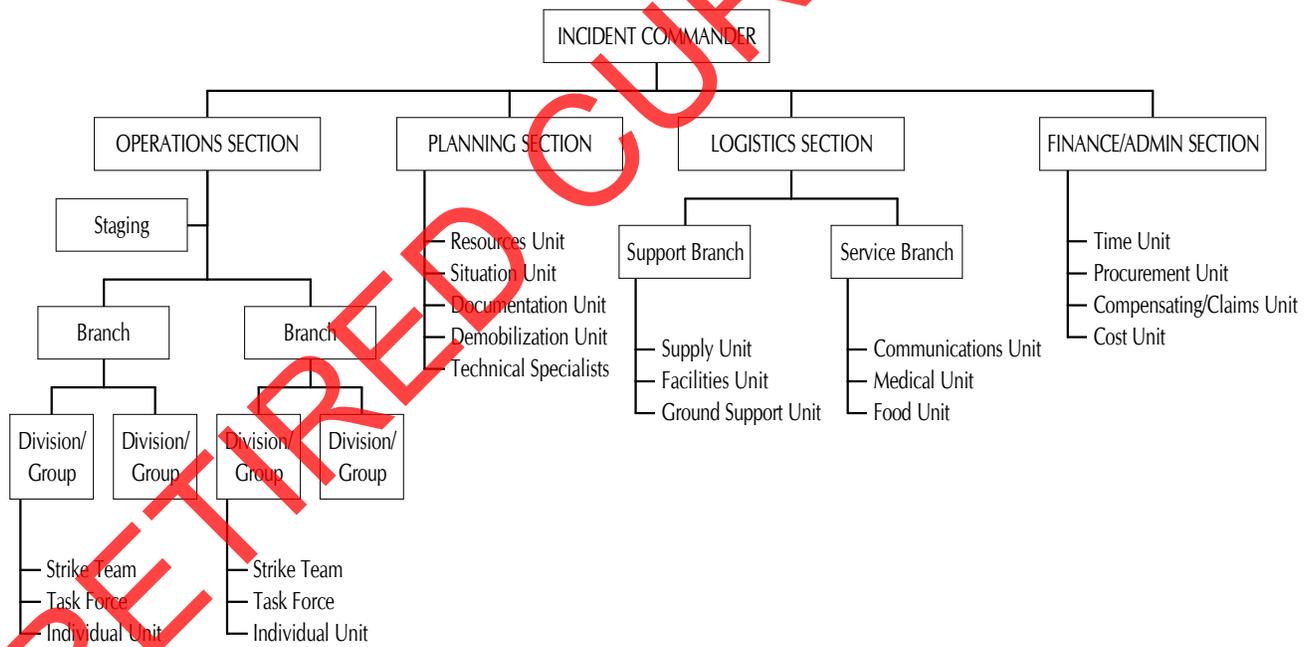
The Liaison Officer's function is to be a point of contact for representatives from other agencies. In a Single Command structure, the representatives from assisting agencies would coordinate through the Liaison Officer. Under a Unified Command structure, representatives from agencies not involved in the Unified Command would coordinate through the Liaison Officer. Agency representatives assigned to an incident should have authority to speak on all matters for their agency.

**General Staff**

The General Staff consists of the Operations, Planning, Logistics, and Finance Sections. These staff positions direct and control a great number of people who are the operating areas of the incident. A breakdown of each position follows in the next section.

**EXPANDED ORGANIZATION**

INCIDENT MANAGEMENT



**Operations Section**

The Operations Section is the unit responsible for the action going on in the mitigation of the emergency. This section has not changed from when the first arriving officer was in charge of the incident. The officer set the mode of action, distributed resources, and attacked the situation. In the expanded ICS, the responsibilities have not changed.

This person reports to the IC and may supervise a number of divisions, groups, and single resources. In very large operations, the Operations Chief may break the operation into branches in order to maintain the span of control.

It is possible to expand the organization to include a number of entities within the Operations Section. These entities may be vital to the outcome of the operation. Some of the entities possible in a common large-scale operation are:

- Staging
- Branches
- Divisions or Groups
- Air Operations
- Air Attack
- Air Support
- Others ...

Staging is an important feature of large-scale operations. It keeps responding units from filling the area with equipment and personnel to the point that it becomes unorganized and unwieldy. It is also a very good way to maintain safety on the operational field.

The Operations Chief usually chooses the staging location. It is important to keep the designated staging area strategically identified. It may be moved if the need arises, but usually this is not the case. The Staging Area Manager is responsible for the orderly collection and disbursement of the units in the staging area.

The Operations Chief may, depending on the incident's needs, utilize Branches, Divisions, Groups, or Single Unit resources. This person sets the plan in motion with the resource he/she designates.

Another possible position manned is the Air Operations Director. This person is responsible for the operation of the aircraft on the incident. It is a ground-based position that is supported by a number of other positions described in the following paragraph.

The Air Attack Supervisor and Air Support Supervisors are the support positions under the Air Operations Director in a wildland incident. The Attack Supervisor is generally in the air coordinating the aircraft flow patterns and drop targets. The Air Operations Director is in charge of the ground locations where the aircraft land and operate.

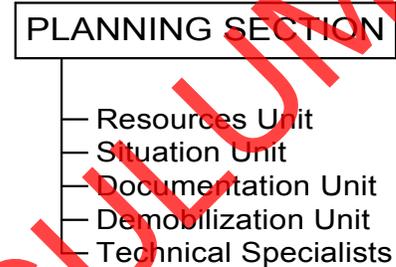
### **Planning Section**

The Planning Section is responsible for gathering, assimilating, analyzing, and processing information needed for effective decision-making. Information management is a full-time task at large and complex incidents. The Planning Section serves as the Incident Commander's "clearing house" for information. This allows the Incident Commander's staff to provide information instead of having to deal with dozens of information sources. Critical information should be immediately forwarded to Command (or whoever needs it). Information should also be used to make long-range plans. The Planning Section

Chief's goal is to plan ahead of current events and to identify the need for resources before they are needed.

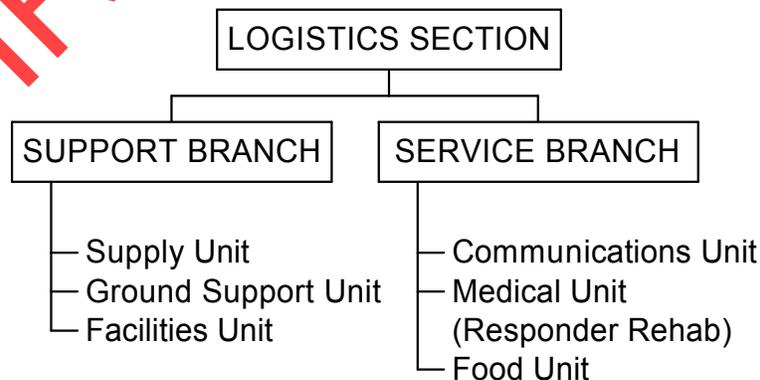
*Roles and Responsibilities*

- Evaluate current strategy and plan with the Incident Commander.
- Maintain resource status and personnel accountability.
- Refine and recommend any needed changes to plan with Operations input.
- Evaluate incident organization and span-of-control.
- Forecast possible outcome(s).
- Evaluate future resource requirements.
- Utilize technical assistance as needed.
- Evaluate tactical priorities, specific critical factors, and safety.
- Gather, update, improve, and manage situation status with a standard systematic approach.
- Coordinates with any needed outside agencies for planning needs.
- Plan for incident demobilization.
- Maintain incident records.



**Logistics Section**

The Logistics Section is the support mechanism for the organization. Logistics provides services and support systems to all the organizational components involved in the incident including facilities, transportation, supplies, equipment maintenance, fueling, feeding, communications, and medical services, including Responder Rehabilitation.

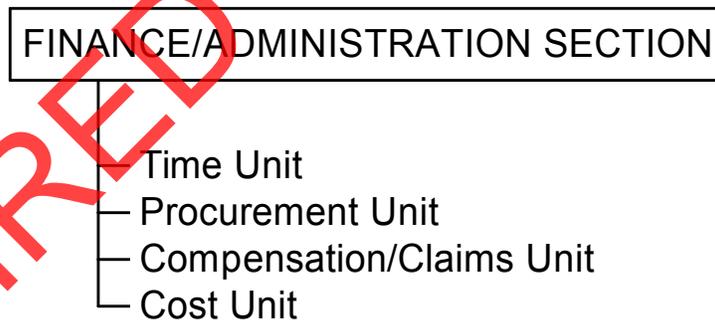


*Roles and Responsibilities*

- Provide for medical aid for incident personnel and manage Responder Rehabilitation.
- Coordinate immediate critical incident stress debriefing function.
- Provide and manage any needed supplies or equipment.
- Forecast and obtain future resource needs (coordinate with the Planning Section).
- Provide for communications plan and any needed communications equipment.
- Provide fuel and needed repairs for equipment.
- Obtain specialized equipment or expertise per Command.
- Provide food and associated supplies.
- Secure any needed fixed or portable facilities.
- Provide any other logistical needs as requested by Command.
- Supervise assigned personnel.

**Finance/Administration Section**

- The Finance/Administration Section is established on incidents when the agencies involved have a specific need for financial services. Not all agencies will require the establishment of a separate Finance/Administration Section. In some cases where only one specific function is required; e.g., cost analysis, that position could be established as a Technical Specialist in the Planning Section.



*Roles and Responsibilities*

- Procurement of services and/or supplies from sources within and outside the Fire Department or City as requested by Command (coordinates with Logistics).
- Documenting all financial costs of the incident.
- Documenting for possible cost recovery for services and/or supplies.
- Analyzing and managing legal risk for incidents (i.e., hazardous materials clean up).

- Document for compensation and claims for injury.
- The Finance/Administration Section is responsible for obtaining all needed incident documentation for potential cost recovery efforts.

**Summary**

The Incident Command System grew out of a need to be organized, well managed, and successful in our war with fire. The California FIRESCOPE system was a product of that need. It is designed to be an organized, well-managed effort to make our job safer, easier, and more effective.

The ICS organization is an organized flow chart of responsibility. It emphasizes span of control and enhances lines of authority. It is adaptable to all emergencies and will grow or shrink as the incident dictates.

**Chapter Review Questions**

1. What is the purpose of the Incident Command System?  
\_\_\_\_\_  
\_\_\_\_\_
2. An important feature in ICS is the number of subordinates working for a particular leader. Limiting this number entails the use of what management concept?  
\_\_\_\_\_  
\_\_\_\_\_
3. What are two reasons for an Incident Commander to begin assigning Divisions/Groups at an incident?  
\_\_\_\_\_  
\_\_\_\_\_
4. What are the four General Staff positions?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

5. What are the three Command Staff positions?

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6. What are the two specific areas of work the Logistics Unit provides for the large, active incident?

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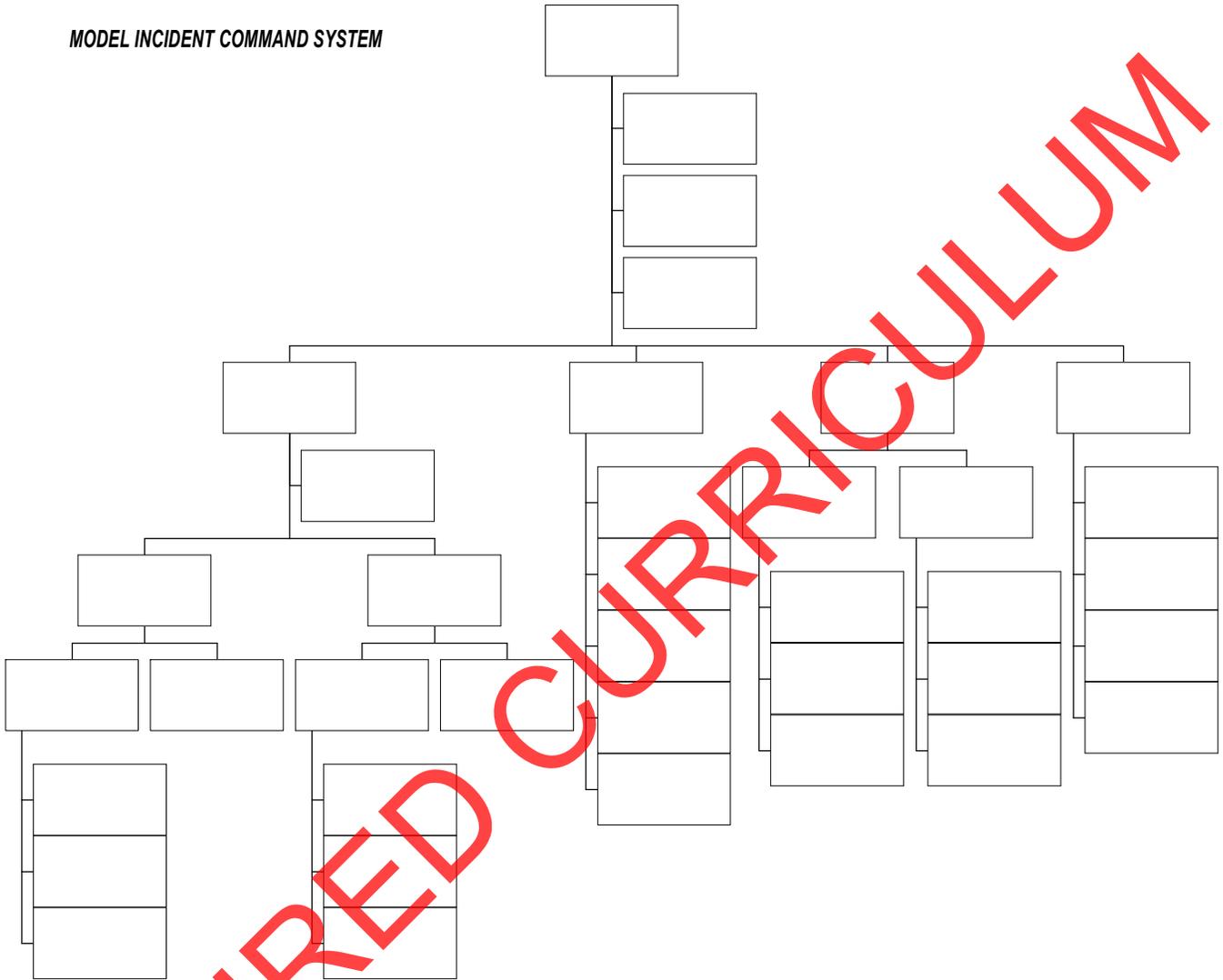
RETIRED CURRICULUM

**Activity 1-4-1**

<b>TITLE:</b>	ICS Organization Chart
<b>MATERIALS NEEDED:</b>	<ul style="list-style-type: none"><li>• Blank organization chart</li><li>• Pen or pencil</li></ul>
<b>INTRODUCTION:</b>	At an incident that has grown from simple to complex, an organizational structure will exist. This structure can be drawn in an organization chart from top to bottom. Knowing the positions in the command system will enhance the efficiency and safety of most field operations. This activity is designed so you may put in use the information you just learned.
<b>DIRECTIONS:</b>	<ol style="list-style-type: none"><li>1. In your group, review Unit 1-Topic 4.</li><li>2. Without looking at or copying from the student manual, fill in each block on the following ICS chart by writing in the position name used within the ICS.</li><li>3. You have 20 minutes to complete the activity.</li><li>4. Choose a spokesperson to explain your completed chart.</li></ol>

RETIRED

MODEL INCIDENT COMMAND SYSTEM



RETIRED CURRICULUM

### Topic 2-1: Components of Triage and Start

Slide 1

**DISASTER DEFINED**

*Any event that  
overtaxes the resources  
of the  
responding agency*

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Slide 2

**TRIAGE DEFINED**

*A French term meaning to sort; assign medical priorities*

- ◆ Efficient use of personnel, equipment, and facilities
- ◆ Don't relocate disaster to the hospitals
- ◆ Provide organized care within the disaster setting

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Slide 3

**TRIAGE TAG**

The image shows two triage tags. The left tag is labeled 'PART I' and includes fields for 'NAME', 'GENDER', 'AGE', 'WEIGHT', 'HEIGHT', 'ALLERGIES', 'MEDICAL COMPLAINTS', and 'PERSONAL INFORMATION'. The right tag is labeled 'PART II' and includes fields for 'ALLERGIES', 'MEDICAL COMPLAINTS', 'PERSONAL INFORMATION', 'NAME', 'GENDER', 'AGE', 'WEIGHT', 'HEIGHT', 'ADDRESS', 'CITY', 'STATE', 'ZIP', 'PHONE', 'FAX', 'EMAIL', and 'MOBILE'. Both tags have a color-coded bottom section with categories: DECEASED (black), IMMEDIATE (red), DELAYED (yellow), and MINOR (green).

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Slide 4

**START Victim Assessment**

- ❶ Ventilation
  - ◆ None, >30 per minute, <30 per minute
- ❷ Perfusion
  - ◆ Capillary blanch test
  - ◆ Radial pulse test
- ❸ Mental status
  - ◆ Altered, normal

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RETIRED CURRICULUM

Emergency response personnel frequently encounter situations where there are multiple casualties. Many relatively simple auto accidents make it necessary to triage casualties and determine priorities. However, in a mass casualty incident it becomes even more critical to have a simple system that can be implemented quickly, without necessarily having a high degree of emergency medical training.

This chapter specifically deals with the START system, which stands for "Simple Triage and Rapid Treatment." It is specifically designed for first responders. However, there are other systems in use. Emergency response personnel must be familiar with the triage system used in their jurisdiction.

### What Is Triage?

Any event that overtaxes the resources of the responding agency will require personnel to triage the casualties. Triage is a French term meaning "to sort." In this case, response personnel must quickly assess all casualties and allocate resources according to priorities.

The goal of triage is to do the greatest good for the greatest number of casualties while making efficient use of personnel, equipment, and facilities. Proper triage at the scene can help prevent relocating the disaster to the hospitals. Proper triage makes it possible to provide organized care to casualties within an otherwise chaotic setting. Planning and training is a must. The Incident Command System should be established as soon as possible to facilitate scene control.

### Triage Tags

An important component of triage is the triage tag. This makes it possible for all response personnel to quickly identify those casualties who have already been assessed, and the priority that they assigned based on severity of injury. There are several types of triage tags in use. The following is an example of a commonly used triage tag.

**TRIAGE TAG PART I**

№ 463289

№ 463289

CALIFORNIA FIRE CHIEFS ASSOCIATION

FRONT

C-SPINE  
CARDIAC  
BLUNT TRAUMA  
PENETRATING INJURY  
BURN  
FRACTURE  
LACERATION

BACK

OTHER: \_\_\_\_\_

VITAL SIGNS:

ORIENTED  DISORIENTED  UNCONSCIOUS

TIME	PULSE	B/P	RESPIRATION

**DECEASED**

**IMMEDIATE** № 463289

**DELAYED** № 463289

**MINOR** № 463289

**TRIAGE TAG PART II**

MEDICAL COMPLAINTS/HISTORY

ALLERGIES:

PATIENT RX:

TIME	DRUG SOLUTION			DOSE
	D/W	R/L	NS	

NOTES:

PERSONAL INFORMATION

NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

CITY: \_\_\_\_\_ TEL. NO.: \_\_\_\_\_

MALE  FEMALE  AGE: \_\_\_\_\_ WEIGHT: \_\_\_\_\_

**DECEASED**

**IMMEDIATE**

**DELAYED**

**MINOR**

## Color Coding on Triage Tags

Color	Location On Tag	Degree Of Injury	Description
Green	Bottom strip	Minor	No immediate hospital care needed. Injuries may be managed by basic first aid only.
Yellow	Second strip from bottom	Delayed	Hospital care needed. Treatment may be delayed.
Red	Third strip from bottom	Immediate	Immediate care is needed. These casualties should receive attention before all others.
Black	Fourth strip from bottom	Deceased	Dead or non-salvageable. No care is required.

## The Triage Process

The first step in the triage process is simply to get a quick overview of the emergency scene in order to get an idea of the number of casualties and the types of injuries they have.

The next step is to identify the "walking wounded" by instructing all those who can walk to move to a designated area away from the immediate emergency. This one step is the single most effective way to simplify the burden of triage since the walking wounded will rarely have life threatening injuries. Response personnel can focus their initial efforts on the other casualties. It is important not to lose track of all the walking wounded. When time permits, they should all be tagged "minor," or reassessed to determine the extent of their injuries. Besides the extent of and degree of injuries, the triage tag will assist in record keeping and accounting of all casualties.

It is important to have a systematic approach when assessing the remaining casualties. Response personnel should start where they stand and progress in an orderly fashion in order not to miss anyone. They must not fall into the trap of darting back and forth from one patient to another based on how bad their injuries look or how loudly they cry out for help. Nor can they afford to be stuck helping any one patient. The total time spent assessing any one patient should not exceed 60 seconds. A common approach is to "sweep" the area from one side to the other rather than piercing right down the middle. This will assist teams that follow in an orderly flow of triage and/or treatment.

The first thing to assess when checking a patient is breathing or respiration. If the patient is breathing, the breathing rate needs to be assessed. If respirations are greater than 30 per minute, it indicates that the patient is in distress. The patient receives a red "immediate" tag. If respirations are less than 30 per minute, the rescuer can continue on to monitor perfusion.

If the patient is not breathing at all, he/she will fit into the black "deceased" category. The only treatment that may be applied at this stage is to open the airway if it is not already open. The rescuer can try repositioning the head or clearing an obstruction from the mouth. If that does not work, the patient is assumed dead and the rescuer can go on to the next patient. If the patient begins to breathe, he/she should be tagged as an immediate priority.

The capillary refill test is used to evaluate whether or not the patient is getting adequate perfusion. The rescuer should blanch a nail bed and look to see how quickly it regains color. If it takes more than two seconds, it indicates that the patient is not getting adequate perfusion and should be tagged as "immediate." If normal color returns within two seconds, the rescuer can continue on to evaluate mental status. If the patient is wearing nail polish, the rescuer can blanch the fingertips instead.

If the lighting levels are poor, making it difficult to see, response personnel can check radial pulse instead. If the radial pulse is not palpable, it indicates that the systolic blood pressure is below 80 and the patient should be tagged as "immediate." If the pulse is palpable, the rescuer should go on to the next step.

The final vital sign to check in the START system is mental status. If the patient is unable to follow simple commands, his or her mental status is considered to be altered. The patient should be tagged as "immediate." If the mental status is normal, the patient falls into the yellow "delayed" category.

The table below provides a quick overview of how to categorize casualties based on vital signs. It is important to realize that the patient is categorized as "immediate" as soon as he or she fits any one of the criteria. It is not necessary to go all the way through the entire assessment.

### ***Categorizing Casualties Based on Vital Signs***

Vital Sign	Immediate (Red Tag)	Delayed (Yellow Tag)
Respiration	>30 per minute	<30 per minute
Perfusion	Capillary refill >2 seconds or pulse not palpable	Capillary refill <2 seconds or pulse palpable
Mental Status	Altered (Inability to follow simple commands)	Normal

The START system provides a quick method of triaging casualties into specific categories in order to facilitate treatment. However, a patient may move from one category to another throughout the duration of an incident. For example, a patient who is initially tagged as "delayed" may be upgraded to "immediate" if his/her condition begins to deteriorate. The patient may also be downgraded if further assessment demonstrates that the initial assessment was incorrect or the patient's condition has improved. When a patient is upgraded, it is simply a matter of tearing off the appropriate tag so that the proper tag is displayed. When the patient is downgraded, it presents a more complex problem, because the appropriate colored tag has already been removed. In this situation, the existing tag should be stripped of all the colored tags. Then a new tag should be attached to the patient with the appropriate category identified by the colored tag. The old tag should be left with the new tag to avoid the possibility of confusion with the numbers that are identified on the tags.

### **Rapid Treatment**

Once again, remember that triage is designed to quickly assess and prioritize casualties. Actual emergency care is usually not started until after all casualties have been triaged. However, there are a few rapid treatment procedures that may be applied as rescuers sort through the casualties. If a patient

is not breathing, the rescuer should quickly open the airway by repositioning the head or removing obstructions in the mouth. In some cases, this may be sufficient to allow the patient to start breathing again. Due to the complexity of the situation and the number of casualties, it may be necessary to ignore usual spinal precautions, but take this into consideration whenever possible.

The rescuer can also take some simple measures to control bleeding. These may include having the patient or one of the walking wounded apply direct pressure to the wound, or trying a quick bandage over the wound. The patient's legs may be raised to combat shock and maximize perfusion to the brain and vital organs.

**Summary**

Emergency response personnel frequently encounter situations where it becomes necessary to triage multiple casualties and determine priorities for treatment. The goal of triage is to do the greatest good for the greatest number of casualties while making efficient use of personnel, equipment, and facilities. The START system provides a simple method that can be implemented quickly by the first responders. Triage tags are used to identify casualties as "Immediate," "Delayed," "Minor," or "Deceased" based on respiration, perfusion, and mental status. With the exception of opening an airway or implementing simple measures to control bleeding, treatment is not started until after all casualties have been triaged.

**Chapter Review Questions**

1. How can rescuers quickly distinguish between casualties who may need immediate care and those who may only have minor injuries?

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2. What guideline is recommended regarding the order in which to triage casualties?

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3. Indicate the criteria to be used in categorizing casualties.

Vital Sign	Immediate (Red Tag)	Delayed (Yellow Tag)
Respiration		
Perfusion		
Mental Status		

4. What treatment measures may be implemented during the triage process?

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RETIRED CURRICULUM

### Activity 2-1-1

- TITLE:** Simple Triage and Rapid Treatment
- MATERIALS NEEDED:**
- Triage worksheet
  - Pen or pencil
- INTRODUCTION:** As a first responder to a major incident, you must be able to quickly establish priorities for a large number of victims. You must be able to deal with only the initial assessment phase, and not allow retriaging or transportation to interfere with this assessment.
- DIRECTIONS:**
1. In your group, review Module 5, Chapter 1 and the following scenario:  
*You are the first responder to an airport accident. A shuttle plane was unable to get off the ground at take-off and ran off the runway into an occupied building. You have 30 victims.*
  2. Triage the six victims assigned to your group:  
Group 1 = Victims 1-6  
Group 2 = Victims 7-12  
Group 3 = Victims 13-18  
Group 4 = Victims 19-24  
Group 5 = Victims 25-30
  3. Use the following categories:  
M = Minor  
D = Delay  
I = Immediate  
D/NS = Deceased/Nonsalvagable  
WW = Walking Wounded
  4. Fill in the shaded box on the worksheet with the correct triage category.
  5. List your reasons for triaging the victims into the categories chosen, as well as any rapid treatment you would deliver during your triage assessment.
  6. You have 15 minutes to complete the activity.
  7. Choose a spokesperson to explain your decisions.

Victim	Type Of Injury	Pertinent Information			Category	Reason	Rapid Treatment
		Respirations	Perfusion	LOC			
1	Compound fracture of right femur	32	>2 sec.	Follows commands			
2	Chest pain with difficulty breathing	34	<2 sec.	Follows commands			
3	First degree burns over 10% of body	None	<2 sec.	Unresponsive			
4	Mouth injury	33	<2 sec.	Follows commands			
5	Unable to move legs	29	<2 sec.	Follows commands			
6	No apparent injuries	28	<2 sec.	Follows commands			
7	Chest injury	31	<2 sec.	Follows commands			
8	Separated left shoulder	29	<2 sec.	Follows commands			
9	No visible wounds	None	None	Unresponsive			
10	Scalp wound	33	<2 sec.	Follows commands			
11	Head injury	29	None	Unresponsive			
12	Abdominal pain	31	<2 sec.	Confused			
13	Shrapnel impales in one eye	28	<2 sec.	Follows commands			
14	Female, 8 months pregnant, with broken lower right leg	27	<2 sec.	Follows commands			
15	Difficulty breathing	32	<2 sec.	Follows commands			

Victim	Type Of Injury	Pertinent Information			Category	Reason	Rapid Treatment
		Respirations	Perfusion	LOC			
16	No movement or response	26	<2 sec.	Unresponsive			
17	Amputated arm with bleeding controlled	29	<2 sec.	Follows commands			
18	Large head wound	None	None	Unresponsive			
19	Skin abrasions	28	<2 sec.	Follows commands			
20	Bruise on back of head; blood in the ears and nose	29	<2 sec.	Confused			
21	Third degree burns over both anterior legs	29	<2 sec/	Follows commands			
22	Compound fracture of left femur	26	<2 sec.	Follows commands			
23	Rebar impaled in the back	20	>2 sec.	Follows commands			
24	First degree burns on arms	34	<2 sec.	Follows commands			
25	Broken nose	28	<2 sec.	Follows commands			
26	8-month-old infant with no movement	None	None	Unconscious			
27	Object impaled in leg; difficulty breathing	36	>2 sec.	Follows commands			
28	Laying on ground with slurred speech	26	<2 sec.	Confused			
29	Arterial bleed from arm injury	28	>2 sec.	Follows commands			
30	Patient with leg pain	29	>2 sec.	Confused			

## Topic 2-2: ICS and EMS Multi-Casualty

Slide 1

**MEDICAL EMERGENCY CONDITIONS**

- ◆ Acts of nature
  - ◆ Floods, earthquakes, etc.
- ◆ Airplane crashes
- ◆ Large fires
  - ◆ High-rise, wildland, etc.
- ◆ Hazardous materials incidents

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Slide 2

**MUTUAL AID DEFINED**

Agreements intended to establish systematic sharing of emergency resources by all fire departments within the region or state

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Slide 3

**TYPES OF EMERGENCIES**

- ◆ Expanded Medical Emergency
  - ◆ Exceeds the normal response capabilities
- ◆ Major Medical Emergency
  - ◆ Requires the access of local mutual aid resources
- ◆ Medical Disaster
  - ◆ Requires the access of county-wide mutual aid resources
- ◆ Medical Catastrophe
  - ◆ Beyond the control of the existing county resources

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Slide 4

**EXPANDED MEDICAL**

- ◆ Involves 5 to 15 patients
- ◆ Five or more critical
- ◆ Resources dependent on severity and number of patients

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Slide 5

**MAJOR MEDICAL**

- ◆ Involves 16-50 patients
- ◆ May require a medical group
- ◆ One ALS provider per 3 critical patients
- ◆ One EMT per 7 patients

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Slide 6

**MEDICAL DISASTER**

- ◆ Involves over 50 patients
- ◆ Requires one or more medical groups

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RETIRED CURRICULUM

Slide 7

**MEDICAL CATASTROPHE**

- ◆ Beyond control of existing resources
- ◆ Requires use of master **mutal aid** agreement

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RETIRED CURRICULUM

In the fire service, the incident command system is used on a daily basis for fires and other large incidents. It is just as important in a multi-casualty incident that the same proven system be utilized.

The incident command system is designed as a "management tool" for the Incident Commander (IC). This tool will assist in providing efficient and effective organization of an incident.

### **Key Factors to Consider for an Organized Fire Department Response**

The current trend in the fire service is a decrease in fire incidents and an increase in medical emergencies. In most medical related incidents, the amount of casualties involved ranges from one to five. Initial responding units normally handle these types of incidents.

Incidents that involve large multi-casualty events will usually overwhelm the initial responding resources. It is this type of incident that will require the incident commander to revert to predetermined standard operating procedures/guidelines. To handle the incident, the predetermined guidelines must provide for efficient and effective care that includes patient triage, treatment, transportation, and an organizational structure that allows for the management of complex incidents.

### **Conditions That Cause Medical Emergency Incidents**

When one thinks of some of the tragedies that have occurred in recent years, many of them have included a degree of medical-related situations. Major medical incidents are considered an ongoing threat. Examples include earthquakes, floods, acts of nature, airplane crashes, large high-rise fires, wildland fires, high occupancy fires, hazardous materials, and other related incidents.

### **Mutual Aid Agreements**

A mutual aid system is designed for the systematic sharing of emergency resources by all fire departments within a given area, region, or state. The California Mutual Aid System will be used as an example to explain the origin of a mutual aid system, and the related multi-casualty incident operational procedures.

The Emergency Services Act was established in 1970, and superseded the California Disaster Act. This act established the legal basis for the Governor's response to emergency situations with which the state might be faced.

The Master Mutual Aid Agreement is an agreement made and entered into by and between the state of California, its various departments and agencies, the various political subdivisions, municipal corporations, and other public agencies of the state of California to facilitate implementation of the "California Emergency Services Act."

The California Fire and Rescue Mutual Aid Agreement is an extension and supportive document to the Emergency Services Act. "This plan supports the concepts of the Incident Command System, the Integrated Emergency Management System (IEMS), and Multi-Hazard Response Planning," as stated in the "OES Mutual Aid Plan" handout.

## Types of Emergencies

Medical/EMS emergencies are categorized by the amount of resources needed to control the incident. In most medical emergencies, the initial responders will be sufficient to handle the incident. Sometimes, it may be necessary to request additional companies for extra equipment or personnel needs; additional transport resources may also be needed in the case of multiple casualties.

There are four categories of emergencies: expanded medical emergencies, major medical emergencies, medical disaster, and medical catastrophes.

### **Expanded Medical Emergency**

This type of medical emergency is one that exceeds the initial response capabilities of a jurisdiction. It may involve additional alarm resources or utilize specialized apparatus or equipment. An example might be multiple transport units or buses.

#### **Key Components**

- Five to fifteen patients.
- Five or more critical.
- Resources will be dependent on the number of patients in a critical state.

It may not be necessary to fill the Medical/Group Division Supervisor, but key line positions should be utilized, such as:

- Triage.
- Treatment.
- Medical communications.
- Transportation.

#### **Ideal Resource Use**

- One Advanced Life Support (ALS) and one Emergency Medical Technician (EMT) for each critical patient.
- One EMT for each three noncritical patients.
- One ALS provider as the Medical Communications Coordinator using a designated disaster tactical radio frequency.
- One or more EMT for triage.
- One ALS provider as Treatment Unit Leader.
- Law enforcement may be utilized for crowd control and morgue security.

### **Major Medical Emergency**

This type of emergency is described as one that would require the access of local mutual aid resources. Local mutual aid resources usually involve neighboring jurisdictions that have entered into pre-arranged agreements for automatic and/or mutual aid.

**Key Components**

- 16-50 patients.
- One or more medical groups.
- Strike teams, task forces, and branches may be necessary.

**Ideal Resource Use**

- Same as in expanded medical.
- One EMT per seven patients.
- All necessary ICS positions filled within each group/division.

**Medical Disaster**

This type of emergency would require the use of local mutual aid and countywide mutual aid resources.

**Key Components**

- 50 or more patients.
- One or more medical groups.
- Strike teams, task forces, and branches will more than likely be utilized.

**Ideal Resource Use**

- Same as major medical.
- Will require additional ICS positions to be utilized.
- Large numbers of transport resources (consider use of buses).

**Medical Catastrophe**

An emergency determined to be a multi-casualty incident that is beyond the control of the existing resources within a county. This would require resources from proximal counties and/or state and federal assistance. Implementation of master mutual aid would be necessary and handled by the area or region coordinator. It may also be advisable for the county or individual cities to activate their Emergency Operations Center (EOC).

**Assignment Priorities for a Multi-Casualty Incident**

The priorities for a multi-casualty incident can be broken down into four main areas: implementation of mutual aid agreements, establishing command and initial triage, communications, and staging of equipment. These priorities may vary depending on the type of emergency.

**Implementation of Mutual Aid Agreements**

If the first arriving company officer determines that the incident exceeds the capabilities of the normal initial response, additional resources/mutual aid should be requested.

## Establishing Command and Initial Triage

On arrival, the first assigned company officer should perform basic size up and establish command. Other company members will fill key ICS positions and initiate the Simple Triage and Rapid Treatment System (START). The incident commander will order additional companies to prepare the treatment area. The treatment area may be prepared by laying out salvage covers in front of the apparatus on the right and left sides, so that the engines wheels can drive along the edge of the covers to anchor them in place. After covers are anchored, company members may drape salvage covers from rig to rig with rope tie downs. The salvage covers would provide protection from the elements and help to designate each treatment area i.e., delayed, minor, immediate, and deceased.

## **Communications**

The first arriving ALS unit should split crewmembers into the Treatment Unit Leader and the Medical Communications Coordinator (Med Com). Med Com will establish communications with the appropriate coordinating medical agency hospital alert system, using the designated disaster tactical radio frequency. An example of this would be the Hospital Emergency Administrative Radio System (HEAR) in California. The communications unit will set up in an area that will allow for an efficient exchange of information with the transportation group.

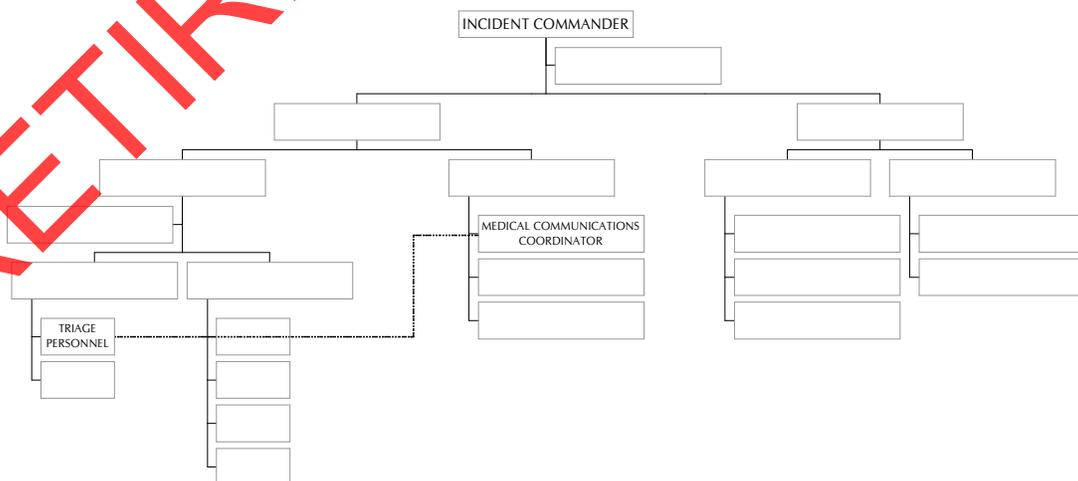
## **Staging of Equipment**

Staging areas for ambulances/transportation resources should be located in an area that will allow for an orderly flow from the staging area to the treatment area. Engines, trucks, and other units should be staged in a separate area that will not impede patient transportation.

## Multi-Casualty ICS Flow Charts

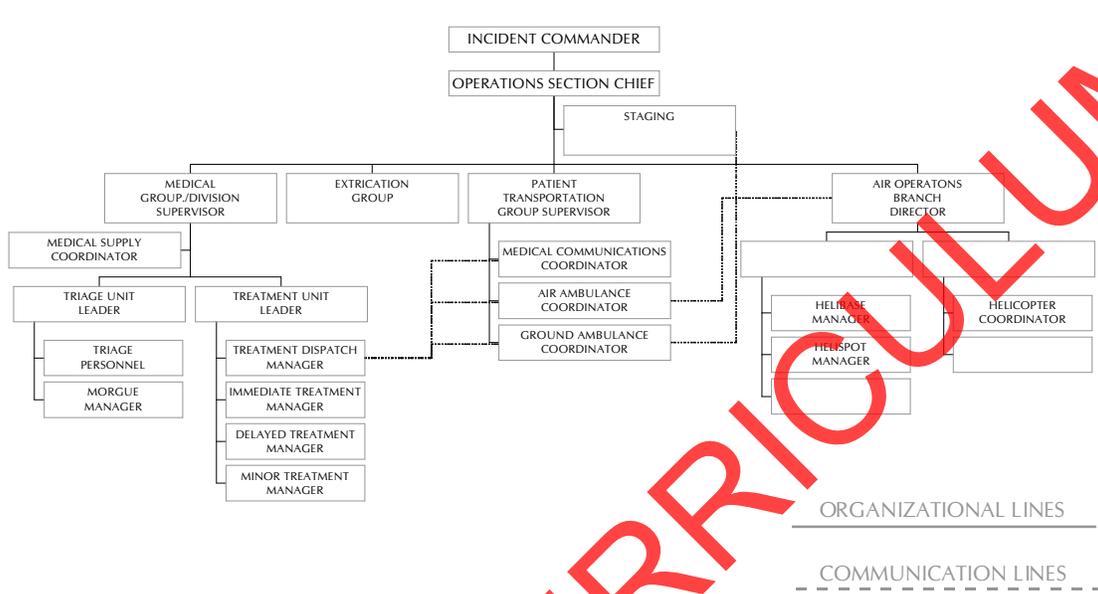
The following charts illustrate the "modular development" of a typical multi-casualty incident. It is essential that the student understand that the MCI ICS organization is expanded as needed.

## **Initial Response**

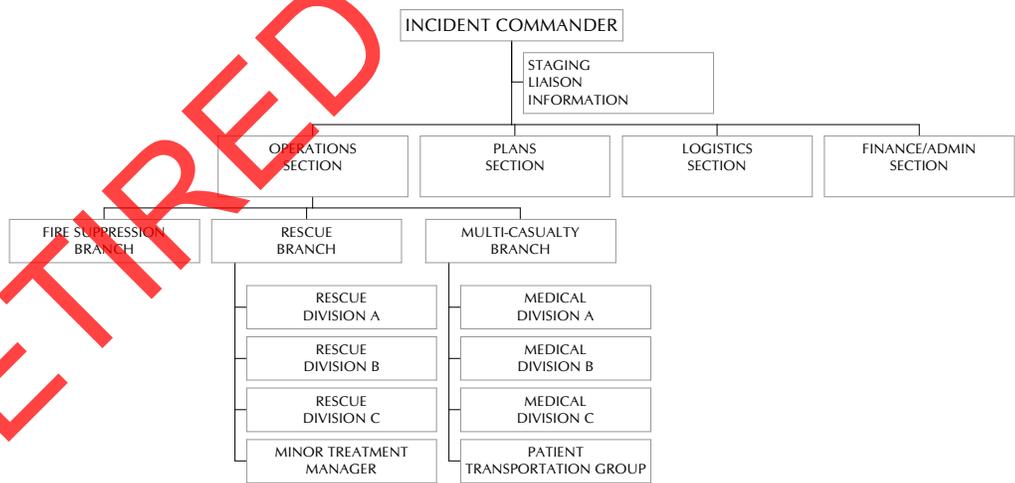




### Multi-Group Response



### Multi-Branch Response



## Multi-Casualty ICS Tactical Worksheet

Tactical worksheets are a very useful resource for the IC. They may be utilized to serve many functions, such as: checklist for incident activities, resource status, situation status, incident history, and a graphic representation of the incident.

Another benefit of the tactical worksheet is in the transfer of command process. The worksheet will provide valuable incident documentation for the arriving IC that may be referenced for a "seamless" transfer of command.

The following sample tactical worksheet illustrates one of its many uses.

<b>LOCATION:</b>		<b>RESOURCES</b>					<b>INCIDENT TYPE: Multi-Casualty/Annex D</b>		<b>STRATEGIC/TACTICAL PRIORITIES</b>			
INC#:	TOC:	<b>STRIKE TEAMS</b>					NOTES/SKETCHES:		<input type="checkbox"/> STABILIZE SCENE			
SIZE UP (BY: )		REQ	ST#	ONS	ASSIGN	AVL			<input type="checkbox"/> ANNEX D			
<input type="checkbox"/> PERSONNEL ACCOUNTABILITY								<input type="checkbox"/> Station X				
INC. NAME:								<input type="checkbox"/> Hospitals # _____				
CP LOC: _____								<input type="checkbox"/> TRIAGE				
IC Unit: _____								<input type="checkbox"/> "Triage Complete"				
Stage LOC: _____		<input type="checkbox"/> CHIEF OFFICERS							<input type="checkbox"/> RESCUE			
Stage Unit: _____		<b>COMPANIES</b>							<input type="checkbox"/> Extrication			
CMD: _____ TAC: _____		ENR	ONS	ASSIGN	AVL			<input type="checkbox"/> Decontamination				
MED GRP: _____								<input type="checkbox"/> TREATMENT				
LOC: _____								<input type="checkbox"/> Medical Supply				
Amb Stg: _____								<input type="checkbox"/> "All Pts in Treatment"				
Air Amb LZ: _____								<input type="checkbox"/> TRANSPORT				
REHAB GP: _____								<input type="checkbox"/> Private Amb. Staging				
LOC: _____								_____ # AMB _____				
<input type="checkbox"/> Red Cross								<input type="checkbox"/> Aeromedical				
PIO: _____								_____ # Helos _____				
<input type="checkbox"/> Code "N"								<input type="checkbox"/> Loading Zone				
<b>LAW ENFORCEMENT</b>								_____ # LOC _____				
<input type="checkbox"/> Traffic								<input type="checkbox"/> Transport Buses				
<input type="checkbox"/> Evacuation								_____ # Bus _____				
<input type="checkbox"/> Secure Scene								<input type="checkbox"/> "All Pts Transported"				
<input type="checkbox"/> Morgue								<b># OF PATIENTS</b>				
<input type="checkbox"/> Station Cover								IMD	MIN	DEL	DOS	
<input type="checkbox"/> S D G & E												
<input type="checkbox"/> Water Dept								<b>RESOURCES SUGGESTED</b>				
<input type="checkbox"/> Street Dept								PTS	PM	ENG	AMB	
<input type="checkbox"/> Building Dept								5-10	2	3	3-5	
<input type="checkbox"/> Photo Support								11-15	3	5	5-7	
<input type="checkbox"/> Demobilization								16-20	3	7	7-10	
<input type="checkbox"/> Transfer Scene								21-30	3	10	10-12	
<input type="checkbox"/> Documentation								31-40	4	15	12-15	
<b>CASUALTIES</b>		FF	CIV					41-50	5	20	15-18	
Injury								51+	6	20+	19+	
Fatality												

## Summary

One of the critical elements to effective utilization of resources is a plan. The plan must be simple, easy to use, and meet the desired objectives. In the implementation of an MCI plan, it is essential to define the types/levels of emergencies, identify key resources, and provide personnel with the opportunity to practice. It is only with a thorough knowledge of the local system and available resources, that company officers can take advantage of the pre-established plan, and use it to mitigate the incident in a safe and effective manner.

## Chapter Review Questions

1. Why are predetermined standard operating guidelines important to the Incident Commander?

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2. What are the key components of the "Expanded Medical Emergency?"

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3. The "Medical Disaster" type of emergency has at least how many casualties?

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4. What is the difference between primary staging and ambulance staging as it applies to a MCI incident?

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### Topic 2-3: ICS-MCI Implementation Overview

Slide 1

**BENEFITS**

...OF STANDARDIZED INCIDENT  
MANAGEMENT SYSTEM

- ◆ Common procedures
- ◆ Common organization
- ◆ Common terminology

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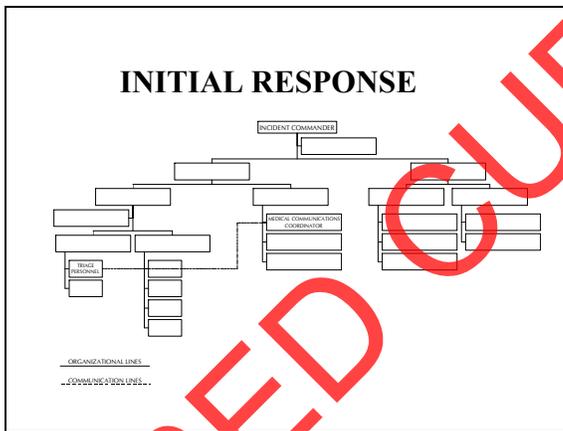
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Slide 2




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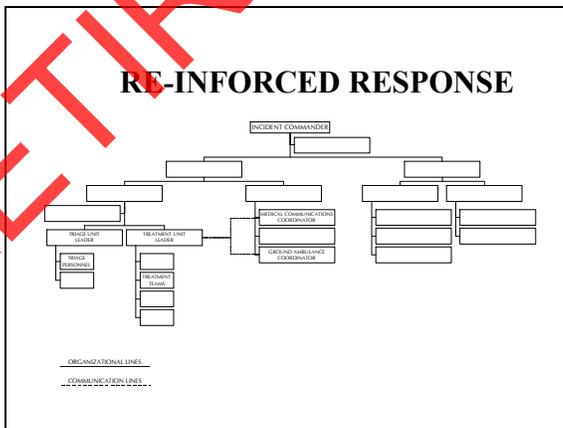
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Slide 3




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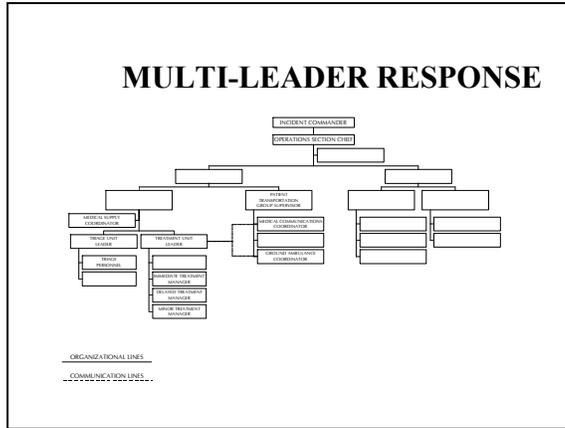
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Slide 4




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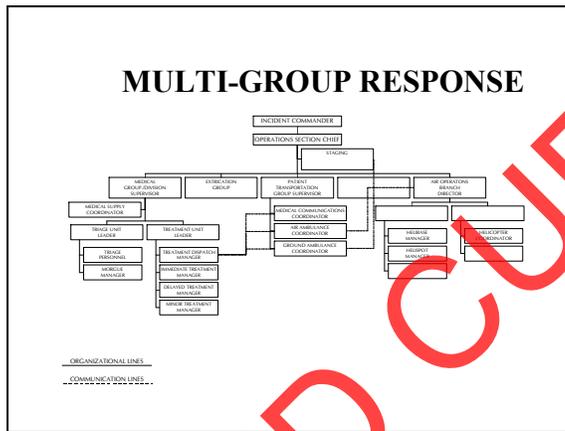
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Slide 5




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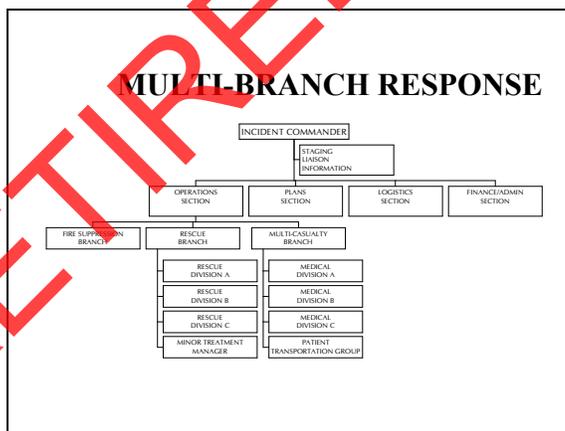
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Slide 6




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The Incident Command System was developed as an organizational tool to assist in the management of incidents. It allows a great deal of flexibility to develop from the simple to the complex. This system allows for common procedures, common organization, and common terminology. The multi-casualty branch shares the same theory as other components of the incident command system. The following is a guide to be used when implementing the multi-casualty branch of the system (company resources have been identified with a minimum staffing of three positions).

This guideline was developed using the "modular development" section in FIREScope's Field Operations Guide (ICS 420-1) and may differ slightly from local policies and procedures.

## **Modular Development**

### **First Company**

The first arriving company will need to split up and assume the following positions:

#### ***Captain (Company Officer)***

The company officer will assume the position of Incident Commander (IC). The IC should establish a Command Post (CP) close to the scene, but not in an area that could be hazardous. The IC should consider:

#### ***Equipment and Personnel Needs***

- Hose lines for fire protection and/or crew safety
- Tools and ladders for access
- Availability for radio use or public broadcasting

The IC will perform size-up and request additional resources and/or specialized resources. The IC should declare the incident to be a multi-casualty incident when there are five or more significant injuries (or otherwise specified by local policies and procedures). Rule of thumb: declare MCI whenever the emergency exceeds normal response capabilities, and is severe enough to require the use of a streamlined mode of operations to assure proper patient care.

The engineer/apparatus operator will assume the position of Triage Unit Leader. Initial triage should focus on an immediate estimation of the severity and number of casualties involved. The Triage Unit Leader should always start the triage process by asking all those patients that can, to walk to a designated area (walking wounded). Identify a civilian with first-aid training and utilize that person as the initial Minor Treatment Manager. As with most incidents, the Triage Unit Leader will initially be involved in actual triage with limited managerial function, until the arrival of additional resources. As additional resources arrive, the Triage Unit Leader will report to the Medical Group Supervisor (MGS) and utilize the additional resources to assist with triage of all casualties.

### **First Ambulance (ALS)**

The first ambulance unit should be split into two positions: the Medical Communications Coordinator and the Treatment Unit Leader. The Medical Communications Coordinator reports to the Patient Transportation Group Supervisor and is responsible for establishing communications with the hospital

alert system or the designated medical facility, to assure proper patient transportation and destination. The other position, the Treatment Unit Leader, reports to the MGS/IC. This position is responsible for supervising the Treatment Dispatch Manager and the Immediate, Delayed, and Minor Treatment Managers.

### **First Chief Officer (Incident Commander)**

The first chief officer obtains a briefing and assumes the position of IC. The IC establishes a Command Post (CP) in an advantageous position of operation that will not interfere with overall operations. The IC coordinates the suppression branch activities with the medical branch activities and develops the incident command system to meet the needs of the incident. Overall, scene management is the responsibility of the IC. The previous IC should be appointed the position of Operations Chief or MGS.

### **Second Company**

The second-in officer will assume the Patient Transportation Group Supervisor. The other company members will assist in filling the immediate, minor, and delayed Treatment Managers, or assist in the triage area if needed.

### **Third Company**

The third-in officer will assume the position of Triage Unit Leader. This transfer should include a briefing from the current Triage Unit Leader, notification to MGS or IC, and a current status report. The additional company members should be utilized to start moving patients to the treatment area.

### **Second Ambulance**

One individual should assume the Ground Ambulance Coordinator. The other should assume the Medical Supply Coordinator. The Ground Ambulance Coordinator reports to the Patient Transportation Group Supervisor, and manages the ground ambulance staging area and dispatches ambulances as requested. The Medical Supply Coordinator reports to the MGS, and acquires and maintains control of appropriate medical equipment and supplies from units assigned to the medical group.

### **Fourth Company**

The fourth-in officer assumes the position of Treatment Dispatch Manager. The Treatment Dispatch Manager reports to the Treatment Unit Leader and is responsible for coordinating with the Patient Transportation Group, and the transportation of patients out of the treatment area.

### **Third Ambulance**

The third ambulance should be utilized to start transporting patients to the identified hospital. Rule of thumb, the most severely injured should be taken to the closest hospital facility. An air ambulance can also be utilized; in this case, it would be appropriate to take the most severely injured to a further hospital facility.

## Additional Companies/Resources

Additional resources should be utilized to fill other ICS multi-casualty positions as the incident develops.

## Sample "Priority of Assignment" Guideline/Procedure

Having an established guideline/procedure for handling major multi-casualty incidents will give fire departments a tremendous advantage should such an incident occur in their jurisdiction. Utilization of the concepts developed in the Incident Command System will provide fire department personnel with operational procedures. The following example identifies priorities of assignments for arriving units in a multi-casualty incident. *This example was developed from the information provided in the "modular development" section of FIRESCOPE's Field Operations Guide (ICS 420-1).*

### **First Company:** Assumes Incident Command and Initiates Initial Triage

Positions near the scene for equipment needs. Captain established command by radio. Captain determines if incident exceeds normal first response capabilities. Captain reports a "multi-casualty incident" if there are five or more significant injuries and requests appropriate resources.

Company standard of three personnel: Captain shall assume the position of IC/MGS. The captain will assign engineer as Triage Unit Leader with fire fighter assisting in triage, applying the START principles and procedures.

Captain should be thinking about the following priorities: Treatment area for immediate, delayed, and minor patients, Traffic plan for the fire apparatus for medical supply; and a separate traffic plan for ambulances.

### **First Ambulance:** Assumes Treatment Unit Leader and Medical Communications Coordinator

One person to assume Treatment Unit Leader and establish immediate, delayed and minor treatment areas based on the severity of the incident. Obtain information from IC/MGS for location. Establishes treatment area with salvage covers or occupies building space appropriate for incident. Coordinate with resources assigned to establish and build-up treatment teams, if necessary. Utilize ambulance for initial medical supply, equipment, and resources as needed. Other crewmember to assume Medical Communications Coordinator. Responsibilities include establishing communications with designated hospital or hospital alert system and coordination of proper patient transportation and destination. This person/position can utilize an ambulance or an apparatus having the communication capabilities that meets the requirements of the designated disaster control hospital.

### **Battalion Chief:** Assumes Incident Command

Receives briefing from the present IC/MGS by face to face or radio and assumes the IC. Battalion Chief establishes CP (in advantageous position or operation). First Company Officer becomes Operations or MGS.

### **Second Company:** Assumes Patient Transportation Group Supervisor

Establishes transportation unit and assumes the position of Patient Transportation Group supervisor. This position should be located at or near the treatment area. This position supervises the Medical Communications Coordinator and directs the transportation of patients to designated hospitals, as determined by the Treatment Unit Leader. Additional personnel assist in triage or assume positions treatment managers.

### **Third Company:** Assumes Triage Unit Leader

Apparatus positions at treatment area if needed for set-up. Captain and crew report to triage area. Captain will obtain report from the Triage Unit Leader and assumes position of Triage Unit Leader by advising MGS or Operations. Crew becomes additional triage teams, if needed, otherwise initiate movement of patients from impact area to appropriate treatment areas.

### **Fourth Company:** Assumes the Treatment Dispatch Manager

Apparatus positions at treatment area if needed for set-up. Captain assumes Treatment Dispatch Manager; remaining crew reports to Triage Unit Leader to initiate/assist movement of patients from impact area to appropriate treatment areas. The Treatment Dispatch Manager communicates with the Ground and Air Ambulance Coordinators and Medical Communications Coordinators as well as the Treatment Managers to prioritize patients for transportation.

### **Second Ambulance:** Assumes the Ground Ambulance Coordinator and Medical Supply Coordinator

One person will assume the Ground Ambulance coordinator in the transportation group. This position will coordinate with the Treatment Dispatch Manager and Staging Manager to supervise the ground ambulances/transportation resources for patient transport. Ground transportation resources for patient transport. Ground transportation resources may include busses, vans, or other similar vehicles.

### Additional Companies

Will position in traffic plan for medical strip of all medical supplies and equipment. After medical strip is complete, crew will have three options as determined by Medical Group Supervisor, Operations, or Incident Commander.

First option is being assigned to the medical group. Personnel may be assigned by the Medical Group Supervisor to assist in other ICS positions, i.e., Morgue Unit Leader, Air Ambulance Coordinator, etc. apparatus should be parked at Incident Base, and assigned as requested.

Second option is being assigned to operations for an assignment in divisions or groups as needed for fire suppression, light, moderate, or heavy rescue or other incident command positions as needed.

Third option is being assigned to staging or base for availability.

### Additional Ambulances

Will position in medical traffic plan for ambulance staging. Ambulances will be utilized for transport and medical supplies.

**Overhead:** As requested By Incident Commander

**Second Chief Officer:** Reports to the Incident Commander for briefing and then proceeds to Operations to assume Operations Chief.

**Third Chief Officer:** Reports to the Incident Commander for briefing and establishes Logistics in position of best operation. Report location to Incident Command.

**First Chief Executive Officer:** Receives briefing from the IC (face to face) and assumes incident command. First Battalion Chief now becomes plans located in the command post.

NOTE: If this transfer takes place earlier in the incident, the first Battalion Chief still goes to plans. The BC's knowledge of objectives, company assignments, and activities will be invaluable to the new IC.

### Ambulance Staff Personnel

Report to IC to establish a unified command operation. Positions for unified command may involve MGS, Operations depending upon fire suppression activities, and IC if all resources are committed solely to fire suppression-type activities. Ambulance staff may also be valuable in the command staff in the liaison position.

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## Topic 2-4: Multi-Casualty ICS Positions

Although the ICS positions for a multi-casualty incident are not used as frequently as typical "fire" incidents, it does not mean they are any less important. In fact, it is for that reason that these positions be understood and reviewed on a regular basis. As with some of the other ICS positions, the MCI positions are very specific in nature, i.e., wildland, urban search and rescue, swiftwater, etc. Personnel may be utilized to fill positions at a moment's notice; a thorough understanding is essential for efficient and effective incident control.

The following sections identify the functions of the positions that are identified in multi-casualty ICS.

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### **Medical Group Supervisor**

Definition: Qualified Group Supervisor

Supervised By: Branch Director

Subordinates: Triage Unit Leader, Treatment Unit Leader, and Medical Supply Coordinator

Function: Establish command and control the activities within a Medical Group in order to assure the best possible emergency medical care to patients during a multi-casualty incident.

### **Duties**

1. Receive briefing from Branch Director
2. Establish and supervise a Medical group at a level of personnel and other resources sufficient to handle the magnitude of the incident.
3. Designate officers and Patient Treatment Area locations as appropriate. Isolate Morgue and Minor Treatment Areas from Immediate and Delayed Treatment Areas.
4. Ensure law enforcement/coroner involvement as necessary.
5. Ensure activation of the hospital alert system, local EMS, or local health.
6. Determine amount and types of additional medical resources and supplies, e.g. medical caches, ambulances, helicopter, and other methods of patient transportation.
7. Establish coordination with Patient Transportation Group Supervisor.
8. Direct and/or supervise on-scene personnel from agencies such as Coroner's Office, Red Cross, law enforcement, ambulance companies, county health agencies, hospital volunteers.
9. Ensure that proper security, traffic control, and access have been established for the Medical Group Division area.
10. Direct other medically trained personnel to the appropriate Unit Leader.
11. Maintain Unit Log. (ICS-214)

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## **Triage Unit Leader**

Definition: Qualified Unit Leader

Supervised By: Medical Group Supervisor

Function: Assume responsibility for providing triage management and movement of the patients from the triage area. When triage has been completed, the Unit Leader may be reassigned as needed.

### **Duties**

1. Receive briefing from Medical Group Supervisor.
2. Report to designated on-scene triage location.
3. Acquire medical supplies from the Medical Supply Coordinator for the triage areas. Examples: backboards, stretchers, triage tags, etc.
4. Coordinate with Treatment Unit Leader to assure that the patient is delivered to the correct treatment area.
5. Maintain security and control of the triage area.
6. Maintain Unit Log. (ICS-214)

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## **Triage Personnel**

Definition: Medically qualified personnel

Supervised By: Triage Unit Leader

Subordinates: Triage Team Assigned Personnel

Function: To triage patients on-scene and assign them to appropriate treatment areas.

### **Duties**

1. Receive briefing from Triage Unit Leader.
2. Report to designated on-scene triage location.
3. Triage and tag injured patients. Classify patients while noting injuries and vital signs if taken.
4. Direct movement of patients to proper Treatment Areas.
5. Provide appropriate medical treatment (ABCs) to patients prior to movement as incident conditions dictate.

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## **Treatment Unit Leader**

Definition: Qualified Unit Leader

Supervised By: Medical Group Supervisor

Subordinates: Treatment Dispatch Manager, Immediate Treatment Manager, Delayed Treatment Manager, and Minor Treatment Manager

Function: Assume responsibility for treatment, preparation for transport and coordination of patient treatment in the Treatment Areas. Direct movement of patients to loading location(s).

### **Duties**

1. Receive briefing from Medical Group Supervisor.
2. Implement, direct, and supervise Treatment Dispatch Manager, Immediate, Delayed, and Minor Treatment Areas.
3. Request sufficient Medical Teams and qualified emergency medical personnel to staff Treatment Areas.
4. Coordinate patient movement from triage area to treatment areas with Triage Unit Leader.
5. Request caches and medical supplies as necessary.
6. Ensure that communication and coordination has been established with Patient Transportation Group.
7. Maintain triage assessment of patients throughout Treatment Areas.
8. Assure appropriate use of all other medical personnel assigned to the Treatment Areas.
9. Direct movement of patients to loading location(s).
10. Maintain Unit Log. (ICS-214)

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## **Immediate Treatment Manager**

Definition: Qualified Manager

Supervised By: Treatment Unit Leader

Subordinates: Medical Teams

Function: Responsible for treatment and re-triage of patients assigned to Immediate Treatment Area.

### **Duties**

1. Receive briefing from Treatment Unit Leader and brief subordinates.
2. Request or establish Medical Teams as necessary.
3. Assign treatment personnel to patients received in the Immediate Treatment Area.
4. Treatment of patients triaged to the Immediate Treatment Area.
5. Assure that patients are prioritized for transportation.

6. Coordinate transportation of patients with Treatment Dispatch Manager.
7. Assure that appropriate patient information is recorded.
8. Notify Treatment Dispatch Manager of patient readiness and priority for transportation.

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### **Delayed Treatment Manager**

Definition: Qualified Manager  
Supervised By: Treatment Unit Leader  
Subordinates: Medical Teams  
Function: Responsible for treatment and re-triage of patients assigned to Delayed Treatment Area.

#### **Duties**

1. Receive briefing from Treatment Unit Leader and brief subordinates.
2. Request or establish Medical Teams as necessary.
3. Assign treatment personnel to patients received in the Delayed Treatment Area.
4. Treatment of patients triaged to the Delayed Treatment Area.
5. Assure that patients are prioritized for transportation.
6. Coordinate transportation of patients with Treatment Dispatch Manager.
7. Assure that appropriate patient information is recorded.
8. Notify Treatment Dispatch Manager of patient readiness and priority for transportation.

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### **Minor Treatment Manager**

Definition: Qualified Manager  
Supervised By: Treatment Unit Leader  
Subordinates: Medical Teams  
Function: Responsible for treatment and re-triage of patients assigned to Minor Treatment Area.

#### **Duties**

1. Receive briefing from Treatment Unit Leader and brief subordinates.
2. Request or establish Medical Teams as necessary.
3. Assign treatment personnel to patients received in the Minor Treatment Area.
4. Treatment of patients triaged to the Minor Treatment Area.
5. Assure that patients are prioritized for transportation.
6. Coordinate transportation of patients with Treatment Dispatch Manager.
7. Assure that appropriate patient information is recorded.
8. Notify Treatment Dispatch Manager of patient readiness and priority for transportation.

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## **Medical Teams**

Definition: Qualified Personnel with Supervision

Composition: Medical Teams

Type I: 2 ALS plus 3 BLS Responders

Type II: 2 ALS Responders

Type III: 3 BLS Responders

Note: Medical Team Type refers to qualification of personnel only. It does not refer to means of transportation, equipment, or ability to transport patients. "ALS Company" or "BLS Company" includes qualified personnel and appropriate equipment to qualify as an ALS or BLS Company.

Supervised By: Assigned Manager/Unit Leader

Subordinates: Assigned personnel or volunteers

Function: Responsible for treatment and/or triage of patients as assigned.

### **Duties**

1. Receive briefing.
2. Perform triage and treatment as assigned.
3. Record patient information on triage tags.
4. Report changes in patient status to appropriate assigned Manager/Unit Leader.

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## **Patient Transportation Group Supervisor**

Definition: Qualified Manager

Supervised By: Medical Branch Director

Subordinates: Medical Communications Coordinator, Air Ambulance Coordinator, and Ground Ambulance Coordinator

Function: Coordination of patient transportation and maintenance of records relating to patient identification, injuries, mode of off-incident transportation and destination.

### **Duties**

1. Receive briefing from Medical Group Supervisor.
2. Establish hospital communications.
3. Designate an ambulance staging area.
4. Direct the transportation of patients as determined by Treatment Unit Leader(s).
5. Assure that patient information and destination is recorded.
6. Assure communication with Ambulance Coordinator(s).
7. Request additional ambulances, as required.

8. Notify Ambulance Coordinator(s) of ambulance requests.
9. Coordinate requests for air ambulance transportation through the Air Operations Director.
10. Establish air ambulance helispot with the Multi-Casualty Branch Director and Air Operations
11. Maintain Unit Log. (ICS-214)

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### **Medical Communications Coordinator**

Definition: Qualified Coordinator  
Supervised By: Patient Transportation Group Supervisor  
Subordinates: Transportation Recorder and personnel as required  
Function: Maintain communications with the hospital alert system and/or other medical facilities to assure proper patient transportation and destination. Coordinate information through Patient Transportation Group Supervisor and the Transportation Recorder.

#### **Duties**

1. Establish communications link with hospital alert system and/or other medical facility.
2. Determine hospital availability.
3. Receive basic patient information and injury status from Treatment Dispatch Manager.
4. Coordinate patient off-incident destination with the hospital alert system. Communicate appropriate hospital availability to Treatment Dispatch Manager.

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### **Treatment Dispatch Manager**

Definition: Qualified Person  
Supervised By: Treatment Unit Leader  
Subordinates: As needed  
Function: Responsible for coordinating with Patient Transportation Group Supervisor, the transportation of patients out of the Treatment Area.

#### **Duties**

1. Receive briefing from Treatment Unit Leader.
2. Establish communications with the Immediate, Delayed, and Minor Treatment Managers
3. Establish communications with Patient Transportation group Supervisor.
4. Assure that patients are prioritized for transportation.
5. Coordinate transportation of patients with Medical Communications Coordinator.
6. Assure that appropriate patient information is recorded.
7. Advise patient Transportation Group Supervisor of patient priority for transportation.
8. Coordinate ambulance loading with Treatment Manager and ambulance personnel.

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## **Air/Ground Ambulance Coordinator**

Definition: Qualified Personnel with Supervision  
Supervised By: Patient Transportation Group Supervisor  
Subordinates: Transportation Recorder and personnel as required  
Function: These positions supervise and manage the Air/Ground Ambulance Staging Areas and dispatch ambulances as necessary.

### **Duties**

1. Establish appropriate staging areas for ambulance.
2. Establish routes of travel for ambulances for incident operations.
3. Establish and maintain communications with the Air Operations Branch Director.
4. Establish and maintain communications with the Medical Communications Coordinator and Treatment Dispatch Manager. Provide ambulances upon request from the Medical Communications Coordinator.
5. Maintain records as required.
6. Assure that necessary equipment is available in the ambulance for patient needs during transportation.
7. Establish immediate contact with ambulance agencies at the scene.
8. Request additional transportation resources as appropriate.
9. Provide an inventory of medical supplies available at the ambulance staging area for use at the scene.

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## **Medical Supply Coordinator**

Definition: Qualified Personnel as assigned  
Supervised By: Medical Group Supervisor  
Subordinates: Personnel as required  
Function: Acquire and maintain control of appropriate medical equipment and supplies from units assigned to the Medical Group.

### **Duties**

1. Receive briefing from Medical Group Supervisor
2. Acquire, distribute, and maintain status of medical equipment and supplies within the Medical Group.
3. Request additional medical supplies (medical caches) as needed through the Medical Group Supervisor.
4. Coordinate medical supplies with Treatment Manager(s).

Note: If Logistics Section were established, this position would report to and receive direction from the Supply Unit Leader.

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## **Morgue Manager**

Definition: Qualified Personnel as assigned.  
Supervised By: Triage Unit Leader  
Subordinates: Personnel as required  
Function: Assume responsibility for Morgue Area activities until relieved of that responsibility by Law Enforcement/Office of the Coroner.

### **Duties**

1. Receive briefing form Triage Unit Leader.
2. Coordinate all Morgue Area activities.
3. Keep area off limits to all personnel except those needed.
4. Coordinate with law enforcement and assist the Coroner's Office as necessary.
5. Keep identity of deceased patients confidential.
6. Maintain records, including deceased identity (if available), where the deceased was found, etc.

### **Summary**

As discussed in Fire Command 1A, the Incident Command System is best identified as an incident management system. Although it is designed to be an "all risk" system, some of the terminology is incident specific. The development of the Multi-Casualty Branch and all its components can be convoluted and require numerous personnel. It is essential that fire fighters and EMS personnel understand the critical positions and their functions. These positions must be utilized in an effective and efficient manner to provide for the orderly and rapid triage and transportation of all injured patients.

### **Chapter Review Questions**

1. The first ALS ambulance unit should be split into which medical group ICS positions?

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2. What are the benefits of using a tactical worksheet?

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3. When is it appropriate to establish the Multi-Casualty Branch Director?

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## Case Study #2-1: Multi-Casualty Vehicle Accident

### Facts Known Prior to the Emergency

The intersection involved is controlled by a two-way stop sign. The side street (Elm Lane) is a two-lane residential street with a 25-mph speed limit. The other street (Spruce Parkway) is commercial with many strip malls and individual business occupancies. The speed limit on Spruce Parkway is 45 mph with four lanes and a center turn lane.

### Information Upon Dispatch

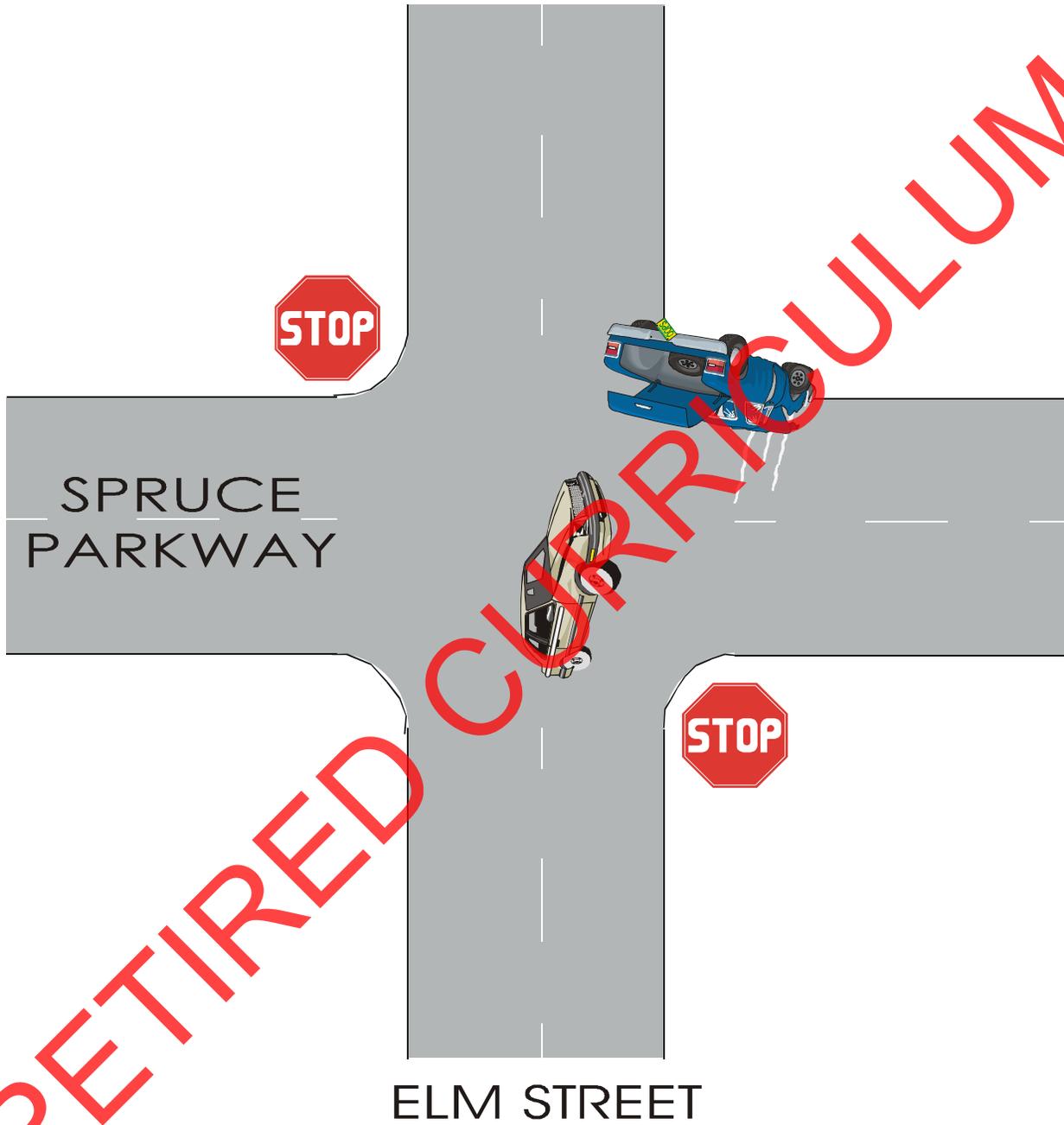
The emergency is reported as a traffic accident with rollover. This will bump up the usual "vehicle accident" response to a "rescue response." The time is 0745 on a Monday morning. The weather is foggy with slight drizzle. The initial response will be one engine, one truck, one medic unit, and one Chief Officer.

### Observed Upon Arrival

Upon arrival, the first-in engine finds two passenger vehicles involved. Vehicle #1 has moderate damage with four passengers still in the vehicle. Vehicle #2 has rolled over onto the passenger side with six passengers trapped in the vehicle.

*How Would You Solve This Problem?*

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## Case Study #2-2: Multi-Casualty Shooting

### Facts Known Prior to the Emergency

A medium sized public high school with six classroom complexes, a gymnasium, library, and administrative offices.

### Information Upon Dispatch

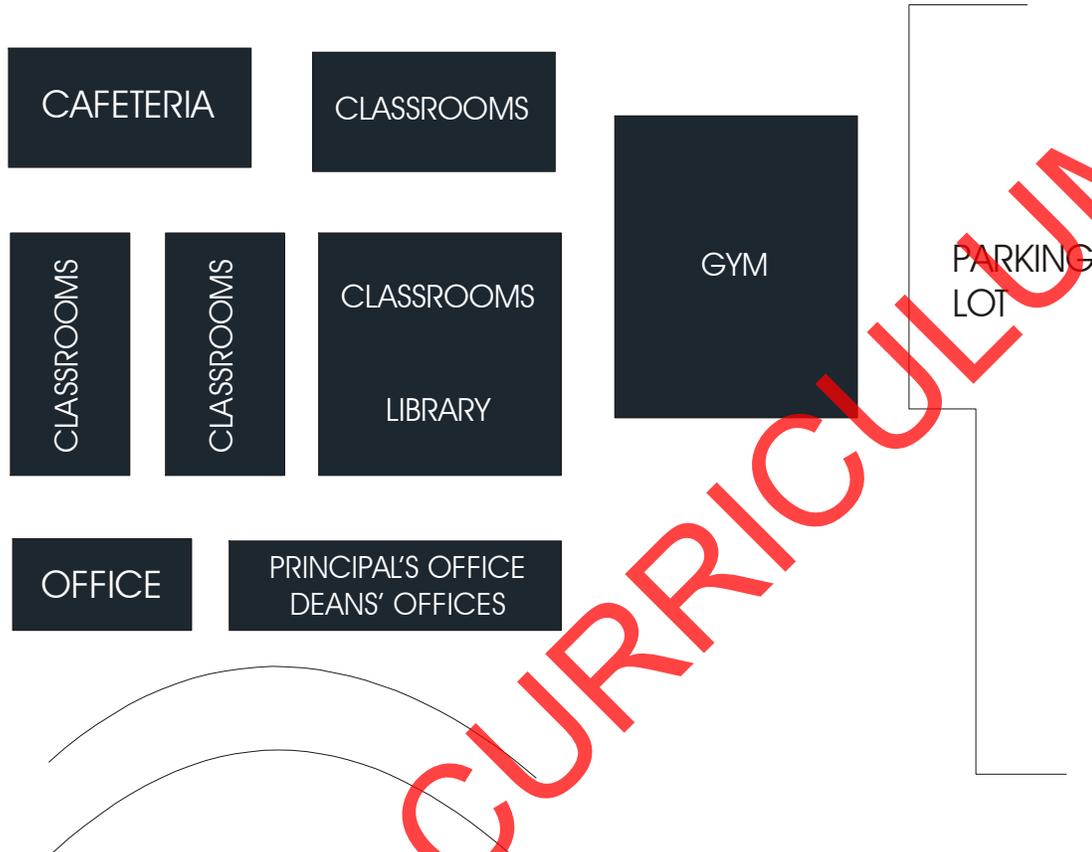
The emergency is reported as a shooting at a local high school. Dispatch has received numerous calls. School security reports that the assailant has left the scene and the scene is now secure. Security is also reporting multiple victims. The time is 1200, March 20.

### Observed Upon Arrival

The school building has been evacuated, but students are wandering everywhere. You are asked to report to the cafeteria, gym, attendance office, and library. Security cannot be found.

*How Would You Solve This Problem?*

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## Case Study #2-3: Vehicle Accident on a Bridge

### Facts Known Prior to the Emergency

The Hilltop Bridge has four lanes (two in each direction) and spans the Salmon River for approximately  $\frac{3}{4}$  of a mile. The bridge is heavily traveled during rush hour because it is the way to get to the industrial area of the city.

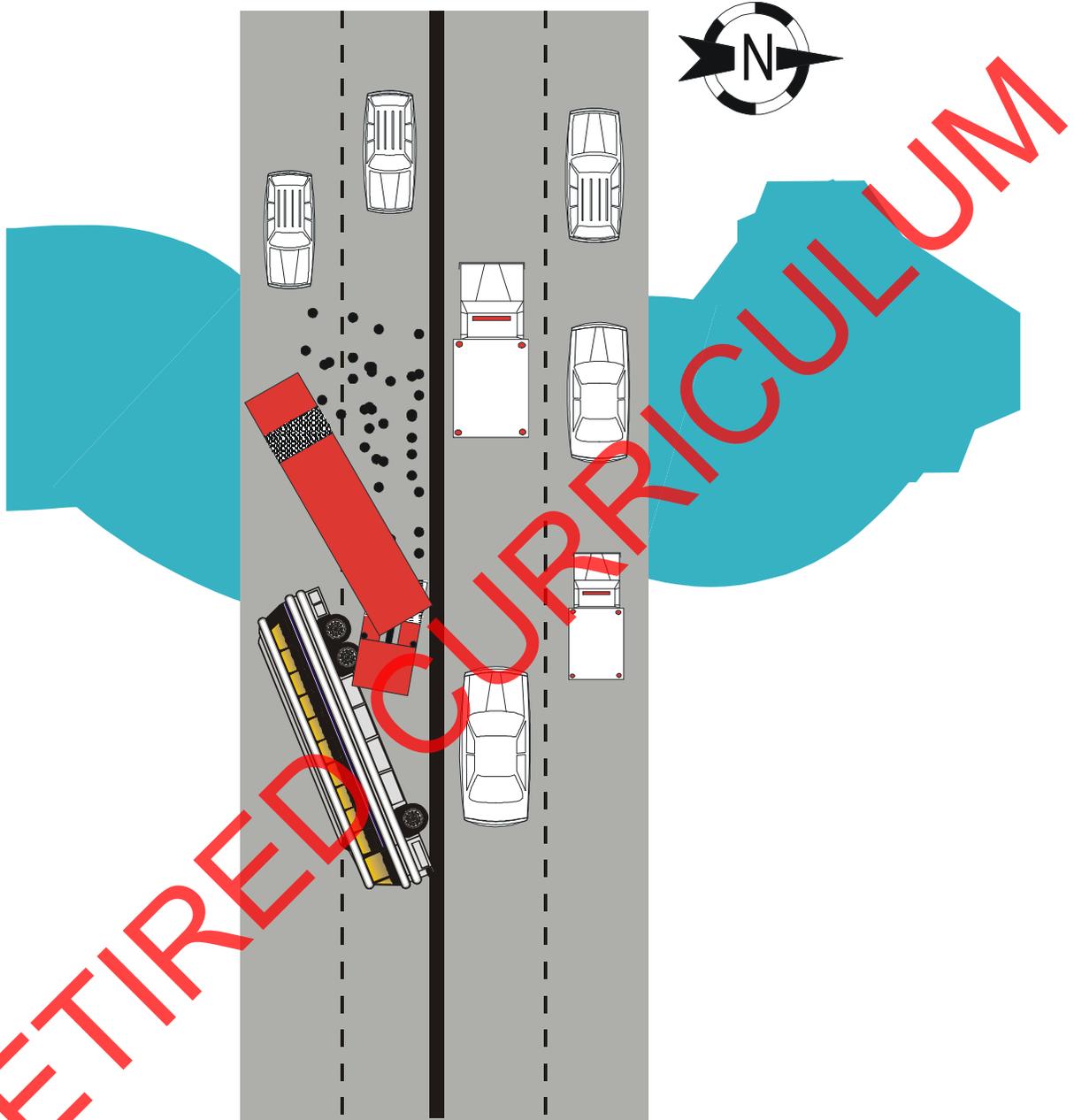
### Information Upon Dispatch

The emergency is reported as a traffic accident involving a city commuter bus and a semi-truck. The weather is cold (45°F) and rainy with heavy, thick fog. The wind is out of the west at 15-20 mph. The time is 1715 on a Friday. The initial response is one engine, one medic unit, and one Chief Officer.

### Observed Upon Arrival

Upon arrival, the first-in engine finds the bus on its side and the truck jack-knifed. The bus carries twenty-five commuters. Eight people in the first six are seriously injured. The remaining passengers are all slightly injured. The bus driver and several of the seriously injured victims require extrication from the bus. Throughout the incident, paint spilled from the damaged delivery truck is flowing onto the opposing lanes of traffic causing a severe slippage problem. Police and additional fire units are responding, but are having difficulty getting through the gridlock.

*How Would You Solve This Problem?*



## Case Study #2-4: Building Collapse/Mud Slide at a Junior High School

### Facts Known Prior to the Emergency

A small junior high school sits at the front of a large hill covered with light vegetation. The school normally holds up to 300 students and staff during an average weekday. It has been raining hard, off and on, for two weeks.

### Information Upon Dispatch

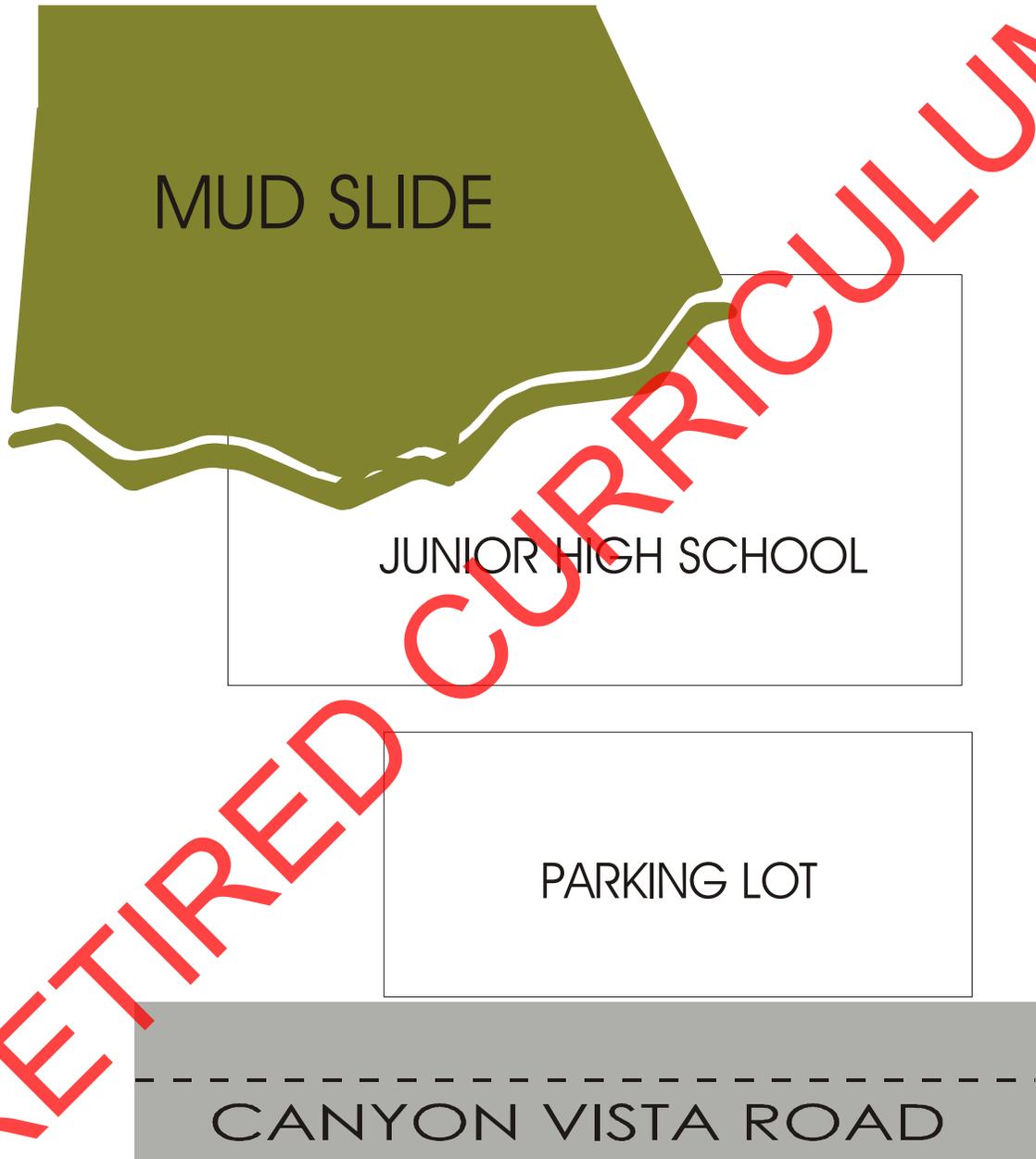
The emergency is reported as a mudslide that has covered up to half of the junior high school. Many students and staff are injured, and some others are trapped or missing. The time is 1500 hours on a cloudy day with light drizzle.

### Observed Upon Arrival

A very large number of noninjured students and adults are standing in front of the school wet and cold. The back part of the school has been badly damaged by a mudslide. You are met at the curb by the principal who tells you that about two dozen people have various injuries and four people are missing.

*How Would You Solve This Problem?*

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## Case Study #2-5: Traffic Accident with Numerous Injuries

### Facts Known Prior to the Emergency

The intersection of Miller Blvd and Jimott Street is known for major traffic collisions. Each street has four lanes; two in each direction, with a center turn lane. Left turns are controlled at the intersection by a signal light.

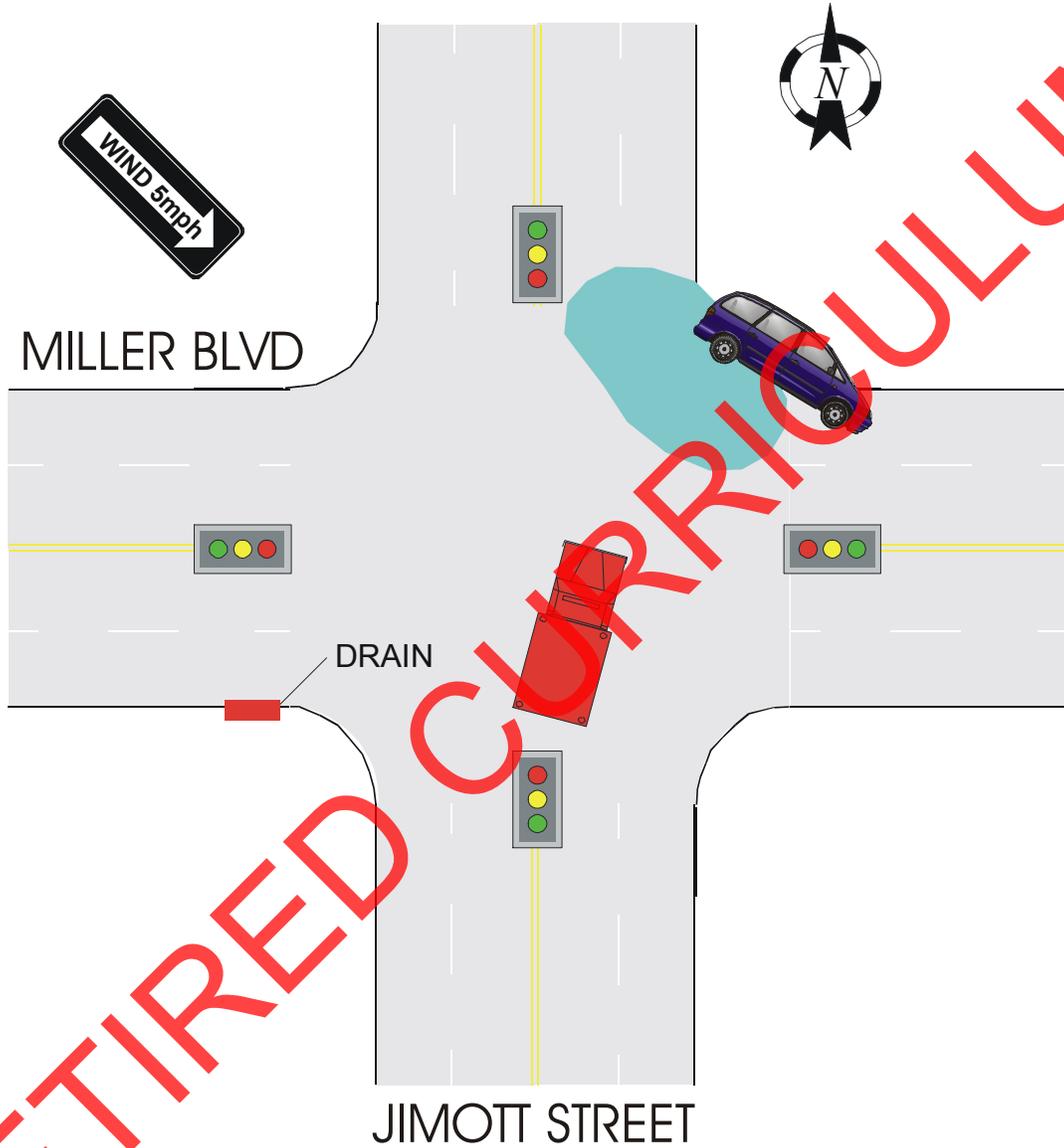
### Information Upon Dispatch

The emergency is reported as a truck versus van. The time is 1435 on a rainy Tuesday. Temperature is 60°F with wind from the northwest at 5-mph. Initial response is a one Type 1 engine, one medic unit, and one ambulance.

### Observed Upon Arrival

You arrive prior to the police or highway patrol. The intersection is partially flooded with rainwater. You see that a pick-up truck has apparently struck a van midway on the right side. The van has tipped over onto its left side and is lying in the flooded street and partially on the sidewalk. Several people have stopped and are signaling you to the van. You discover that the woman driving the van, Driver #1, is probably dead. There are ten children also in the van. None of the children had been restrained. The pick-up truck driver, Driver #2, appears to be intoxicated. His two passengers also appear intoxicated. As your attention is still with the van, the Driver #2 begins to leave the scene and drive away. You have a total of four immediates, three delays, one minor, and one possible deceased.

*How Would You Solve This Problem?*



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## Topic 3-1: Hazardous Materials Overview

As an Incident Commander, there are numerous factors that play into your thought process in determining the best (and most economical) mitigation to your incident. Without at least a basic knowledge of hazardous materials, you are severely handicapping yourself and your team. It is your responsibility to ensure the safety and well being of not only the civilians in the area, but your entire team. In today's world, it is imperative that you understand the implications of your actions. In days gone by, it was permissible to flush gasoline into the nearest storm drain. In today's atmosphere, actions like this may well find you personally liable.

It is our earnest attempt to make available to you the information that you will need to successfully handle a hazardous materials incident. In the following chapters, we will indulge ourselves into several of the most pertinent areas needed to solve an incident. Included will be discussions on properties of hazardous materials, toxicology, site control, evacuation considerations, ICS, and others.

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## Topic 3-2: Properties of Hazardous Materials

Slide 1

**HAZARD**

- ◆ All chemicals possess *more than one* hazard
  - ◆ Physical
  - ◆ Chemical
  - ◆ Health
  - ◆ Environmental

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Slide 2

**PLACARD IDENTIFICATION**

UN #	HAZARD CLASS	COLOR	PICTOGRAPH
1	Explosives	Orange	Bursting Bomb
2	Compressed Gases	Multi	Multi
3	Flammable Liquids	Red	Flame
4	Flammable Solids	Red/White	Flame
5	Oxidizers	Yellow	Ball/Flame
6	Poisons	Black/White	Skull/Crossbones
7	Radioactives	Yellow/White	Propeller
8	Corrosives	Black/White	Hands/Test Tube

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Slide 3

**Fire Triangle & Organics**

- ◆ Oxidizers
  - ◆ Hazard Class 5
  - ◆ Yellow Placard
  - ◆ Heat Sensitive
- ◆ Organic peroxides
  - ◆ Subclass of oxidizers
  - ◆ "Per" indicates "extra"
    - ◆ In this case, extra oxygen
  - ◆ Handle with respect
  - ◆ If involves heat or refrigeration
    - ◆ Do not turn unit off

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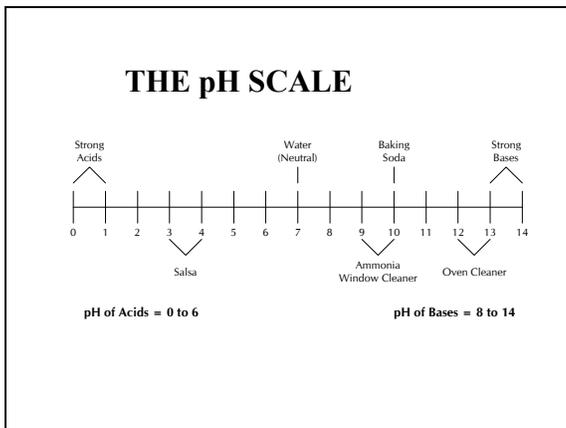
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Slide 4




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Slide 5

### COMMON STRONG ACIDS

- ◆ Sulfuric Acid
  - ◆ H<sub>2</sub>SO<sub>4</sub>
  - ◆ Battery acid
- ◆ Hydrochloric Acid
  - ◆ HCl
  - ◆ Concentrated pool acid
- ◆ Nitric Acid
  - ◆ Used in metal plating
  - ◆ Also a strong oxidizer

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Slide 6

### COMMON STRONG BASES

Called by several different names but mean the same  
**BASES = CAUSTICS = ALKALINES**

- ◆ Sodium Hydroxide
  - ◆ NaOH
- ◆ Potassium Hydroxide
  - ◆ KOH

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Slide 7

**PARACLEUS**

*WHAT IS NOT POISON?*

*All things are poison and nothing is  
without poison.*

*It is the dose that makes things not a  
poison.*

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The essence of your involvement in a hazardous materials incident will most likely be in the realm of scene management. In this capacity, it is not necessary for you to have the extensive background that a Hazardous Materials Technician or a Hazardous Materials Specialist must have, but you must understand basic chemical properties. There will be discussion in the four properties that all chemicals possess: physical, chemical, health, and environmental. Furthermore, we will discuss each of the chemical classes defined by the Department of Transportation (DOT). It is presumed that you have a working knowledge of the DOT North American Emergency Response Guide.

Fire fighters will be exposed to numerous chemicals during their careers. With the production of thousands of new chemical combinations each year, the chance is great that contact will be made with chemicals that the government really does not know what the long and short term exposures might be. Indeed, there are chemical combinations that are designed to create better widgets. For a variety of reasons, not all of these new combinations are tested as thoroughly as we might like; yet, we have "intimate" contact with them. There will be discussion on this later in toxicology; the focus now is on the properties of hazardous materials.

A very important fact that must be committed to memory (for the safety and well being of all) is that ***all chemicals possess more than one hazard.***

This is not only true but it is an extremely important concept to understand. For example, gasoline is flammable. What hazards would fire fighters be exposing themselves to when they roll onto a traffic accident that has a gasoline spill if the flammable potential of gasoline is forgotten? By the end of this discussion we hope that the fire fighter asks the question, "What hazards am I exposing myself and my crew to, in addition to the flammability potential?" You must be consciously aware of the toxic and corrosive qualities of gasoline as well.

All chemicals possess more than one hazard. Take this scenario. The fire department is called to an agricultural field where a farmer is in seizure. In the field, a tractor is spotted. Next to the tractor, is a tank that is leaking some type of liquid. A placard on the tank identifies the product as a "flammable." Stenciled on the tank is the word "dichloropropene." Is the leaking material the cause of the farmer's seizure? Probably not, the placard identified the material as a flammable. ***Wrong.*** There are some significant secondary hazards. Dichloropropene is a pesticide used as a soil fumigant. Though it is very flammable, (dichloroPROPENE is another form of propane), it is also very toxic. The "chloro" in dichloropropene indicates that chlorine is present. Chlorine is a member of the halogen family and ***all halogens are toxic.***

As stated earlier, all chemicals possess more than one hazard. These hazards are broken down into four different groups: physical, chemical, health, and environmental.

### **Physical Hazard**

What is meant by the physical hazard of a chemical? Is the chemical a solid, liquid, or a gas? Usually a visual inspection can answer the first question. Remember, with the sun coming up or a rainstorm coming in, what is currently a solid, etc. may not be so in a couple of hours. What difference does the physical form matter?

## Solids

We realize that under most conditions, and excluding the concerns about a chemical, health, and environmental issues, solids don't possess a great deal of concern. Again, excluding all concerns other than those associated with its physical form; solids are not difficult to control and mitigate. Primarily the wind (and the bottoms of our feet) translocates them. That makes them easy to clean up. Another plus when dealing with solids is that they are primarily toxic by ingestion only. That is not to say that all solids fall into this category, but the majority of solids do.

We hope we have not painted a picture where you do not feel the need to use extreme caution when dealing with solids. We have been discussing only the physical aspects of the chemical. There are certainly other aspects that must be addressed also. Take for example the spill of a solid oxidizer (calcium perchlorate). You had better consider more than just the physical hazard. If you do not, some very graphic, violent, and potentially deadly events may take place.

## Liquids

The second physical state that matter may exist is liquid. Liquids pose a greater hazard than do solids because they may be easily translocated. It is bad enough when Methyl Ethyl Bad Stuff (MEBS) flows down the curb line. It is much worse when it flows into the storm drain that flows into a creek where the last remaining family of one eyed, split toed tadpoles live. What happens when the liquid MEBS is solar heated enough and starts to off-gas forming Ethyl Methyl Worse than the other stuff. To make matters even more interesting, liquids may be toxic by ingestion, injection, absorption, and inhalation (is there anything left).

## Gases

The third and last physical state that matter exists is, of course, gas. Incidents involving gasses are the most difficult to handle. Obviously, gasses translocated quite rapidly. When the wind is blowing hard, this may work to your advantage. However, if the material you are dealing with is harmful (or lethal) at extremely low dosages, your problem has been magnified exponentially. On a virtually windless day (or night), your problem most likely will not be blown about (remember traffic etc. as a source of wind) but you now have a highly concentrated area. Gases are normally toxic by inhalation. However, they may well be a skin absorbable hazard as well (as is a common house fumigant, methyl bromide). Bromide is formed from bromine, another of the halogens.

## Chemical Hazards

What do we mean by the chemical hazards of an element? Is it really something I must concern myself with? Yes. This information may assist you in running a more efficient and safer incident.

The DOT divides hazardous material into different categories. These categories cover the spectrum of the different materials that we may run into. Also, the DOT identifies the category of the substance while in transport by use of placards and labels. These categories are identified in Table 3-2-1.

## Placard Identification - Table 3-2-1

UN NUMBER	HAZARD CLASS	COLOR	PICTOGRAPH
1	Explosives	Orange	Bursting Bomb
2	Compressed Gases	Multi	Multi
3	Flammable Liquids	Red	Flame
4	Flammable Solids	Red/White	Flame
5	Oxidizers	Yellow	Ball/Flame
6	Poisons	Black/White	Skull/Crossbones
7	Radioactives	Yellow/White	Propeller
8	Corrosives	Black/White	Hands/Test Tube

## Product Location - Table 3-2-2

CATEGORY	PRODUCT
1. Explosives	Normally not found, until the products are mixed
2. Compressed Gases	Aerosol cans, propane tanks, cigarette lighters
3. Flammable/Combustibles	Hydrocarbons, products containing hydrocarbons, many aerosols, pesticides, petroleum derivatives
4. Flammable Solids	Fusees (flares), elemental sodium & calcium, finely divided solids (dust explosions)
5. Oxidizers	Pool products, bleaches, pesticides
6. Poisons	Pesticides, also a common secondary hazard of many products, petroleum derivatives, hydrocarbons
7. Radioactives	Smoke detectors, lantern mantels, old watches (with luminescent dials)
8. Corrosives	Most cleaners, drain cleaners, oven cleaners

### Explosives

- Hazard Class 1
- Placard color is orange
- May be anything from dynamite, TNT (trinitrotoluene), to fireworks
- Some oxidizers act as explosives under certain conditions (more on this in Hazard Class 5)

## Compressed Gases

- Hazard Class 2
- Placard color is varied, depending on other hazards
- Flammable gases (methane, ethane, propane, butane, etc.) carry a red placard but a Hazard Class number of 2
- Poisonous gases (methyl bromide) carry a black & white placard with a Hazard Class of 2 and a pictograph showing a skull and crossbones
- Primary hazard may be the kind of substance (poison, etc.)
- Secondary hazard of a sudden release may result in
  - Rocket effect
  - Extreme cold
- The biggest hazard of all
  - Not knowing what the material is
- Oxygen is often placarded (correctly) as a nonflammable gas with a green placard

## Flammable Liquids

- Hazard Class 3
- Placard color is red
- Must be organic
  - An important concept, oxidizers readily react with organics, and sometimes quite dramatically
    - ✦ Therefore, don't store flammables near oxidizers
- Most hydrocarbon (organic and either flammable or combustible) is toxic by ingestion and inhalation
  - To a lesser degree, by absorption
  - Also are mildly corrosive
  - As with all chemicals, the dose makes the poison, like alcohol, aspirin, or malathion

## Flammable Solids

- Hazard Class 4
- Placard color is red and white striped
- Red phosphorous
  - Used in the manufacturing of illicit drugs
  - Matches

- Magnesium
  - Burns brighter with the addition of water
- Many are Group I and II metals
  - Sodium, calcium, potassium
  - Water reactive
  - Resulting reaction produces hydrogen gas that may result in a fire or explosion
  - Resulting solution is very caustic
    - ✦ Sodium hydroxide, calcium hydroxide, potassium hydroxide

### Oxidizers

- Hazard Class 5
- Placard color is yellow
- Pictograph is a flaming ball

Of all the hazard classes, this class will cause you the most problems. Oxidizers, by their very nature, either readily give up their oxygen atoms to something else or cause a material to lose its oxygen. The key word here is oxygen. Oh, but oxygen is no big deal. We carry it on our rigs for medicinal purposes. It does not burn. All right. We are not going to insult you with rhetoric on the dangers of oxygen. There are plenty of accounts that exhibit its ferocious behavior when mishandled. Look at the three Apollo astronauts who lost their lives while awaiting a launch.

Why then are oxidizers so critical to my career? Journey back to the good old fire triangle; the three needed components are oxygen, heat, and fuel. Well, we do not need to discuss much more about oxygen. Suffice it to say that when oxidizers are present there is sufficient oxygen.

So, what is a fuel? Hint, if in its chemical make-up, it has carbon, then it is organic, and therefore, it is considered a fuel. That light bulb in your head should be shining brighter. We have fuels all around us. Will they all react with an oxidizer? Most, if not all, will. The important thing is that you do not want to be around when it does.

Heat is just another word for energy. How much heat do we need? "Oh, about that much." Sometimes you might need a blasting cap. Other times, simply the energy released (or heat produced) by unscrewing a cap off the jar. Even more insidious is the heat of reaction. That is right, the reaction between some oxidizers and an organic produces sufficient heat to cause ignition, as in fire or explosion.

There is also a particular type of oxidizer that is even more of a concern (could it be possible?). This type of oxidizer has in its basic component both oxygen and fuel. They are known as organic peroxides. The prefix "per" denotes additional quantities of something, in this case extra oxygen. Obviously, when dealing with organic peroxides all that is needed to produce that fire or explosion is heat (energy). Again, the amount needed may be some or less. Remember, simply opening the cap off a jar *may* produce the heat needed to cause a fire or explosion. Take the case of picric acid (actually,

not an acid at all). After it ages, picric acid may form crystals (peroxides) on the inside of the cap between the male and female threads where you cannot see them. The resulting explosion has taken several hands from their owners and deposited them elsewhere. Other unlucky persons will never again celebrate a birthday.

Organic peroxides may also become very sensitive to heat. Some are transported in refrigerated transports. Others must be stored in "ovens." Picture this scenario. You respond to a train derailment. One of the cars is a refrigerated unit. The car is sitting on its side with the diesel motor still running. In an attempt to eliminate sources of ignition, you order the motor shut down. Guess what! You have just lit the fuse to the biggest bomb of your career. Is there a guarantee that an explosion will result? No. But it might. And when it does... the lesson.

When dealing with organic peroxides and oxidizers, **do not** shut down cooling, or heating, or heat regulating devices. After exposure to temperatures outside the range of their storage temperature, these materials may become **shock sensitive**. After reacting with other materials, those materials may become shock sensitive.

Just a few more examples and we will move on. By this point, we have all heard about ammonium nitrate and fuel oil (ANFO). Two more graphic depictions of the deadly effects that may result can't be found in other than the Kansas City incident, where several fire fighters lost their lives, and of course the most recent, the Oklahoma City terrorist act.

Enough said about this group of chemicals. When dealing with this category, we strongly urge you to consider the use of a Bomb Squad. After all, that is what you are dealing with... a bomb. If nothing else, consider a Unified Command or use them as Technical Specialists. Wherever you use them, use them!

### Poisons

- Hazard Class Number 6
- Placard color is black and white
- Pictograph is a skull and cross bones

The only type of incident that comes close to oxidizers in complexity and length of incident is that involving poisons. Poisons are designed by their very nature to kill. Maybe it is to kill grass (herbicide) or rodents (rodenticides) or fungus (fungicide). It does not matter. What is the difference between people and a rodent? In some cases, there maybe not much difference. Most of us are not educated enough to be able to differentiate between that which is designed to eliminate a rat and that which will harm us. Certainly, there are biological and physiological differences between human beings and a strand of grass. But, as a great rule of thumb, if the material is designed to kill something, **it can kill you!** Even more insidious in nature are those chemicals that are not designed to kill, but nonetheless do a great job of it. If you see a label that states, "diazinon," "metasystox," or "lindane," you might clue into the fact that you are dealing with a pesticide and your radar antennae should go up. But what if you see something like "acrolein," "acetaldehyde," "cyanogen," or "dimethyl sulfate." All of these, and many more, are extremely poisonous substances. But, so what. Do I really need to know all this. The truck will be placarded and that is enough for me. Well, we are not going to get into placarding

requirements at this time, but commodities are placarded by their highest degree of hazard. Therefore, you may not see that "poison" placard on the truck. Remember the case of dichloropropene. Most definitely poisonous. However, it is placarded as Hazard Class 3, Flammable Liquid. **Remember, all chemicals are poisonous, and it's "the dose that makes the poison."**

### Radioactives

- Hazard Class 7
- Placard color is yellow and white
- Pictograph is the "Radioactive Propeller"

This discussion will be short (you're welcome). Radioactive incidents are unusual for emergency responders. Part of the reason deals with the regulations attached to the handling of radioactives. Secondly, and again due to regulations, the containers used in the transportation of radioactives are quite substantial, to say the least. Most of you have probably seen the video of a radioactive container being struck by a speeding train with negligible integrity loss. This is a real plus for our side. However, with radioactive isotopes being used medicinally, in construction, meat packaging (a well known restaurant chain uses a radioactive to measure fat content in their hamburgers), and in the manufacturing of wallboard and aluminum foil (to control thickness) you will eventually respond to an accident involving a radioactive.

So, what should I do? I am certain you will remember, **isolate, and deny entry**. That is your first duty. However, and the earlier the better, call for expert assistance in the form of a Hazardous Materials Response Team (HMRT) or a local Radiological Response Officer. HMRTs are beneficial not so much in the sense that they will mitigate the incident, but because, with the use of instrumentation, a HMRT will determine a "2 mR Line." That is, they determine the Hot Zone for you. What this usually accomplishes is reducing the size of the Hot Zone that you determined without instrumentation. Secondly, it provides us with instrument readings that will help define our position for not allowing (or allowing) people back to work or for opening (or closing) a freeway.

The biggest thing that first responders must remember about radioactive incidents is that it is beyond your scope of training and expertise. Call for assistance early and keep folks out of the area.

### Corrosives

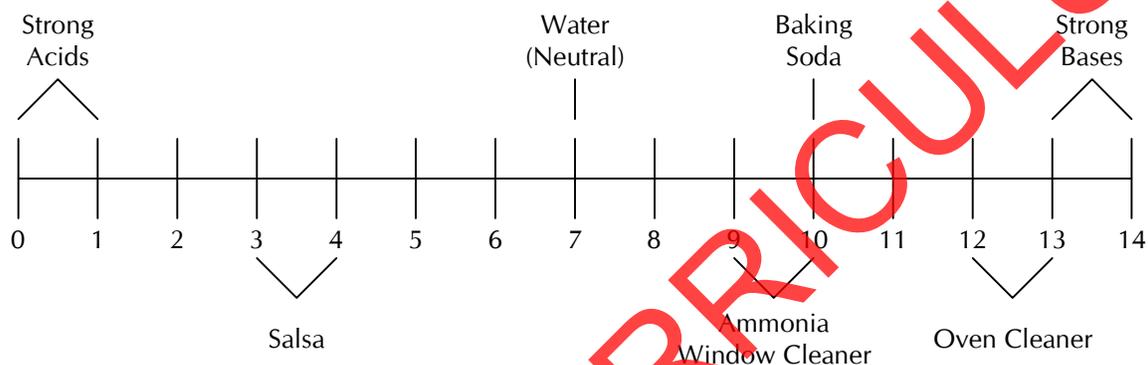
- Hazard Class 8
- Placard color is black and white
- Pictograph is test tubes with a hand and block of metal

The definition of a corrosive is "A solid, liquid or gas that causes the destruction or irreversible alteration in human skin tissue at the site of contact, or in the case of leakage from its packaging, a liquid that has severe corrosion rate on steel."

Corrosives are used so widespread that it does us well to discuss them in some detail. Corrosives are divided into two major categories: acids and bases. Bases are also known as caustics or alkalines.

Acids range in pH (the negative log of the hydrogen ion concentration) from zero to less than seven. Bases range in pH from above seven to fourteen. Chemicals that have a pH equal to seven are described as neutral. Graphically, we show it like this:

### pH Scale – Table 3-2-3



**pH of Acids = 0 to 6**

**pH of Bases = 8 to 14**

Strong acids are those in the pH range of 0 to 1. Common strong acids are hydrochloric **acid**, sulfuric **acid**, and nitric **acid** (also a strong oxidizer). Notice how the nomenclature helps us in describing acids by using the word "**acid**." Vinegar is really acetic **acid**. Phosphoric **acid** is used in food preparation and so on. Read labels of some of the products at your home. See how many chemicals you can now classify as an acid.

Strong bases are those in the pH range of 13 to 14. Common strong bases are potassium **hydroxide** and sodium **hydroxide**. Again, to help us better identify bases (=caustic = alkalines) the word **hydroxide** is used.

A word of caution: *never, under any circumstances, mix strong acids with strong bases!* The resulting reaction is what is commonly called an explosion. All right! We have heightened this fact, so you will never do it, right? Hopefully not. However, sometimes the things we use around the house are viewed as "nonhazardous." Take some time and read some labels. Look at how many acids and bases you find. Also, look to find how many strong acids and strong bases are used. Even products that do the same thing may contain different chemicals to make things work.

To exemplify this point, and to make an indelible impression on you, go to the local hardware store and find drain-cleaning products. Read the labels. Recently, this was discussed with a community group. Two bottles of liquid drain openers were shown. Both stated that it would dissolve the "gunk" and clean the pipes. Both were clearly identified as simply liquid drain openers. Most drain openers (solid as well as liquid) use sodium hydroxide as the active ingredient (a strong base). However, some

use sulfuric acid as the active ingredient (a strong acid). Now picture this scenario. You have a slow drain. You use the drain opener you find on your shelf at home without regard to how old and crystallized it may be. You pour it into the drain, following directions carefully. When you come back, the drain is still slow. Oh well. Maybe that stuff was too old; I will go buy some new stuff. Then, upon your return and without reading or understanding the labels, you pour the new improved stuff into the sink. Guess what. The old stuff used sodium hydroxide. The new used sulfuric acid. The result is an immediate and violent expulsion of all materials and chemicals that were in the sink. Not only have you just ruined the flooring, ceiling, and wall coverings, but also you have probably just covered yourself with the drain cleaner. This is not a fable. It really has happened and will happen again. One such participant ended up in the emergency room with third degree chemical burns.

What can you do with incidents involving corrosives? There are commercial products available for neutralizing acid and base spills. Most of these products are hazardous in and of themselves. Most also contain a color change feature so you will not take the reaction too far (making an acid spill into a caustic spill). However, you must realize that neutralization is a chemical reaction that produces heat, salt, water, and some type of gas. It is for this reason that neutralization procedures are legally permissible only by a Hazardous Material Specialist (the highest level of training). Obviously, for large spills, you will need the assistance of a HMRT.

There is a notion that has been around for years that dilution is the same as neutralization. This is not true. Dilution is simply trying to lessen the concentration by the introduction of a solvent, normally water. Neutralization is actually a chemical reaction. Secondly, it takes massive amounts of a solvent (water) to dilute even a gallon of acid. How much is a massive amount? It varies, but figures in the thousands of gallons are not exorbitant. Therefore, ***dilution is not a solution.***

### **ORMs**

1. = Other Regulation Materials
2. No placards, though there are labels

To simplify the area of ORM's think of them this way. They are commodities that are not regulated by any other section (i.e. flammable liquid, etc.) but that may cause harm if released.

### **Health Hazards**

We will not go into great depth at this time because later we will explore the wonderful science of toxicology. A simple quote sums things up sufficiently at this time. From Paracelus, "All substances are poisons; there is none that is not a poison. The right dose differentiates a poison and a remedy."

Have we gotten your attention? Probably, but just as probable you are thinking that this is an exaggeration. Not really. Milk is toxic when too much is consumed or someone is allergic to it. Aspirin, and for that matter, all medication, has an effective dose. Exceed it, you have a toxic dose frequently referred to as an overdose. The very things we rely on for our existence have a toxic limit. This limit may not result in death, but sometimes it does.

## **Environmental Hazards**

Unless you have just crawled out from under a rock, you cannot help but realize the concern that people globally are feeling about the place we call home. For as long as humankind has inhabited this earth, we have abused it. It has only been in the past few decades that scientists have become concerned. More importantly, it has only been in the past millisecond (in geologic time) that we have learned some of the technology to eliminate or reduce our negative impact on our environment.

There are many laws, codes, and ordinances that govern what the populace at large may do with their hazardous waste. Many municipalities have established separate sections within their departments that deal only with the enforcement of these laws. Many counties now have Household Hazardous Materials Collection Sites so that we may bring in our household hazardous wastes to have them disposed of, recycled, or remanufactured properly. Obviously, protecting our environment from unnecessary and illegal contamination is high on your priority list. Do not think that you can simply flush the gasoline from a traffic accident down a storm drain any longer without someone video taping the whole thing. You will have one heck of a time trying to explain your actions on the six o'clock news, much less than in court. ICs have, and will continue to have, disciplinary actions and fines levied against them because of their poor choices of mitigation and the effects on the environment.

When speaking of environmental impacts, we must consider land, air, and water. All medias must be considered. In times gone past, for which we now are paying the consequences for, we had either no concern or were not aware of long-term implications.

### **Land Contamination**

When we talk of land contamination, that leads to underground water reserve contamination, some places may come to mind. Locally, the McCall Dumpsite, and Springfellow Acid Pit. What about the Love Canal?

### **Air Contamination**

One cannot discuss air contamination without discussing smog issues in the Los Angeles basin. The emissions from our automobiles, trucks, and from industry continue to pollute. However, due to the stringent enforcement of many different laws, things are getting better. Let us not forget also, the depletion of the ozone layer. Certainly, we did not release chlorofluorocarbons (CFCs) into the atmosphere with the idea of increasing the occurrences of skin cancer. But, as technology and science grew, we learned how we affected our home.

### **Water Contamination**

It seems on a weekly basis you hear of some barge or oil tanker that has run aground and spilled hundreds of barrels of crude oil into the ocean or some tributary that leads into the ocean. Certainly one of the most noted incidents involved the Exxon Valdez. The mitigation and rehabilitation efforts are ongoing and will continue for years to come. How many eons will it take before the fisheries are replenished, before the land is as pristine as it once was, or the wildlife returns?

In the mid 1990s, a Southern Pacific train carrying a tanker load of metam sodium derailed near the town of Dunsmuir, California. Metam sodium is used as a pesticide and soil fumigant. It worked very well, but also, very badly. Dunsmuir is an old train settlement located alongside the picturesque upper

Sacramento River, a premier trophy trout fishery. After the spill, there was no aquatic vegetation to support the insect population that supported the fish population that helped support the wildlife population. Essentially, the once life-filled upper Sacramento River, from spill site down to Lake Shasta, was sterile. Even the surrounding land suffered. When deer and bear came to the river to drink or feed, they too fell prey to the effects of the derailment. Dunsmuir, the town that relied on tourism, faltered. Even today, though the certain governmental agencies would like you to think differently, a 100% recovery is still a dream.

**Summary**

In closing this chapter, we hope that this information, and the impression it has made upon you, will remain vivid in your consciousness (at least your subconscious) for the remainder of your time on this earth. Do not focus on only a singular hazard when dealing with these incidents. Consider not only the immediate consequences of your actions, but those that may surface years from now. There is a saying that you have probably heard but bears repeating. It goes something like this, "We don't own this earth. We are only borrowing it from our children." All chemicals have more than one hazard. Do not key in to only the most obvious.

**Chapter Review Questions**

1. What are the four categories for chemical hazards?

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2. How might each of the four categories in number 1 affect your incident?

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3. What does a yellow colored DOT placard with a hazard class of 5 denote?

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4. What state of matter is the most difficult to control and why is it so difficult?

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5. Corrosives may be acidic or caustic. What are two other terms that describe caustics?

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RETIRED CURRICULUM

RETIRED CURRICULUM

## Topic 3-3: Toxicology

Slide 1

**TOXICOLOGY DEFINED**

The science that investigates the adverse systemic effects of chemicals

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Slide 2

**TIME FRAMES**

- ◆ Short-term exposure (acute)
  - ◆ Short duration/high dose
  - ◆ Measured in seconds, minutes, hours
  - ◆ Single exposure can result in death
  - ◆ Usually leads to an emergency situation
- ◆ Long-term exposure (chronic)
  - ◆ Long duration/small dose
  - ◆ Sublethal quantities over a long period

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Slide 3

**TYPES OF ACTION**

- ◆ Local
  - ◆ Takes place at site of contact
  - ◆ Burns, rashes, necrosis
- ◆ Systemic
  - ◆ Occurs at site other than point of contact
  - ◆ Target organs

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Slide 4

**CHEMICAL INFLUENCES**

- ◆ Solid
  - ◆ Ingestion hazard
- ◆ Liquid
  - ◆ Ingestion or absorption
- ◆ Gas
  - ◆ Inhalation or absorption

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Slide 5

**EXPOSURE INFLUENCES**

<ul style="list-style-type: none"><li>◆ Route<ul style="list-style-type: none"><li>◆ Respiratory/inhalation<ul style="list-style-type: none"><li>◆ Greatest of hazards</li></ul></li><li>◆ Dermal/absorption</li><li>◆ Oral/ingestion</li><li>◆ Injection<ul style="list-style-type: none"><li>◆ Not normally considered</li></ul></li></ul></li></ul>	<ul style="list-style-type: none"><li>◆ Duration<ul style="list-style-type: none"><li>◆ Dose and concentration</li><li>◆ Local or systemic action</li></ul></li></ul>
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Slide 6

**INDIVIDUAL INFLUENCES**

<ul style="list-style-type: none"><li>◆ Sex<ul style="list-style-type: none"><li>◆ Women more susceptible</li></ul></li><li>◆ Age<ul style="list-style-type: none"><li>◆ Metabolic rate slows with age</li><li>◆ Respiratory/cardiac disease</li></ul></li></ul>	<ul style="list-style-type: none"><li>◆ Individual susceptibility<ul style="list-style-type: none"><li>◆ Allergies</li><li>◆ Physical impairments</li></ul></li><li>◆ Nutrition/health<ul style="list-style-type: none"><li>◆ Fitness = less susceptible</li><li>◆ Poor health may mask exposure</li><li>◆ Vitamins and proteins protect</li></ul></li></ul>
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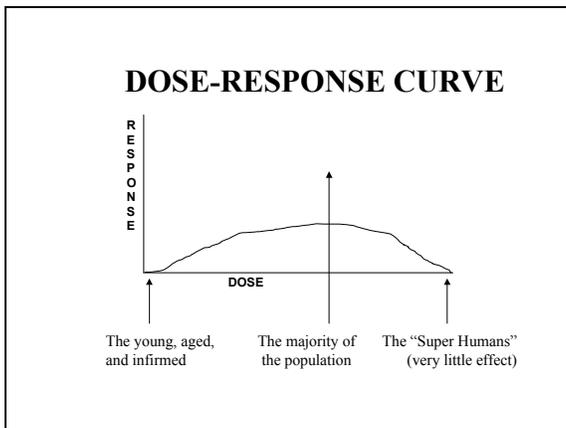
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Slide 7




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Slide 8

- ### LETHAL DOSE/CONCENTRATION
- |  |   |
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| <ul style="list-style-type: none"> <li>◆ Lethal dose</li> <li>◆ LD50                     <ul style="list-style-type: none"> <li>◆ Death of 50% of test population</li> </ul> </li> <li>◆ LD1o                     <ul style="list-style-type: none"> <li>◆ First death in population</li> </ul> </li> <li>◆ Oral or dermal exposure</li> </ul> | <ul style="list-style-type: none"> <li>◆ Lethal concentration</li> <li>◆ LC                     <ul style="list-style-type: none"> <li>◆ Inhalation exposure</li> </ul> </li> </ul> |
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Slide 9

- ### OCCUPATIONAL EXPOSURE LIMITS
- ◆ Threshold limit value (TLV)
  - ◆ Dose or concentration with *no adverse effect*
  - ◆ Airborne concentrations
  - ◆ Subject to change as data develops
  - ◆ Guidelines only

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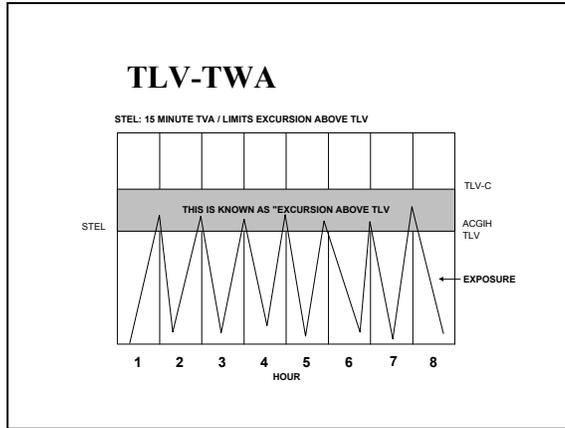
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Slide 10




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Slide 11

### IDLH

- ◆ Life-threatening concentrations
- ◆ Maximum level for worker to escape *without* impairing symptoms or irreversible health effects

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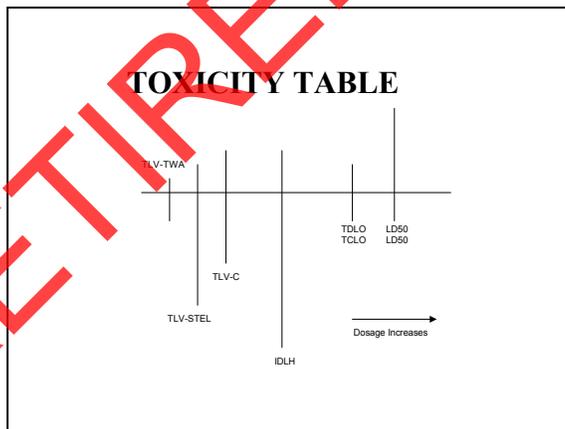
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Slide 12




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Slide 13

**CARCINOGENS**

- ◆ 200+ known carcinogens
- ◆ Must use highest level of protection
- ◆ Use specialized assistance
- ◆ Protect with SCBAs

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Slide 14

**BIRTH DEFECTS**

- ◆ Causing agents
  - ◆ Teratogens
    - ◆ Effects this generation
    - ◆ Kids in womb, children, women of child-bearing age
  - ◆ Mutagens
    - ◆ Effects the next generation
    - ◆ Alters DNA genetic code
- ◆ Use specialized assistance

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Slide 15

**OXYGEN DEFICIENT ATMOSPHERE**

- ◆ Occur naturally or as a result of chemical displacement of oxygen in a confined space
- ◆ Less than **19.5%** oxygen is **dangerous**
- ◆ Diminishes mental and physical capacities
- ◆ Use SCBAs
- ◆ Chemical concentrations may be increased

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In order to make wise decisions in the field, you need to have a basic understanding of how the human body reacts to different chemical (toxins). Some chemicals may affect you when exposed by one route but not another. Some are toxic after a one-time exposure; others are toxic only after a long period of exposure. There are also elements of our society who are more susceptible to certain toxins. In this chapter, we will present to you some information that will help you make an informed decision in the field.

Toxicology is defined as, "The science that investigates the adverse systemic effects of chemicals." A more easily understood definition is "The effects of chemicals on us."

### **Short and Long-term Exposures**

When discussing toxicology, you must understand several terms, the first of which is short-term exposure. This is, by definition, exposure of short duration but high dose. The length of time of exposure is expressed in seconds, minutes, or hours. Due to the high dose, it is normal that this type of an exposure leads to, or is considered to be, an emergency. Some of these exposures can result in unconsciousness or death. For example, exposure to pesticides. The early effects of a pesticide poisoning mimic the flu. Vomiting, headaches, body aches and possibly fever. If left untreated, and if the exposure is significant, the secondary effects are described as:

**SALIVATION, LACRIMATION, URINATION, DEFECTION, GASTRO-INTESTINAL PAIN, EMESIS**

Easily remembered as **SLUDGE**, these symptoms often lead to seizures and death. We will discuss more about pesticides in later chapters. The point to remember here is that pesticides may be toxic by **acute** (short-term) or by **chronic** (long-term) exposures. Therefore, long-term exposures are those that take place over an extended period of time and in small doses. Times of exposure are normally discussed in terms of days, weeks, months, and even years. For example, recently the ill effect of diesel smoke in fire stations has become an issue. Obviously, these exposures are sub-lethal and measured over years.

When discussing exposure, it is necessary to understand whether a chemical is toxic acutely, chronically, or both. Sodium fluoride is a salt that is toxic acutely (in high doses) but not chronically (in small doses). NaF (sodium fluoride) has a LD50 (lethal dose-50%) of 36 mg/kg (milligram per kilogram). However, in small doses of 1 to 2 mg/kg it provides good dental health. Conversely, mercury (Hg) is not toxic acutely but is toxic chronically.

For this reason, a broken thermometer is not a major concern if properly cleaned. However, take that same thermometer where the mercury seeps into the carpet or wood flooring and a baby playing in this area day after day. Chronically, you can experience illnesses or worse.

### **Effects**

We now understand the difference between acute and chronic exposures and how important it is to know how a substance is toxic. But how does the toxin work within the body? There are two descriptions for a toxic effect. The first is described as a **local effect**. This means that the chemical has an effect at the site of exposure. An example of this may be an acid dropped onto the skin causes a

local effect by chemically burning the site. Rashes, necrosis, and blindness are also signs of a local effect.

The second type is called a **systemic effect**. In this case, the damage takes place at some site in the body other than the site of exposure that is a target organ. For example, hydrofluoric acid (HF), **not** hydrochloric acid (HCl). HF is considered a weak acid having a pH of 3 to 4. However, it may have a local effect in the form of a rash or minor burn, but its biggest damage is performed insidiously. The fluoride ion of HF has an affinity for calcium. Therefore, and this is the important part, the fluoride ion passes through the skin and into your bones where the calcium is. Once there, it does not stop but proceeds to the marrow where red blood cells (RBCs) are produced. Once there, HF prohibits the uptake of oxygen by the RBCs. The result is oftentimes necrosis of digits and other parts of the body. Needless to say, HF is a bad actor and needs to be handled by only properly trained and equipped personnel.

Other factors that influence the toxicity of a substance are the chemical or physical make-up of the substance. Solids are primarily only an ingestion hazard, though when broken into finely divided dust, they can become an inhalation toxin, and some are even a dermal hazard.

Liquids are considered an ingestion and dermal toxin. Some, such as HF and pesticides, are skin absorbable. Also, substances that are presently a liquid may off-gas at the present or future time as temperature rises or reaction continues.

Gases are primarily an inhalation hazard. There are, however, exceptions. Methyl bromide is applied as a gas for fumigation purposes. Thinking  $\text{CH}_3\text{Br}$  (methyl bromide) was only an inhalation hazard, more than one burglar has been too smart for his or her own good. They wear a "gas mask" that may or may not be suitable for  $\text{CH}_3\text{Br}$  only to find out (if they are lucky) that methyl bromide is also a quite powerful skin absorption hazard as well.

## **Route of Exposure**

Another major consideration is the route of exposure. Remember what they are? There are three primary routes: 1) inhalation (respiratory), 2) dermal (absorption), and 3) oral (ingestion). There is a fourth, though much less discussed, but it is important for you as a responder working in less than ideal conditions to remember. The fourth route is injection.

### **Inhalation**

The greatest hazard to us is the inhalation hazard. This is due to two factors. First, the lung surface is a very poor barrier to chemicals and allows an immediate transfer of the toxin to the bloodstream and other parts of your body (systemic). Secondly, the surface area within the lungs is nothing less than amazing. The skin surface area of an average adult is approximately 20 square feet. The lung surface area of this same person would be approximately 750 square feet. We protect ourselves from inhalation exposure by using our SCBAs or air purifying respirators (APRs). There are several OSHA requirements that must be met before an APR may be used. These will be discussed later.

## Dermal

The skin is actually a good barrier to chemicals. Remember, however, that you may have a local or a systemic effect from a dermal exposure. We protect ourselves against dermal exposures by wearing ensembles that are chemically resistant to the substance being handled. There is no one chemically resistant material that is chemically resistant to all chemicals. Also, *your turnouts are not considered to be chemically resistant and provide little, if any, protection. Therefore, they are acceptable in only a very few cases.* Another factor to consider when using turnouts is the simple fact that they are difficult at best (and impossible in some cases) to decontaminate.

## Oral

Now, we figure that the vast majority of students reading this material are not going to go up to some spill, grab a handful, and eat it. This is not acceptable. However, how many of you practice good hygiene, particularly in the field. Translocation of contaminants from food or smoking materials is possible and does happen. We can lessen this by thoroughly washing with soap and water. Due to this, we are compelled to practice good hygiene and take other safeguard measures. Such as:

- No eating, drinking or smoking in any zone other than the Support Zone.
- No horseplay while anyone is in either the Hot or Warm Zones.
- All safety measures are in place when anyone is in the Hot or Warm Zones. (i.e., Safety Officer, Back-up or Rescue Teams)

## Injection

The last route we will discuss is that of injection. As you would not intentionally eat a substance, nor would you load it into a needle and stick it in your arm. However, while working in a "hostile" arena, it is common to find sharp metal edges, broken glass, exposed nails, etc. All of which may have chemicals on their surface. Your protective ensemble, including gloves, may be punctured resulting in a scratch, laceration, or an injection of this chemical. We prevent this type of exposure by being careful. Secondly, by:

1. Identifying and tagging potential hazards
2. Stopping work and refreshing/replacing personnel before being fatigued.
3. Providing for good hydration and nutrition (Rehab)

## Exposure Duration

Another factor that will influence the amount of degree of damage is the duration of the exposure. Obviously, the longer the contaminant (toxin) is in contact with you, the greater the degree or severity of damage to you. This fact, amongst all others, should prompt you to immediately decontaminate all personnel who have been exposed without delay. This type of decontamination is an emergency decontamination. That is, where responders are exposed unexpectedly. If "decon" has not been set up (why not?) then do not hesitate. Do not worry about run-off (at this time - later you will). Use booster lines or other means to immediately wash personnel off.

NOTE: State and Federal regulations require that the Decontamination Process be set-up and staffed prior to entry into a contaminated area. However, it is understandable (though not acceptable) that someone is going to cut corners and enter into an area for simply an inspection or a "recon" of the area. Remember things happen. And usually, when you least expect them.

Another factor that influences the toxicity of a substance is its concentration. The more concentrated (or stronger) the toxin, the greater the injury. Also, as has already been discussed, the greater the dose, the greater or more severe the injury can be expected. There are exceptions (of course) but they are minor and few.

There are also individual factors that influence the toxicity. Women have a higher average of body fat than do men. Therefore, women are more likely to store fat-soluble toxins. Secondly, women are child bearers. Therefore, women are more susceptible to those toxins that effect the fetus (i.e., teratogens and mutagens).

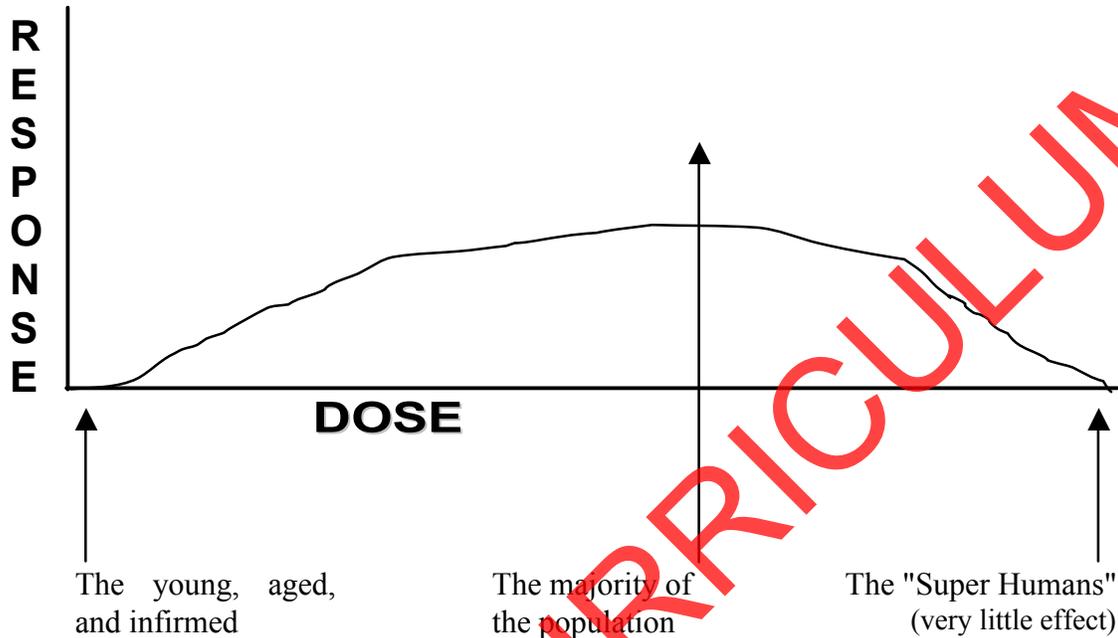
Age also plays an important role in chemically induced injuries. In infants, if not only by their minimal mass to begin with, certainly with their increased heart rates and respirations, toxins transfer much more quickly than in adults. Secondly, their immune systems are not as developed as in an adult. On the other hand, the sick and elderly are also compromised. Their immune systems may also be less than optimum; they may have pre-existing conditions such as respiratory and cardiac diseases. To their advantage, though, is the fact that metabolism slows with age. The counter side to this is though it may take the toxin longer to reach a target organ, that target organ may have already been weakened by disease or years.

Have you ever wondered why some people can eat (figuratively speaking) poison oak, whereas others break out scratching by just looking at the plant? This is due to individual susceptibilities. Allergies do not only exist with hay fever and bee stings. You may have sensitivity to, or an allergy to, certain chemicals and not even know it. You may have been born with physical impairments that may worsen the effects of toxins. For example, a weakened liver that may not be able to adequately filter out toxins. We see this quite often (if you live in certain areas) during high smog or high wind days. People with asthma or other pulmonary problems are exposed to higher concentrations of toxins ( $SO_x$  and  $NO_x$ ).

Persons who are ill or in poor health are generally more susceptible to the effects of toxins. The illnesses that these people are suffering from may even mask the effects of some chemicals. Picture this scenario at a water treatment facility near a convalescent home. A chlorine leak occurs at the facility that is upwind from the convalescent home. Without getting into a lengthy discussion on evacuation criteria, think about how many folks are experiencing the ill effects of the chlorine gas or those who normally live with dyspnea (COPD patients).

NOTE: Diets high in vitamins and proteins, generally protect against the toxic effects of many chemicals.

Generally speaking, the longer the contact time, the higher the concentration and individual susceptibilities will all play an adverse role in the effects of a toxin. When toxicologists attempt to explain the effects of certain toxins, they sometimes use a bell shaped curve to illustrate.



The bell-shaped curve helps us to graphically understand some things. For beginners, it becomes obvious that not all of us are going to react the same to a given dose of a toxin. There are those of us who react at very small doses. There are also those who apparently have little or no effect from even a much higher dose. We can also see that the majority of the population reacts the same, or nearly the same. This mid-point, or that point at which the majority of the population fits into, is very important in understanding other toxicological terms.

Toxicologists and industrial hygienists use terms to describe limits that we may be exposed to. These limits are referred to as 1) lethal dose/concentrations, 2) occupational exposure limits, and 3) life-threatening concentrations.

### Dose vs. Concentration

What is the difference between a dose and a concentration? The term "dose" refers to a given amount per body weight or surface area. For example: mg/kg and mg/sq cm. These terms are normally used when discussing an ingestion or a skin absorption toxin.

"Concentration" normally refers to an airborne toxin. It is usually expressed in parts per million (ppm) or parts per billion (ppb). It refers to a toxin that is a respiratory hazard.

The point at which a defined portion of the test population expires determines lethal dose/concentration. For example:

- Lethal Dose - Low = LD10
  - That point at which the *first* of the test population dies.

- ❑ Lethal Dose - 50 = LD50
  - That point at which **50%** of the test population dies.
  - Theoretically, the high point of a bell-shaped curve.
- ❑ Lethal Concentration - 10 = LC10
- ❑ Lethal Concentration - 50 = LC50

Table 3-3-1 will assist you in understanding what is meant when a chemical is labeled "Highly Toxic."

**Toxicology – Table 3-3-1**

LD50 (dermal) up to 2000 mg/kg	Dermally Toxic
LD50 (dermal) below 200 mg/kg	Highly Toxic
LD50 (oral) up to 50 mg/kg	Highly Toxic
LD50 (oral) 50 to 500 mg/kg	Moderately Toxic
LD50 (oral) greater than 5000 mg/kg Or LD50 (dermal) greater than 2000 mg/kg	Are legally classed outside the toxic range, or nontoxic (by default) (Federal and California Hazardous Substances Acts)
LC50 less than 20 ppm or 2 mg/1 (dust)	Highly Toxic
LC50 up to 20,000 ppm or 200 mg/1 (dust)	Toxic by Inhalation
LC50 greater than 20,000 ppm or 200 mg/1 (dust)	Nontoxic (by definition)

**Occupational Exposure Limits**

Occupational exposure limits are those values that workers may be exposed to while they are working. These limits are expressed in terms of Threshold Limit Values, Permissible Exposure Limits, and Immediately Dangerous to Life and Health.

**Threshold Limit Values**

Threshold Limit Values (TLVs) are based on the concept that there is a threshold dose or concentration below that there is no adverse effect. They refer to airborne concentrations of substances and represent conditions in which *it is believed* that *nearly all* workers may be repeatedly exposed to without adverse effect. It is important to note the terms, "it is believed" and "nearly all." These statements should raise a flag to you. TLVs and the other terms we will discuss are obviously not conclusive. These values are considered **guidelines**. Remember the bell-shaped curve. Not all people react to a toxin the same. Some can take a higher dose, others are susceptible at a much lesser dose. Also, and just as important, is the fact that these numbers can and do change. Why? Tests are conducted on animals and the results are then interpolated to humans. The animals used in the test are selected to emulate humans. That is, if we are testing a chemical for skin absorption, a pig may be used because its skin is very similar to ours. However, the numbers obtained are interpolated from animal studies. Secondly, as more data comes in,

these numbers will change. Where does the additional data come from? Well, sometimes it is from further animal studies. But, when a worker is harmed by what was considered a "safe" level of exposure, the limits may be changed upwards. Granted (and unfortunately so) a single case probably would not change the numbers. It may take several cases where workers have suffered ill effects from a "safe" level before the exposure limits are changed.

An example of this is a common chemical used in autoclaves for sterilization. Ethylene oxide (ETO), a carcinogen with a flammable range of 3% to 100%, at one point had an exposure limit of 100 ppm. Several years passed when it was noted that workers were being diagnosed with cancer. In reaction to this, the exposure limits for ETO were dropped to 10 ppm. Things went along fine for a while until it was again noted that workers were still being diagnosed with cancer. The exposure limits were dropped again to 1 ppm. The time frame for these changes to occur was approximately 10 years. It should be clear to you that we are all guinea pigs.

Threshold Limit Values (TLV) are expressed in terms of:

- Threshold Limit Value - Time Weighted Average (TLV-TWA)
- Threshold Limit Value - Short-Term Exposure Limit (TLV-STEL)
- Threshold Limit Value - Ceiling (TLV-C)

TLVs-TWAs represent the **average** concentration of a chemical a worker can be exposed to during a 40-hour week, 8-hour a day, without showing any toxic effects. In other words, at the end of the workday, the exposure must average at or below the TLV-TWA.

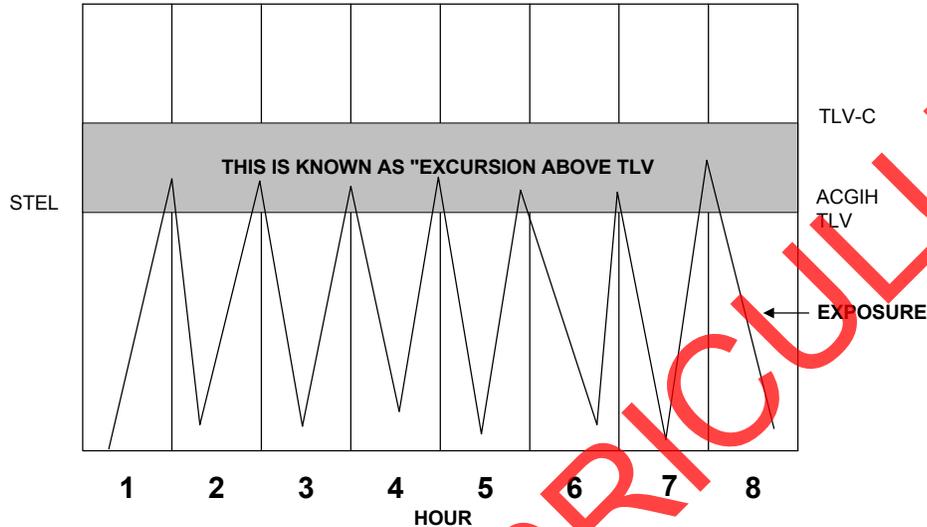
TLVs-STELs are created in response for the need to sometimes go over the TLV-TWA. For example, the TLV-TWA for a gas, Methyl Ethyl Eat Your Lips, is 40 ppm. However, during the workday, a worker must open the lid to a vat containing MEEYL. The concentration the worker is exposed to goes up to 50 ppm. This is permissible if:

- The "excursion" is no longer than 15 minutes in duration and,
- The excursions are spaced out at least 60 minutes apart and,
- There are no more than four excursions during any one 8-hour day.

### **Threshold Limit Values - Ceiling**

Threshold Limit Values - Ceiling (TLV-C) defines the maximum allowable limit. At no time may this concentration be exceeded. There are no exceptions. Compare a TLV-C with the ceiling in a house. Short of poking a hole through it, you cannot get any higher. Such is the same with a TLV-C. In a house, a pike pole makes a nice hole through the ceiling. In the case of a TLV-C, the "pike pole" may be special chemical protective clothing with SCBA, monitoring, and training. However, these ensembles are applicable to HMRT members. A first responder does not have the necessary training and equipment to even consider this sort of venture. Therefore, for the purposes of this course, the TLV-C is an ***absolute maximum and may not be exceeded, even momentarily.***

STEL: 15 MINUTE TVA / LIMITS EXCURSION ABOVE TLV



TLV - Time Weighted Average = exposure over an 8-hour day is averaged so that the average exposure for the day is below the TLV

TLV-C = a ceiling level that limits how high an excursion may go above TLV

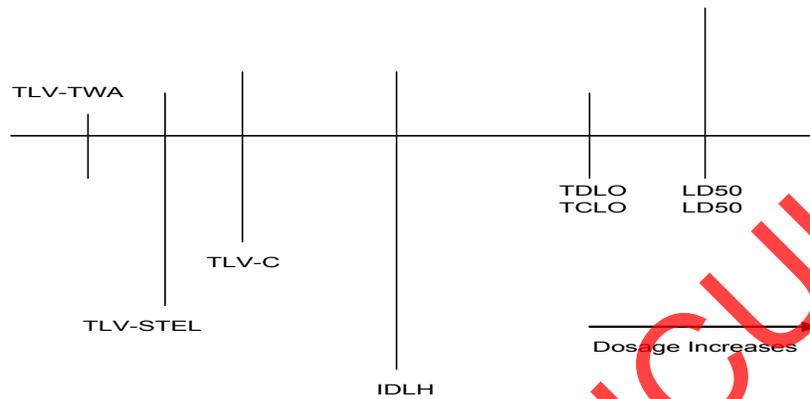
STEL = 15 minute short-term exposure

You will also hear and read about Permissible Exposure Limits (PELs). These are essentially (although not exactly) the same as TWAs. The difference is that OSHA enforces PELs whereas NIOSH enforces TWAs. It is interesting to note that although NIOSH may make recommendations to OSHA, there does not need to be consistency with their numbers. Therefore, this information should urge you to use the most conservative figures available. Remember, not everyone responds to a toxin the same. There are those who are much more sensitive to certain toxins than others. Always error on the side of safety.

Another term that you must be familiar with to make safe and accurate decisions is Immediately Dangerous to Life and Health (IDLH). The title, by itself, is descriptive to say the least. IDLHs "... represent the maximum concentrations from which, in the event of respirator failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing or irreversible health effects." (e.g., severe eye irritation).

Care should be taken in the words "irreversible health effects." By this definition, you may well be injured as long as the injuries will not impair your escape or be irreversible. For the purposes of this course, consider IDLHs as being just that... Immediately Dangerous to **your** Life and Health.

**Relationship between Various Measurements of Toxicity Table 3-3-2**



**Carcinogens** are cancer-causing agents. There are approximately 200 known carcinogens. There are many other substances that, for time, money, or political reasons, are considered to be **suspected carcinogens**. It needs to be emphasized that whenever dealing with suspected carcinogens, consider them a **known carcinogen**. It is also highly recommended that when dealing with these materials that you consider the use of specialized assistance.

**Teratogens** are those agents that cause abnormal development resulting in congenital defects (birth defects). Therefore, women in their childbearing years and fetuses are most at risk. Some toxins (or chemical inducted toxins) effect the mother and not the fetus; others effect the fetus and not the mother. The bottom line from our perspective is it does not make a difference. These are bad actors and the highest degree of protection needs to be utilized.

**Mutagens** are those agents that alter the DNA (deoxyribonucleic acid) molecule. It effects this generation, but may also effect later generations. You may be exposed and suffer no noticeable changes. The changes may not appear in your children, but may appear in their children. As with carcinogens and teratogens, these are also very bad actors. You are encouraged to utilize only the highest degree of protection with the highest trained personnel when dealing with these chemicals.

Another term that you will find is "**oxygen deficient atmosphere**" or ODAs. ODAs occur naturally and because of chemical displacement. When you see an electrical vault, hold of a ship, or a storm drain, you probably already think of oxygen deficiencies. However, depressions in the earth, swimming pools, and trailers also need to be considered as a possible ODA. Picture this scenario. You respond to a person down. Upon arrival, you find this person lying in the bottom of an empty swimming pool. Your first reaction (which may be your last) is to run right in and "rescue" the person without a lot of thought as to why the person is down. Was it because of cardiac arrest? Was the cause of the cardiac arrest due to a pre-existing heart condition? Is this an ODA? Is the atmosphere contaminated with something else? Possibly flammable vapors in excess of the LEL? A benchmark that HMRTs use to help define an ODA is anywhere there is less than 19.5% oxygen concentration. Obviously, SCBAs are part of the ensemble needed in these atmospheres. However, caution must be

taken when entering the atmospheres because all chemicals have more than one hazard. Are you entering an area containing methyl bromide vapors (skin absorbable fumigant)?

### Summary

Through our discussion of toxicology, we have learned how some chemicals or toxins may affect us after short duration (acute) exposures and other toxins will affect us only after long-term (chronic) exposures. We have learned that even though a chemical exposure may result in a localized effect, it may also exhibit a systemic effect as well. We have also talked about how not all people will react the same way to a given exposure. This prompts us to consider using occupational exposure limits as guidelines and not a rule. We have taken some time to discuss carcinogens, teratogens, and mutagens and how we must use extreme caution when dealing with these materials. Overall, we have learned how to better protect ourselves from the sometimes insidious bite that all chemicals possess.

### Chapter Review Questions

1. How does a systemic toxin affect us?

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2. Which route of exposure poses the greatest danger to us?

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3. What individual factors affect how we will react to a toxin?

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4. What is the relationship between TLV–TWAs, TLV–STELs and TLV–Cs?

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5. Known or suspected mutagens, teratogens, and carcinogens pose a serious problem to hazardous materials incidents. What precautions might you take when dealing with this type of incident?

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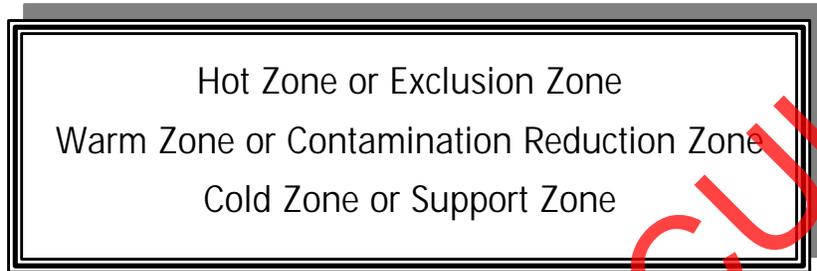
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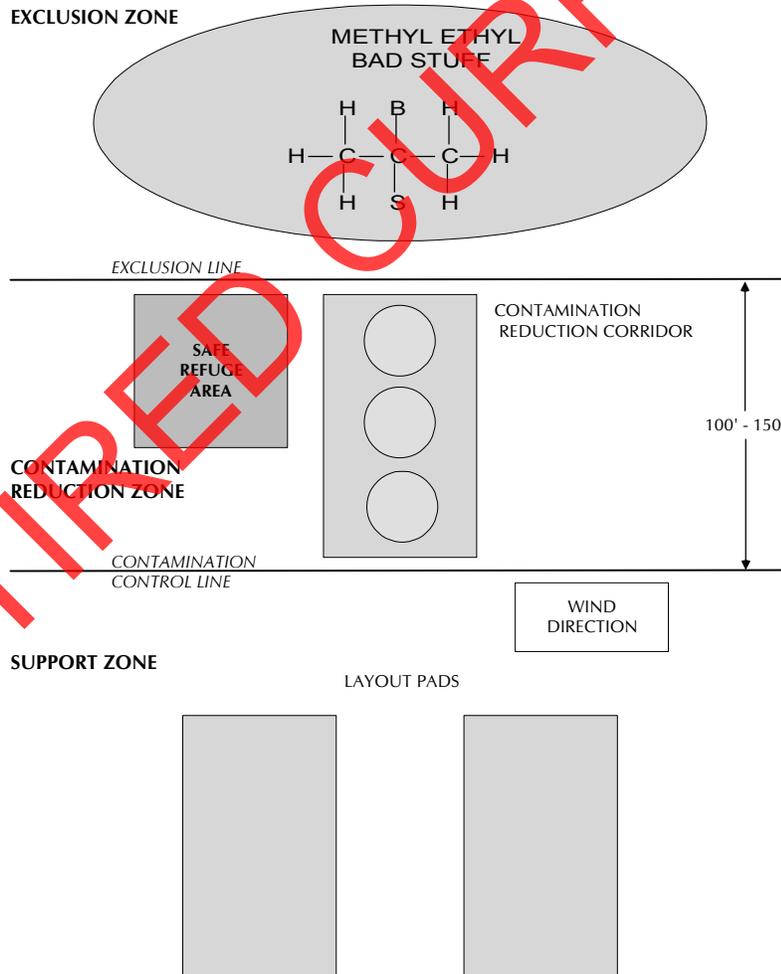
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As recommended by EPA, USCG, NIOSH, and OSHA, three specific zones should be set up and enforced on all haz mat incidents. You, as the Incident Commander, are responsible for ensuring that this is done. While you might already be familiar with the zones, are you familiar with what dictates where the zones are set? The zones, as defined, are:



**Hazardous Materials Site Control Table 3-4-1**



## Hot or Exclusion Zone

Each of these three zones has specific requirements that may not be compromised! The hot or exclusion zone is where the contaminant **exists** or **is thought to exist**. It is also the area where the contaminant may eventually be if things turn for the worse. It is the area of greatest contamination. This zone, as well as the other zones, must never be compromised!

Only authorized personnel who are both trained and properly equipped and are in the presence of a "buddy" are allowed in this area. In the majority of cases, this will mean only members of a Hazardous Materials Response Team. Remember that you must be trained and properly equipped to perform the duties that are expected of you! There are absolutely no exceptions!

## Warm or Contamination Reduction Zone

The next zone, sandwiched between the Hot and Cold Zones, is the Warm or Contamination Reduction Zone (CRZ). Simply by its name, you may conclude that this is where contamination is reduced or where decontamination takes place. This zone is designed and functions as a buffer between the Hot and Cold Zone. As one progresses out of the Hot Zone and proceeds to the Support Zone, contamination to personnel, equipment, and the environment are reduced. Therefore, the main purpose of the CRZ is not to simply reduce contamination, but rather to eliminate all contamination and to prevent its translocation outside of the Hot Zone and the CRZ! By this statement alone, it is imperative that decontamination personnel be trained and practiced in the art of decontamination! Therefore, consider the use of trained professionals. It is easy to become complacent particularly when the contaminant is hard to see as is the case with a clear liquid. To ensure that the contamination is not translocated out of the CRZ, decontamination personnel **must** maintain their professionalism and execute due diligence.

Although the risk potential in the Warm Zone is less than that in the Hot Zone, the law still stipulates that only those personnel who are trained and properly equipped be allowed in this zone. This is due to the presence of contaminants, regardless of concentrations. This does not require nor advocate the use of only Hazardous Materials Response Team members; all personnel must be trained for the duties that they are expected to perform and they must be properly equipped! The CRZ is also that zone where the Safe Refuge Area exists.

## Cold or Support Zone

The Cold or Support Zone is that area where command and support functions take place. The Hot and Warm zones are designed such that no contamination should exist in the Cold Zone. Since this is an area where command functions and decisions are made, it is preferable that civilians and news media not be in this area. Therefore, though not required, it is an option to create yet a fourth area. The purpose of this area is to keep those persons who do not have a role in your incident away from command and support functions. This may be an area away from the incident where maps and charts may be displayed (with IC approval) for the media and others. To help clarify this idea, consider the Support Zone as "staging" and this fourth area more as "base camp." Again, this is not a required area but one that will assist you in controlling your incident.

## Zone Considerations

What are some of those considerations you should look for while establishing your zones? First, though it has already been mentioned, establish your zones based on where the contaminant is or where it might be. It is acceptable to relocate a Command Post (CP) when the unexpected happens. It is not acceptable when the expected happens and you have to move the CP. This is particularly true when injuries may occur. Be familiar with the daily wind patterns in the area of your incident. At what time should the wind shift? How strong will it be? Or what might happen if those two chemicals react and that tank is over pressurized? Always error on the side of safety. It is better to evacuate and impose on a few extra (hundred?) people now rather than having to figure out what to do with them when your incident is turning sour. Remember that you can always justify why you evacuated what appear to be too many civilians. You can never justify why you failed to evacuate them when you realized the potential for what might happen!

To further assist you in establishing your control lines, look for dead or dying vegetation, critters, insects, or people. Use natural boundaries to help you. It is certainly acceptable to use buildings, trees, parked cars, flagpoles, etc. to help define your zone. However, once you have established your zones, you must mark those boundaries. Use fire line (haz mat) tape, rope, barricades etc. And do not forget that many people do not acknowledge these barricades. Consequently, you may have to find the biggest, strongest, and meanest police officer you can find to enforce things.

Also, always position yourself uphill and upwind. Base your judgment on:

- What is happening or is likely to happen
- Past experience
- Worst case scenario
- Always error on the side of safety

There are also some basic rules that are followed by HMRT members. You need to be aware of these so that you may effectively interact with the Teams. The rules are:

- No eating, drinking, or smoking in the Hot or Warm Zones.
- No horseplay anywhere on the incident.
- While there is work going on in the Hot or Warm Zone, all back-up teams and support personnel are in place and ready to assist.

Never leave your entry or decon teams by themselves. Their safety and very lives may depend on you and those working with you! Also, ***all safety considerations are in place and in operation any time there is work being done in the hot or warm zones.*** There are no exceptions!

## Summary

When determining site control lines, consider where the contaminant is and where it might be. Secondly, remember to consider all the hazards of the contaminant, not just the obvious ones.

**Chapter Review Questions**

1. Three major zones have been described. What are they and how do they differ from one another?

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2. Medical treatment should not be implemented in what zone(s) and why?

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3. Before entry into the Hot Zone, certain operations must exist. What are they and why are these rules strictly followed?

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4. What should be considered when determining control lines?

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## Topic 3-5: Evacuation Considerations

Slide 1

**ACTIVE EVACUATIONS**

- ◆ Physically removes people from the area
- ◆ Increases logistical burden on the IC
  - ◆ Transportation
  - ◆ Sanitation
  - ◆ Food and shelter
  - ◆ Medical or psychological assistance
- ◆ Decreases the “worry factor” on the IC

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Slide 2

**PASSIVE EVACUATION**

**SHELTER-IN-PLACE**

- ◆ Leaves people where they are
- ◆ Lessens the logistical burden on the IC
  - ◆ Raises the “worry factor”
- ◆ Buys time
  - ◆ Can still actively evacuate later if needed
- ◆ Problems
  - ◆ Sheltered persons must be monitored
  - ◆ Requires an increase in committed personnel
  - ◆ Protecting people using only windows and walls

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So, you have finally made it. You are the Incident Commander on a major incident with all the television cameras and newspapers. Great place to be. You have worked hard to get there. What is that? Here comes the Fire Chief, City Manager, and Mayor, so much for your moment in the spotlight. Forget them for now; get back to your incident. A concern has arisen and you and your staff need to discuss options. However, you must make the final decision. The question is a simple one. Do we evacuate or not?

The first thing you need to come to grips with is that your decision will be wrong in someone's mind, regardless of what you do. But, you are used to making evacuation decisions when it comes to fire danger. The difference with this decision is that you may be evacuating thousands of citizens. If you evacuate, is it mandatory or voluntary? Very few evacuated people are happy about it. And then as soon as they are evacuated, they want to get back home. If you do not evacuate, all the people left in the area will come down with symptoms or ailments that have nothing to do with your incident! But, they are sick because of you. Great place to be, right?

In this chapter, we will explore the concepts that you will use to come to the right decision.

Evacuations are one of the most perplexing and difficult decisions for an IC to make. If you decide to evacuate, you will be badgered by many people wanting to know why you imposed on so many for so long. If you decide not to evacuate, you will be criticized as soon as someone is symptomatic or they think they are symptomatic.

When to evacuate is simple most of the time. Evacuate when the presence of a hazardous material is known or suspected. Evacuate when there is a potential for fire or explosion. Evacuate when a carcinogen, mutagen, or teratogen is present or thought to be present. Evacuate when the concentrations of the material present are such that they may be harmful. Lastly, evacuate when the affected population are those who are very sensitive.

Who to evacuate is also a simple question to answer. All civilians are evacuated. Only those noncivillian personnel who have an official capacity at the incident are allowed to remain. There is another twist to this scenario that you must be aware of. What happens when you decide to evacuate because the contaminant is indeed present in such concentrations as to be harmful? There is no speculation; the contaminant is more than just suspected. At this point, that area in which contaminants are present is now considered part of the Hot Zone. Therefore, we must revert to who is allowed in the Hot Zone.

Only authorized personnel who are both trained and properly equipped are in the presence of a "buddy" are allowed in this area. In the majority of cases, this will mean only members of a Hazardous Materials Response Team (HMRT). Remember that you must be trained and properly equipped to perform the duties that are expected of you! There are absolutely no exceptions!

So, if this area is now considered part of the Hot Zone, who now performs the evacuation? Only those who are trained and properly equipped etc. This not only implies but also requires the need for additional HMRTs!

So, we have decided that an evacuation is needed and, for the sake of simplicity, this will be a precautionary evacuation. That is, the contaminant is not present but may be. Do we always need to

actively collect people and displace them to an evacuation center? As you have already guessed, the answer is no! There are a couple of ways in which you may accomplish the same result.

### **Active Evacuation**

First, we can order an active evacuation or one in which we actually move people from one location to another. This type of an evacuation has a definite advantage in that people are actually taken out of the area. Therefore, there is no chance of them coming down with symptoms. However, there is also a multitude of problems. First, how are you going to transport these people out of the area? "By police cars," you say. This takes an incredible toll on your police department resources. "By their own private vehicles then." This works and can be very effective. But, as we saw in the Oakland Hills Fire, this can severely tax your roads. "Transport everyone by bus." This usually requires a pre-incident arrangement. Do you have one? Several other problems with this option are sheltering, food, care, and sanitation needs. Do you have predesignated evacuation facilities and contracts for food, care, and sanitation? You say, "Well, yes, we use the Red Cross." This is true in most cases. However you need to confirm with the Red Cross officials what they will provide and for how long.

### **Shelter in Place**

The second type of evacuation is shelter in place. As the name implies, people are not moved out of the area, but rather, kept right where there are. This certainly eliminates some of the problems with an active evacuation, but it does produce some others. It requires the monitoring of those who are sheltered. This requires personnel to check and communicate with the evacuees. If they are at one location, say a school, this is simple. But what if we are talking about a several block area with single-family residences? The way that you protect these people is by having them close all doors, windows, and shutting down all HVAC systems. This may pose a bit of a problem on a hot summer afternoon where the projected down time is several hours.

Here are some other considerations for you to think about. Is the area of impact rural or is it in a highly congested area? What is the weather forecast and what impact will this have on your incident? Included in the weather is the relative humidity and temperatures. Remember, there are chemicals that are water reactive. Also, there are chemicals that may become unstable with an increase in temperature.

Here is another thought. In your media releases, how much information do you release? It is a proven fact that when exposure symptoms are released, a portion of the general population will come down with these symptoms. How do you differentiate between those that are actually suffering the ill effects of an exposure and those that are brought on only because they think they have been exposed?

### **Summary**

We have discussed two basic types of evacuations in this chapter, and the advantages of each. We have also learned that pre-incident planning, particularly with those who will lend logistical support, is a must. We have also discussed particular problems that are posed when those who need to be evacuated are inside the Hot Zone. You have been given the basic tools needed to perform evacuations. It is now your duty to further your studies in this area.

**Chapter Review Questions**

1. Describe the pros and cons of both active and passive (shelter in place) evacuations.

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2. Describe your concerns when civilians are located inside the Hot Zone.

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3. What information should be shared with the media? What information should not be shared?

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4. What are some of the logistical needs of the evacuees that must be considered when contemplating an evacuation?

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## Topic 3-6: Decision-Making Process

Slide 1

**DECIDE**

**Detect**  
**Estimate**  
**Choose**  
**Identify**  
**Do**  
**Evaluate**

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Slide 2

**DETECT...**

... the presence of a hazardous material



A stick figure stands on the left, pointing its right hand towards a dark, irregular spill on the ground to the right.

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Slide 3

**ESTIMATE**

... whether to intervene or leave it alone



A stick figure stands on the left, looking up with a question mark above its head. To the right is a dark, irregular spill on the ground.

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Slide 4

**CHOOSE**

- ◆ . . . the appropriate objective



- ◆ if you plan to intervene

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Slide 5

**IDENTIFY**

- ◆ . . . practical options



- ◆ Dropping Napalm on a pesticide fire is probably not practical!

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Slide 6

**DO**

- ◆ . . . the best option



- ◆ As long as the best option is practical. Remember your priorities.

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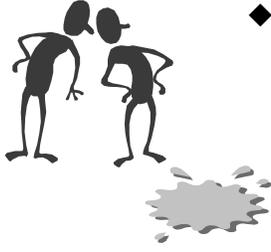
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Slide 7

**EVALUATE**



- ◆ . . . your progress
- ◆ If there is no progress, consider another option!

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By this point in your career, you have no doubt acquired an ability to make decisions. On the fireground, information is coming to you at what seems every direction. You approach that point of "information overload." Things are happening fast! You are required to make quick decisions, often times with only minimal information.

In this chapter, we will explore the hazardous material's response to the fire service's RECEO. It is known by the acronym DECIDE. There are other systems that are available, however, DECIDE is the easiest to learn and use. DECIDE is an acronym that stands for:

D =Detect  
E =Estimate  
C =Choose  
I =Identify  
D =Do  
E =Evaluate

The "D" stands for detecting the presence of a hazardous material. If the product in the drum is nothing more than rain water, our immediate problem is already corrected. How do you detect the presence of a hazardous material? You can talk with on-scene personnel from a business. While they may attempt to mislead you by telling you that there is no danger, they will most often admit to something spilled or otherwise released. Whether or not it is still present still needs to be determined. Some apparatus carry pH paper. A very easily learned technique, and very inexpensive way, to determine if something is corrosive or not. Remember though, all you have proven is that it is not a corrosive. What about flammability or reactivity or toxicity? While there are some things you can do to determine whether a hazardous material is present or not, there comes a time when a HMRT needs to respond. They are trained in methods of categorizing and, in some cases, specifically identifying, hazardous materials. If in doubt, call them.

The "E" stands for estimating the likely consequence with and without intervention. Sometimes it is far better to do nothing at all. Many times the decision to do nothing can be made by you, but quite often, the best way is to confer with other experts in the field. This is a good time to discuss how we prioritize the three areas of main concern: **life, environment, and property**. Without much discussion, it is obvious that life is our first priority. We never compromise this. Nothing else is as important as the protection and preservation of our lives and those of the citizens we serve. The preservation of property is the second priority. We do our best not to adversely affect property. Replacement may be very expensive not only in cost to replace something, but the down time as well. The environment is our third priority. Some may feel that it is more precious than property. Remember, any harm that is done to the environment may take years and millions to repair!

The "C" refers to choosing your objectives. Your primary objectives should be to contain, control, or extinguish in the most expeditious and safe manner with the least number of injuries and losses of life.

The "I" refers to identifying your options. Consider all **practical** options. It is important to limit your time on only those options that are practical. A foam blanket over the spill is a highly desirable and practical option. Find others.

The second "D" represents doing your best option. Before commencing work, make certain that all safety precautions are taken and all needed or expected resources are at hand and ready. Always error on the side of safety and remember your priorities!

The "E" refers to evaluating your work. Before you commenced your operations, you should have set some time frames. In other words, how long should it take to perform the options that you have ordered. Is work progressing faster or more slowly than anticipated? Should we order more resources? Are we being effective or should we regroup and choose another plan? HMRTs utilize this evaluation on their incidents. They have what is called a "two-bottle rule." After two one-hour bottles have been exhausted, they evaluate their progress. Remember, be flexible. Lastly, change your plan if it is not working!

### **Summary**

DECIDE is a tool that may be used to determine what, if any, action is needed. Following each step in order will help you in handling your situation. Two main points to remember are:

1. If there is no chemical present, we do not have an incident.
2. Sometimes doing nothing is better than doing the wrong thing.

### **Chapter Review Questions**

1. Describe what each letter in the acronym, DECIDE, means

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scene and an IC will delegate his or her responsibilities to the person in charge of the team. This is not to be done. Granted, in some very small incidents you may decide not to stay and turn things over to an engine company. That is fine. But the person in charge of the engine is now the IC. That person may decide to continue to assume the responsibilities of handling the hazardous material. That is also OK. However, in larger incidents where you are staying on-scene, do not turn your entire incident over to an HMRT or haz mat type people. As you well know, there are far more things that need to be dealt with other than just the haz mat problem.

The next position to be filled, if needed, is that of Operations Chief. Sometimes you have no needs other than simply the mitigation of the hazardous material. In this case, the IC will most likely handle the job of Operations. It may be delegated to an HMRT member, but you are cautioned away from this. The reason being is what happens when the incident expands. What if things went badly and you now have injured fire fighters? The Operations Section has now grown from a single concern to one that is more complex. It is advisable to keep your haz mat people handling the haz mat portion of your incident and have others fill in the other needed positions within the Command and General Staff.

The haz mat portion of your incident fills the position of a division or, in a large incident, a branch. The Hazardous Materials Group Supervisor is the first position that will be filled by a haz mat type person, usually a member of the HMRT. This person may assume the role of a Division Supervisor or Branch Director and is responsible for all haz mat operations. The Hazardous Materials Group Supervisor supervises all personnel under their command except the Assistant Safety Officer – Haz Mat, who reports directly to the Incident Safety Officer. The Haz Mat Group is responsible to the IC and, if one has been designated, Operations.

The Entry Team Leader is responsible for identifying and implementing the tactics that will be employed to mitigate the hazards of the release. The Entry Team Leader reports to the Haz Mat Group and makes recommendations for the mitigation of the incident. It should be emphasized again that only Entry Team Members are allowed in the Hot Zone.

Only authorized personnel who are both trained and properly equipped and are in the presence of a buddy are allowed in the Hot Zone. In the majority of cases, this will mean only members of a Hazardous Materials Response Team. Remember that you must be trained and properly equipped to perform the duties that are expected of you. There are absolutely no exceptions.

This point needs more discussion. In times gone by, it was suggested and even recommended that, in the event of someone injured in the Hot Zone, paramedics or other medical personnel would enter the area and start treatment. Well, the law simply precludes this. Maybe not in so many words, but by implication. For example, only trained and properly equipped persons are allowed into the Hot Zone and the CRZ. Most medical personnel do not have hazardous materials team training. Not to say there are not exceptions, but you have folks who are paramedics and you have folks who are Hazardous Materials Technicians/Specialists. Secondly, why would anyone wish to start any kind of emergency medical procedure in the Hot Zone where contaminants exist? It makes far more sense to have your Entry Team or Stand-By Rescue Group rescue victims. However, before any treatment, the victim must be decontaminated.

One other thought before we proceed. Have you ever tried starting an IV while dressed in a fully encapsulated suit?

The Decontamination Unit Leader is responsible for the entire decontamination process. There have been times when this process was not given the attention that it deserves. The decontamination process must be thorough and complete. This is the last barrier to ensure that there is no translocation of the contaminant from the Hot Zone. The Decontamination Unit Leader must take this job as seriously as any other detail. Persons who are not detail oriented should not be placed in this position. This position also requires someone who is willing to hold his or her own. It is not unusual for some people, to think that because they cannot see the contaminant, they must be clean. The Decontamination Unit Leader must insist that all persons and equipment that has been or may have been contaminated go through the entire decontamination process.

Another major area of problems in the past is that of the injured. Due to confusion, contaminated patients were often treated, placed in an ambulance, and transported to the hospital. The ambulance, emergency room, operating room, etc. have all been contaminated. It is imperative that all contaminated patients be completely decontaminated by the Decontamination Unit under the direct supervision of the Decontamination Unit Leader before any treatment and transportation. It makes no difference if the patient is critical or in full arrest. No treatment may be administered before decontamination. If you are the Decontamination Unit Leader, insist this rule always be followed.

The Site Access Control Leader is responsible for controlling the movement of all personnel and equipment into and out of the Hot Zone and CRZ. They oversee the placement of the Exclusion Control Line, Contamination Control Line, and ensure that the Safe Refuge Area is established within the CRZ. The Site Access Control Leader also coordinates with the Decontamination Unit Leader, the Safe Area Refuge Manager, and the Medical Unit Leader for the decontamination, movement, and treatment of contaminated victims. The SACL is responsible to the Hazardous Material Group and supervises the Safe Area Refuge Manager.

The Safe Refuge Area Manager is responsible for the placement of the Safe Refuge Area adjacent to the Contamination Reduction Corridor and the Exclusion Control Line. The SRAM is responsible for evaluating and prioritizing victims for treatment and collecting information from the victims. The SRAM is also responsible for preventing the spread of contaminants by the victims.

The Assistant Safety Officer-Hazardous Materials is a required position on all haz mat incidents, regardless of size. This position is responsible for the safety of the haz mat operations only. This is not the Incident Safety Officer. Simply stated, the Haz Mat Safety Officer must have training that is equivalent to that of the Entry Team. Do not place someone in this position that does not meet this requirement. As with the Incident Safety Officer, the Assistant Safety Officer – Haz Mat has the right to stop all haz mat related work that is deemed unsafe.

Technical Specialist-Hazardous Materials Reference is responsible for providing to the Haz Mat Group Supervisor all information dealing with product identification and related hazards. This person is responsible for reading and interpreting all available resources. One major quality that a person in this position needs is the ability to read the technical information from the references, and then take that information and put it into nontechnical terms so the IC and others who are not of a technical nature may understand it. This is not only a desirable trait, but also a required one.

An area not covered in the Field Operations Guide (FOG) is that of the Stand-By Rescue Unit. The sole purpose of this group is to stand-by and rescue the Entry Team if it becomes necessary. Needless to say, this group must be trained and properly equipped. For example, an incident that requires the use of only HMRT members as part of the Entry Team requires the use of equally trained members as part of the Stand-By Rescue Unit.

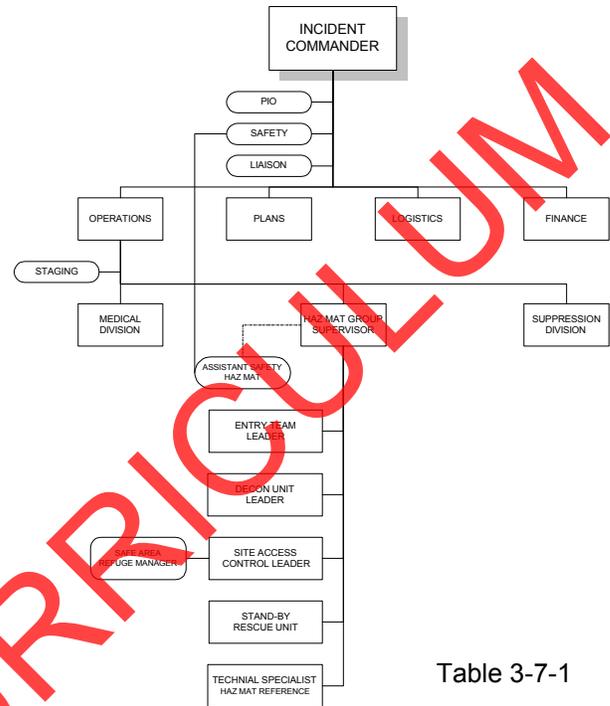


Table 3-7-1

The establishment of an Identification Unit Leader will normally take place only on a large incident where there are many unknown chemicals. When this unit is established, the Identification Unit Leader is responsible for organizing a safe work environment where team members may go about the task of identifying unknown contaminants.

The building of your ICS structure is up to you. Table 3-7-1 was extracted from the FOG and, therefore, does not address the placement of the Stand-By Rescue Unit.

Table 3-7-2, which addresses the placement of the Stand-by Rescue Unit, suggests that the SRU is responsible directly to Haz Mat Group Supervisor, but coordinates with the Entry Team Leader as well.

### Summary

The Incident Command System is a management tool that will organize your incident and ensure that things are being done. It is a flexible tool that will allow you

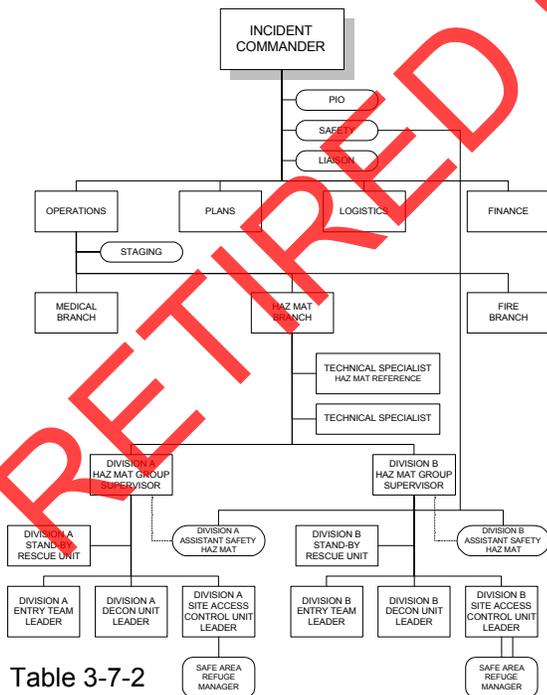


Table 3-7-2

to create the organization you desire. There are rules that need to be followed and there are positions that must be filled. We have provided several suggestions as to how to build your structure. However, the result is yours, you are the author.

### Chapter Review Questions

1. Why is the command responsibility not given to a member of a Hazardous Materials Response Team?

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2. The Assistant Safety Officer – Hazardous Material is a required position. Describe the requirements to fill this role and the structure that this person works under.

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3. Describe the responsibilities of the Safe Refuge Area Manager.

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4. Describe what is required of the Stand-by Rescue Unit.

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5. What are the responsibilities of the Site Access Control Leader?

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## Case Study #3-1: Traffic Accident

### Facts Known Prior to the Emergency

The incident location is the outbound lanes of a major state highway with extremely heavy traffic.

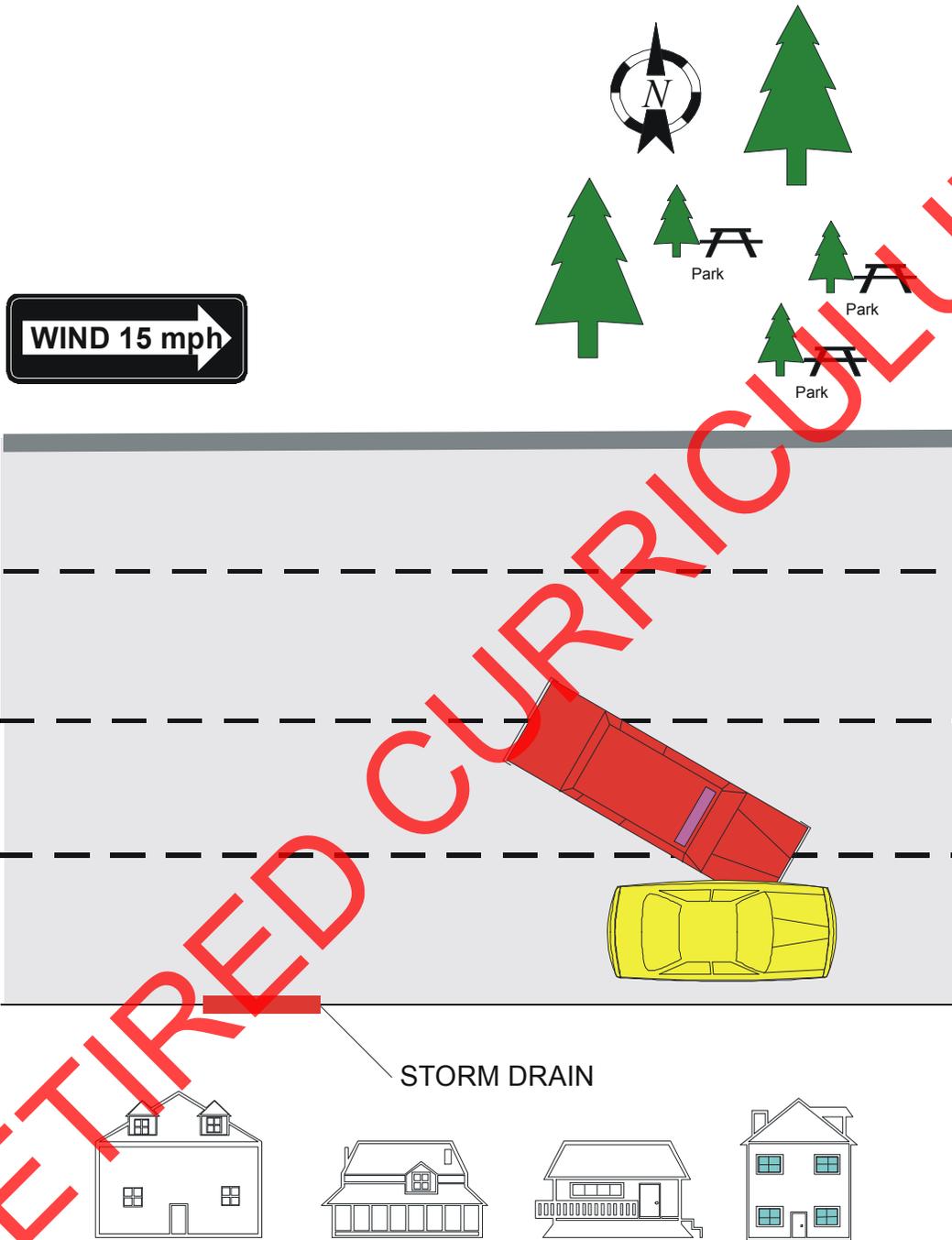
### Information Upon Dispatch

The emergency is reported as a traffic accident involving a truck and a passenger vehicle. The truck is placarded. The time is 1700 on Friday of the Memorial Day weekend. The skies are clear, 70°F, with winds from the west at 15 mph.

### Observed Upon Arrival

After having to fight extremely heavy traffic, you arrive on scene and discover a bobtail-type truck versus a late model sedan. The drivers of both vehicles are still behind the driver's wheel. There are no other victims. Driver #1, the truck driver, is complaining of substernal chest pain radiating down his left arm, neck and back pain, and respiratory distress. Driver #2, a 41-year-old female, is complaining of left arm pain from an apparent fracture and neck and back pain. The truck is emitting a white-to-yellow smoke or haze from the gaps in the rear door after striking the sedan's right front door. A yellow placard with the numbers 2031 is displayed on the truck's back door and on each side. The truck's right saddle tank has also ruptured, spilling all its contents (30 gallons of diesel) onto the road. Your interrogation of the Driver #1 reveals that he is carrying several 55-gallon drums of nitric acid. The first arriving state trooper is very agitated and demands that you immediately open up the freeway.

*How Would You Solve This Problem?*



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## Case Study #3-2: Fire Alarm Sounding

### Facts Known Prior to the Emergency

Childress Furniture is housed in a large warehouse. The time is 0200 hours on January 20.

### Information Upon Dispatch

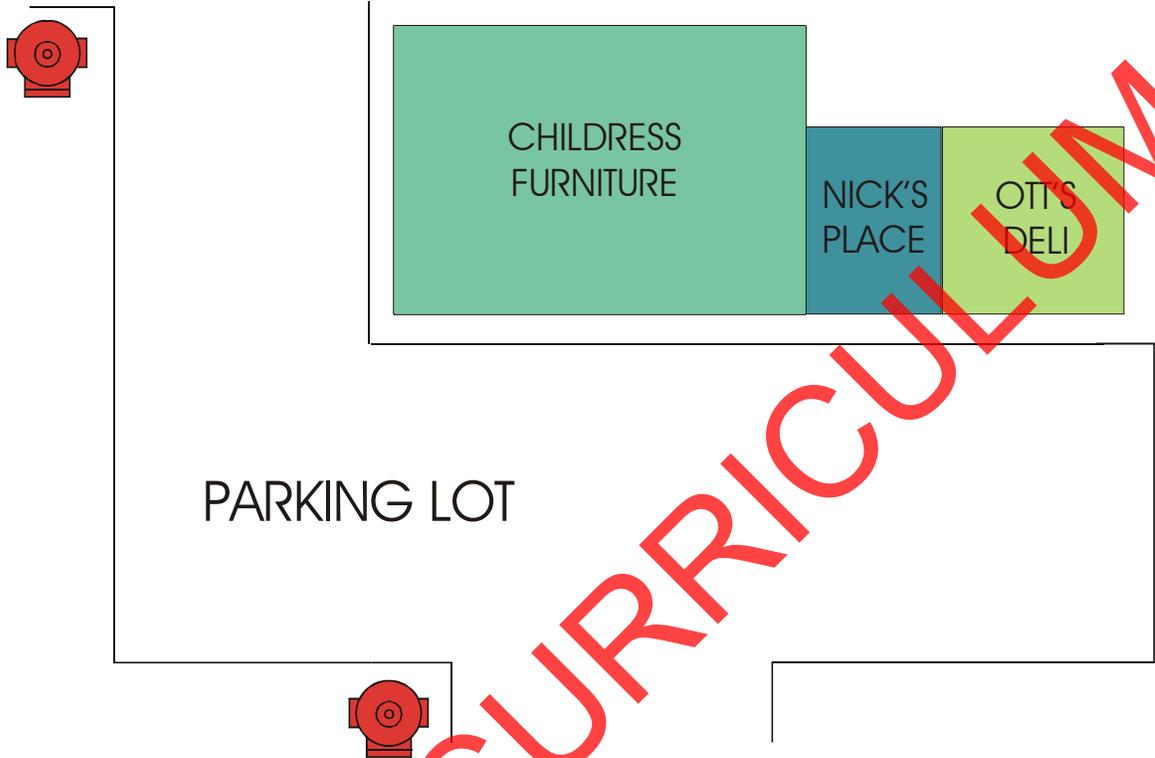
The emergency is reported as an alarm sounding at Childress Furniture. Dispatch and the alarm company are unable to contact the owner or responsible party.

### Observed Upon Arrival

There is light smoke and haze inside the structure. The alarm panel indicates that activated alarm is in the main show room.

*How Would You Solve This Problem?*

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## Case Study #3-3: Hazardous Material Incident at an Apartment Complex

### Facts Known Prior to the Emergency

A large apartment complex sits in a run-down part of town. It has a history of calls for nuisance-type incidents from dumpster fires to health hazards.

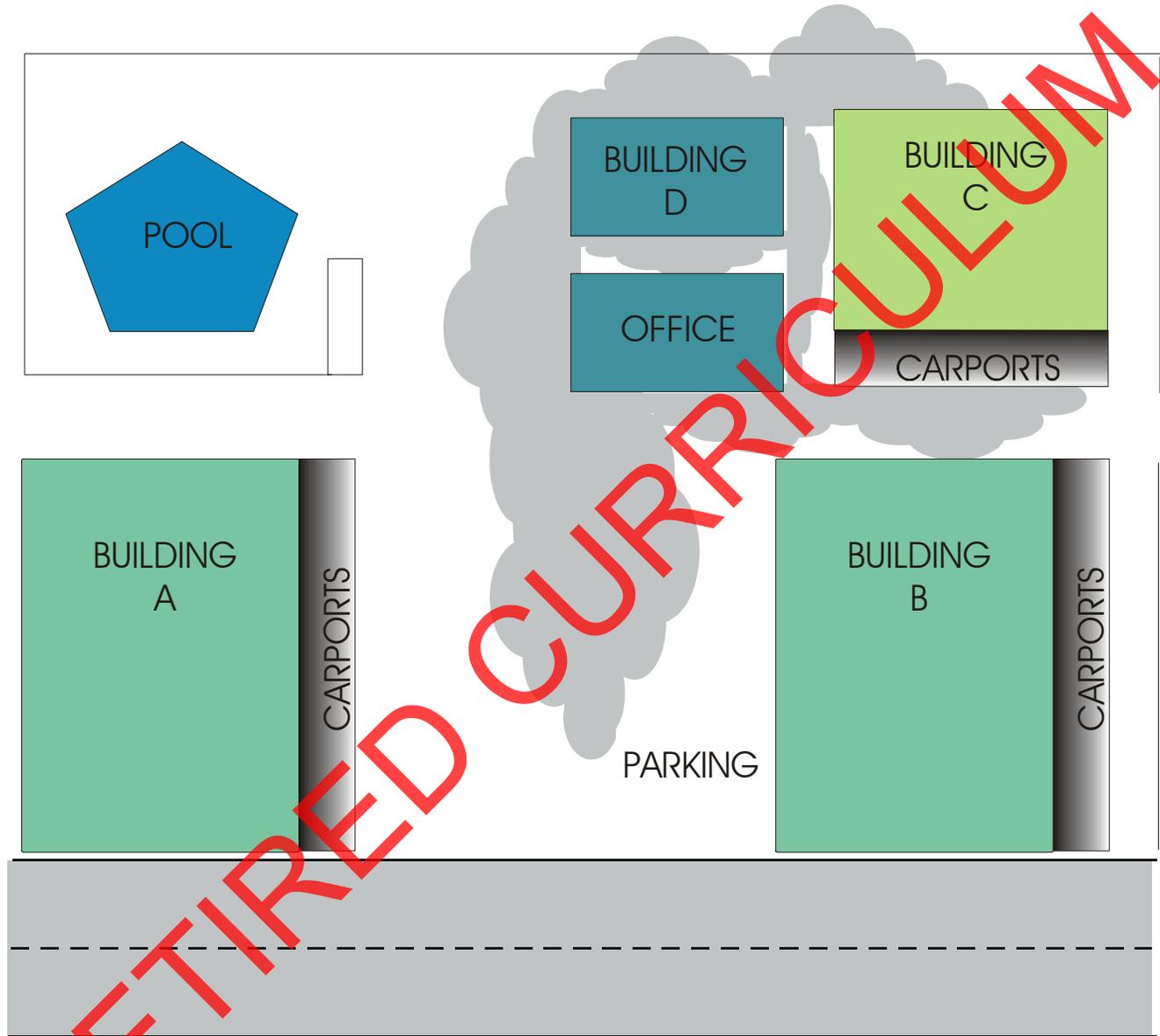
### Information Upon Dispatch

The emergency is reported as a sewer leak at the apartment complex. The time is 1300 hours on a warm summer Tuesday afternoon.

### Observed Upon Arrival

No one meets you as you arrive. Several children are in the driveway playing in water and watching you. As you walk up the driveway and into the complex, you smell a particularly bad odor. About this time, the manager approaches and tells you that the "water" you are standing in is actually sewage. It is also around the building and in the middle of the complex. The manager then takes you to the east side of the building where a two-foot geyser of raw sewage is pouring from the ground and flowing freely about the complex.

*How Would You Solve This Problem?*



## Case Study #3-4: Tanker Rollover

### Facts Known Prior to the Emergency

Pavone Heights is a moderately sized city with a population of 100,000. The area is surrounded by light industrial to the north and residential to the south. The incident area includes a retail strip mall, a service station, a daycare center, and a mobile home park.

### Information Upon Dispatch

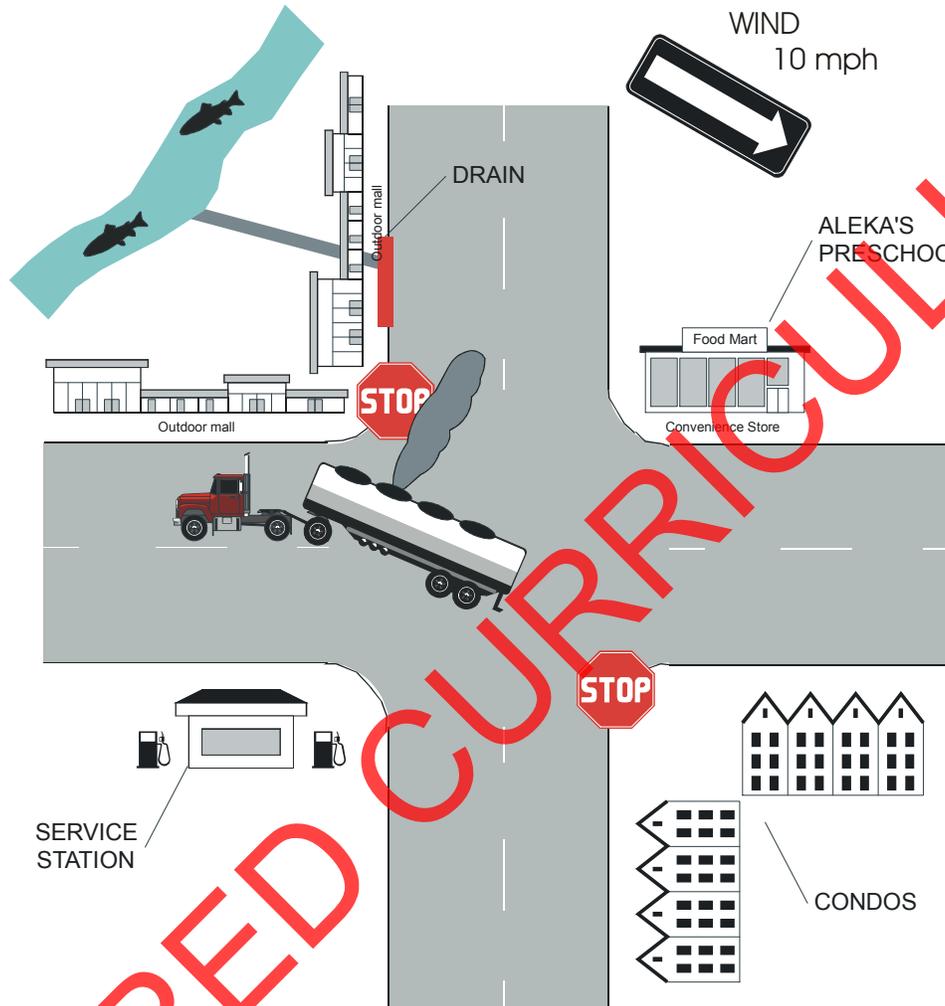
The emergency is reported as a tanker rollover. The tanker has a red placard marked "1203." The time is 1500 on a Tuesday afternoon. The temperature is 87°F with winds out of the northwest at 10-mph. Initial response is one Type 1 engine company.

### Observed Upon Arrival

A tractor-trailer has rolled over while executing a left-hand turn. The trailer, a tanker, is placarded with a red 1203. A leak of approximately 15 gallons per minute is coming from the center dome. The leaking material is moving toward, but has not yet reached, a storm drain that empties into a stream in approximately 300 yards. There are no injuries at this time.

*How Would You Solve This Problem?*

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## Topic 4-1: Factors Affecting Wildland Fires

Slide 1

**What Affects Wildland Fires?**

- ◆ Three major factors
  - ◆ Fuel
  - ◆ Weather
  - ◆ Topography



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Slide 2

**FUEL CLASSIFICATION**

- ◆ Ground fuels
  - ◆ Twigs, leaves, needles
- ◆ Surface fuels
  - ◆ Grass, crops, brush
- ◆ Crown fuels
  - ◆ Suspended fuels
  - ◆ Upright fuels
    - ◆ Large trees

Grouped according to their position on the ground or in the air

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Slide 3

**FUEL RATE OF BURNING**

- ◆ Fuel size determines the ease of ignition and rate of burning
- ◆ Compact fuels have less air available
  - ◆ Tend to burn more slowly
- ◆ Continuity of fuels affects the spread
- ◆ Volume of fuel determines how intense the fire will burn

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Slide 4

**WARNING SIGNS**

- ◆ Unusually low fuel moisture content
- ◆ Large amount of fine fuel
- ◆ Continuous areas of fuels on slopes
- ◆ Crown foliage dried by surface fires
- ◆ High concentration of snags
- ◆ Very high burning and buildup index

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Slide 5

**WEATHER FACTORS**

WIND  PRECIPITATION 

50°  30° HUMIDITY

20° TEMPERATURE

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Slide 6

**EFFECTS OF WIND**

- ◆ Fire spreads faster and unevenly
- ◆ Burns more intensely
- ◆ Carries embers; may cause spot fires
- ◆ Dries fuel out
- ◆ Accelerates evaporation of fuel moisture
- ◆ Changes direction of fire
- ◆ Jeopardizes control of fire & fire fighters

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Slide 7

**WIND CREATION**

- ◆ Wildland fires create their own wind
- ◆ Constant watch is required

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Slide 8

**ATMOSPHERIC TEMPS**

<ul style="list-style-type: none"><li>◆ Warm/hot air</li><li>◆ Absorbs more moisture</li><li>◆ Dries fuel</li><li>◆ Preheats fuel</li><li>◆ Fire burns hotter</li></ul>	<ul style="list-style-type: none"><li>◆ Cool air</li><li>◆ Holds less moisture</li><li>◆ Dampens fuel</li><li>◆ Spread is slowed</li></ul>
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Slide 9

**RELATIVE HUMIDITY**

- ◆ Affects fuels
  - ◆ Absorbs moisture from cool air
  - ◆ Gives off moisture to hot air
- ◆ 30% RH = favorable for burning
- ◆ 10% RH = fire danger is critical

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Slide 10

**PRECIPITATION**

- ◆ Affects the *condition* of fuels
  - ◆ Amount of rain absorbed by soil
    - ◆ Determines length of growing season
    - ◆ Determines moisture in fuels
  - ◆ Dry spells will reduce moisture in fuels
  - ◆ Rainy or damp season
    - ◆ Flash fuels dry out quickly
    - ◆ Heavy fuels retain moisture

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Slide 11

**TOPOGRAPHY**

- ◆ Refers to *slope* of the land
- ◆ Steepness affects both the *rate and direction* of fire
- ◆ Fires move faster uphill
  - ◆ Flames closer to fuel
  - ◆ Uphill winds push heat and flames
  - ◆ Convection heat causes a draft
- ◆ Fires move slower downhill
  - ◆ Burning embers may roll and start new fires

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Slide 12

**DIRECTION OF SLOPE**

<ul style="list-style-type: none"><li>◆ Full southern exposure<ul style="list-style-type: none"><li>◆ Sun more direct</li><li>◆ Higher temperature</li><li>◆ Lower humidity</li><li>◆ Dry, light, flashy-type fuel</li></ul></li></ul>	<ul style="list-style-type: none"><li>◆ Southeastern, southwestern, western exposures<ul style="list-style-type: none"><li>◆ Equal amount of heating</li></ul></li><li>◆ Northern exposure<ul style="list-style-type: none"><li>◆ Cooler temperature</li><li>◆ Higher humidity</li><li>◆ Larger, slower burning fires</li></ul></li></ul>
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Slide 13

**WARNING SIGNS**

- ◆ Saddles, passes, lee side of ridges
  - ◆ Cause horizontal eddies
- ◆ Gradient winds on lee sides of mountain formations
  - ◆ Form vertical eddies
- ◆ Wind on mountain/peak tops
- ◆ Thermal belt
- ◆ Steep slopes, chimneys, and canyons

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Slide 14

**FUEL MOISTURE**

- ◆ Controlled by the relative humidity
- ◆ Location of fuel to the surface affects fuel moisture
- ◆ Larger fuel = slower change in fuel moisture
- ◆ Can be used to help control fires

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Slide 15

**TIME OF DAY**

USED TO PREDICT BURNING CHARACTERISTICS

- ◆ **1000-1800:** fire intensity at its highest
- ◆ **1800-0400:** favorable for fire control
- ◆ **0400-0600:** most easily controlled

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Slide 16

**AREA IGNITION**

- ◆ An advanced stage of a wildland fire
- ◆ Direct attack and control impossible
  - ◆ Sudden increase in intensity and rate of spread
- ◆ Little warning

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Slide 17

**INDICATORS**

- ◆ High, sustained rate of spread
- ◆ Well developed convection column
- ◆ Long distance spotting
  - ◆ Over 600 feet
- ◆ Fire whirlwinds
- ◆ Horizontal flame sheet

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Slide 18

**SIZE OF FIRE**

- ◆ Large wildland fires burn with unique characteristics
- ◆ Size, distribution, compactness, and volume of fuels **does impact** the size
- ◆ Intense heat results

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A wildland fire with no outside factors affecting it will tend to grow in a circle, spreading evenly in all directions. Unfortunately, very few fires spread in this manner. There are three major factors that influence wildland fire situations: fuel, weather, and topography. Other less significant factors can either help or hinder fire fighters in their efforts. Understanding these various factors and their effects will help keep fire personnel out of potentially life threatening situations.

## **Fuel Classification**

There are several hundred vegetation types common in North America that can be considered flammable fuels. These fuels can be classified by weight of live fuel (ton per acre), size and height, geographic location, and plant family. Another common method of classification is to group fuels according to their position on the ground or in the air. Ground fuels are those that are lying on the ground. They include small twigs, leaves, needles, and duff-composition materials. Surface fuels are low-level live fuels including grass, field crops, brush, and small trees. Crown fuels are suspended or upright fuels such as large trees, vegetation, leaves, and needles.

The rate at which fuels burn also depends on a number of factors. As with any fuel, size and surface area determines the ease of ignition and rate of burning. Light fuels or flash fuels such as dry grass, dead leaves, and small brush ignite easily and burn quickly. They serve as kindling for heavier fuels. Heavy fuels are slow burning and usually ignited by fires involving lighter fuels. Examples include links, logs, stumps, and deep duff. Heavy fuels give off large amounts of heat and are more difficult to extinguish than light fuels.

Density and continuity of the fuel affects fire spread, just as it does in any fire situation. Compact fuels, such as duff or dense ground fuels have less air available so they tend to burn more slowly. Patchy, scattered fuels burn more slowly as well, because the transfer of heat is not sufficient to preheat or ignite surrounding fuels. On the other hand, the transfer of heat will cause fire to spread faster in fuels that are closer together. Large volumes of fuel will produce a more intense fire; whereas smaller volumes of fuel will produce much less heat.

## **Fuel Factor Warning Signs**

There are several warning signs of potential extreme fire behavior due to fuel factors. They include an unusually low fuel moisture content, a large amount of fine fuel or continuous areas of fuels on slopes, crown foliage dried by surface fires over a large area, a high concentration of snags, and a very high burning and buildup index.

## **Weather**

Four generally accepted weather factors influence wildland fires. They include wind, temperature, relative humidity, and precipitation.

### **Wind**

There are two factors that cause winds. One is the uneven heating of air. Warm air expands and rises. Cooler, heavier air descends. The second is the earth's rotation, causing air to move from west to east.

High- and low-pressure systems affect wind velocity, direction and temperature. Air flows in a counter clockwise direction in a low-pressure area, and in a clockwise direction in a high-pressure area.

Topography also influences wind. Where there are large bodies of water the wind tends to blow inland during the day as the sun warms up the land. It blows outward in the evening because the land cools faster than water. Mountains tend to act like chimneys. When the slope warms up the airflow moves upslope. When the slope cools down the airflow moves downslope.

Wind affects wildland fires in a number of ways. It causes the fire to spread faster and unevenly. The fire will burn more intensely in high wind conditions. Embers may cause spot fires a considerable distance from the main body of the fire. Wind causes fuels to dry out by accelerating the evaporation of fuel moisture. Wind conditions need to be monitored constantly because wind can change direction quickly and without warning, jeopardizing both control of the fire and safety of the fire fighters, wildland fire will also create their own winds.

### **Temperature**

Atmospheric temperature has many effects. Warm or hot air absorbs more moisture and dries the fuels. It also preheats the fuels and causes the fire to burn hotter. Cool air holds less moisture, and thus will dampen the fuel. It will slow the spread of fire.

### **Relative Humidity**

Relative humidity is the amount of moisture in the air compared with the amount of moisture that the air can hold. Temperature can affect the relative humidity. Hot air holds more moisture; cold air holds less moisture.

Relative humidity impacts fuels and their ability to burn. Fuels absorb moisture from cool air, and give off moisture to hot air. 30% relative humidity creates a favorable atmosphere for burning. When the relative humidity drops to 10%, the fire danger becomes critical. As a rule of thumb, for every 20-degree increase in the temperature the humidity drops by half. Inversely, the humidity will double for every 20-degree drop in temperature.

### **Precipitation**

While precipitation has little direct effect on the flame, it does affect the condition of fuels. The amount of rain absorbed by the soil determines the length of the growing season and the amount of moisture in the fuels. A prolonged dry spell will considerably reduce the moisture in the fuel. Occasional showers will do very little to relieve the fire danger. A rainy or damp season will produce a lot of flash fuels that dry out quickly. Heavy fuels, on the other hand, will retain moisture and slow down the rate of fire spread.

### **Weather Warning Signs**

There are several warning signs indicative of potential extreme fire behavior due to weather conditions. They include:

- Strong surface winds or low winds aloft.

- Unexpected calms, which may be followed by, wind shifts or strong winds that will supply fresh oxygen to smoldering areas.
- High, fast moving clouds that may cause downdrafts or unusual ground winds.
- Unusually high temperatures early in the morning.
- The presence of "dust devils" or whirlwinds.
- Thunderstorm activity moving over the fire.
- Changes in wind slopes from upslope to downslope when areas become shaded.
- Passing cold or warm fronts, which can result in changes in wind direction. Cold fronts can produce turbulent and gusty winds.
- Inversion layers that can cause calming of the fire until such time as a fire or smoke column break through.

### **Topography**

Topography refers to the slope of the land. The steepness of the slope affects both the rate and direction of the fire. As one might expect, fire moves faster uphill than on level ground or downhill slopes. The flames preheat and dry the fuel above, thus causing them to ignite more readily. In addition, normal uphill winds push heat and flames into new fuel. Although fire moves more slowly in a downhill direction, burning embers or debris rolling downhill can easily start new fires.

The direction the slope faces also has a bearing on fire spread and behavior. Slopes with a full southern exposure are the most vulnerable because the sun's rays shine on them more directly. They are prone to higher temperatures and lower humidity. They produce dry, light, and flashy type fuels. Slopes with a southeastern, southwestern, or western exposure receive an equal amount of solar heating as the sun progresses to the west. Slopes with a northern exposure experience cooler temperatures and higher humidity. They tend to have larger, slower burning fuels.

Local terrain and land features have a direct effect on air movements. Restrictions such as a saddle or narrow canyon increase wind velocity and preheat fuels during a fire. These areas have more growth due to drainage during rainy seasons. A steep "V" drainage creates turbulent updrafts and a chimney effect. Fire spreads extremely fast in these areas; they are very dangerous.

### **Topographical Warning Signs**

Warning signs indicative of potential extreme fire behavior due to topography include:

- Saddles and passes which can cause horizontal eddies and the lee side of ridges.
- Vertical eddies formed by gradient winds on lee sides of mountain formations.
- A fire may move upslope on tops of mountains and peaks, and change behavior as it is affected by local winds.
- A thermal belt may produce high intensity burning at night.

- ❑ Steep slopes, chimneys, and canyons can have a dramatic effect on fire behavior.

### **Additional Factors That Affect the Spread of Wildland Fires**

There are a number of other factors, which affect the spread of wildland fires. Although they are less significant than the factors listed above, the fire officer should not overlook their potential impact, especially when combined with one another.

#### **Fuel Moisture**

If a dry piece of wood is exposed to moderate relative humidity of 30% to 40% the fuel moisture will increase rapidly at first, then begin to slow. It will stop when the moisture in the fuel is at equilibrium with the relative humidity. Although the fuel might be exposed for a longer period, the fuel moisture will not change. For every relative humidity, there is corresponding fuel moisture content.

The proximity of the fuel to the earth's surface affects the fuel moisture as well. During the day, the air close to the ground surface is warmer and has a lower relative humidity than the air a short distance above the ground. For example, the fuel moisture of small surface fuels in open areas during the summer can be half that of those fuels just one foot above the ground. At night, the ground surface cools first, thus cooling the air, raising the relative humidity, and raising the moisture content of the fuel. Surface fuels might have higher moisture content at night than fuels above the surface.

This relationship between temperature, moisture content, and proximity to the earth's surface may result in different air temperatures in the same area, and different moisture content in the same types of fuels. Even more significant differences in temperature, humidity, and moisture content can be expected when the fuels vary as they do between deep canyons and exposed slopes, or between timbered areas and open areas.

Finally, the larger the fuel, the slower the change in the fuel moisture. Flash type fuels can reach equilibrium in minutes. Limbs two inches in diameter can take up to four days to equal out. Logs can take weeks or even months.

#### **Time of Day**

The burning characteristics of wildland fires can be predicted based on the time of day, fire is generally most intense between 1000 and 1800 hours. The air and fuels are both dry. Temperatures are high, and winds are strong. Between the hours of 1800 and 0400, the factors are favorable for fire control. The winds are usually moderate. The air is cool. The relative humidity usually increases thereby allowing fuels to absorb moisture. The period during which the fire can most easily be controlled is between 0400 and 0600. Just after dawn, the fire intensity begins to pick up again in hill terrain. Winds that were blowing downslope during the night will blow upslope during the day.

#### **Area Ignition**

Area ignition produces fast, hot spread of fire throughout the area. It is an advanced stage of a wildland fire. Direct attack and control are impossible because of the sudden increase in fire intensity and rate of spread. Area ignition can happen suddenly, with little warning to fire fighters. All personnel must be aware of the indicators that signal an impending area ignition: high, sustained rate of fire spread; well

developed convection column; a long spotting distance (over 600 feet); fire whirlwinds; and horizontal flame sheets.

### Size of the Fire

Large wildland fires burn with certain unique characteristics. However, they react the same toward environmental influences as small fires do. Strong convection currents will cause crown fires and spots ahead of the main fire. Intense heat results in large areas being consumed quickly with a total reduction of all combustible materials. Size, distribution, compactness, and volume of fuel also impact the size of the fire.

### Wildland Fire Behavior Quick Reference Charts

To assist in the planning effort and to forecast fire behavior, a series of quick, ready reference charts have been provided in this information sheet. The information contained will provide you a method whereby you can determine valuable information that is required to have a successful plan of action.

#### Fire Behavior

Flame Lengths (Hauling Chart)		Directly Related to Fire Intensity
0-4'	100 BTUs/Feet/Second	Direct attack, hand tools
4-8'	500 BTUs/Feet/Second	Hose lays, retardant, dozers
8-11'	1000 BTUs/Feet/Second	Direct control difficult, control efforts at head may be ineffective
Over 11'	plus 1000 BTUs	Indirect attack, control efforts at head ineffective, spotting, major runs
RATE OF SPEED (ROS)		
A 10% drop in relative humidity will increase ROS by 1/3		
All factors remaining the same, ROS doubles for every 25% increase in slope		
Fire moving from brush to grass will double the ROS		
Fire intensity will increase, as fire moves into heavier fuels by ROS will decrease		
Chains/hour is roughly equivalent to feet/minute. (Actual: 1.1X ft./min.)		
Flame length is measured from mid-point at the base of the flame to the end of the advancing flame tip		

#### Fuels

TONS PER ACRE	TOTAL	AVAILABLE	DEAD TO LIVE FUEL RATIO
Dry Grass	.5-2	5-2	20%-30% Dead-Low Fire Intensity
Light chamiso, sage, sagebrush	3-10	2-8	31%-45% Moderate Fire Intensity
Medium chamiso	12-15	8-10	46%-100% High Fire Intensity
Tall, dense mixed brush	15-30	10-20	Calculation of dead component using fuel age class - 1% per year for each year of fuel age over 5 years (40-year-old fuels = 35% dead)
Chaparral common to north exposures	20-40	12-24	

3600 BTUs/pound of fuel (average)

CRITICAL LIVE FUEL MOISTURES	
Less than 85%	Active fire in all 10-hour time lag and smaller fuels
80%	Critical level for manzanita
60%	Critical level for chamiso

*Fuels at critical level will burn like 100% dead fuels*

TIME LAG OF FUELS	
1 hour	Less than ¼" diameter (grass, sage, twigs)
10 hour	¼"-1" diameter (brush)
100 hour	1"-3" diameter (heaviest)

### Fuel Moisture

- Fuel Moisture = Relative Humidity ÷ 5
- Dead Fuel Moisture
- Dead fuels will burn fiercely at 10%F
- Dead fuel moisture of extinction = 25%
- Relative Humidity

### Fuel Oil Content

High Oil Content	Black and white sage, California sagebrush, eucalyptus	For every 20 degree increase in temperature, relative humidity will drop by 50%
Moderate Oil Content	Chamiso, manzanita, toyon, sumac	Spotting
Low Oil Content	Oak, scrub oak	Winds of 15-20 mph will cast firebrands 1'-300'

### Weather

Relative Humidity	0	10	20	30	40	50	60	70	80	90	100
Equilibrium Moisture Content	2	4	5	6-7	8	9-10	11	13	16	22	35
Spread Factor (ft/min)	32	25	19	14	10	8	6	4	3	2	1

*Chart calculated at 75°F*

*No spread level for fine fuels*

## Fire Whirl

### *Favored Locations*

Lee sides of ridges exposed to gradient wind, strong convective columns, bottom and sides on two converging drainages, saddles above box canyons.

### Topography - Slope

- Percent of Slope Estimate = Double the degree of slope  
Calculation =  $[\text{Rise} \div \text{Run}] \times 100$
- 1% slope = 1 foot rise for every 100 foot run
- 100% slope = 45 degrees

### Summary

There are three major factors that affect fire spread and behavior in wildland situations: fuel, weather, and topography. Other less significant factors such as fuel moisture, time of day, area ignition, and size of the fire can either help or hinder fire fighters in their efforts. Understanding these various factors and their effects will help keep fire personnel out of potentially life threatening situations.

### Chapter Review Questions

1. The factors affecting wildland fires differ from structure fires. What are the three main factors affecting wildland fires? Provide at least one example of each.

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2. How does the time of day influence wildland fire behavior?

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3. There is quite a list of warning signs that could lead to extreme fire behavior. Describe two warning signs from each area that affects fire behavior.

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## Topic 4-2: Defensive and Offensive Strategies in Wildland Fire Fighting

Slide 1

**DEFINITIONS**

- ◆ Strategy
  - ◆ Broad application of plans and actions
- ◆ Tactics
  - ◆ Details of an action (strategy)
- ◆ Offensive
  - ◆ An action that attacks
- ◆ Defensive
  - ◆ An action that protects

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Slide 2

**DEFENSIVE STRATEGIES**

- ◆ Structure protection
  - ◆ Isolated structures
  - ◆ Communities and subdivisions
  - ◆ Power and utility lines
  - ◆ Radio/satellite towers
- ◆ To “turn” a fire from direction of spread
- ◆ To “slow down” a fire while waiting for resources

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Slide 3

**OFFENSIVE STRATEGIES**

- ◆ Attack fire by extinguishing it
  - ◆ Enough personnel and equipment
  - ◆ Any size fire
- ◆ Attack fire problem by removing fuel
  - ◆ Construct fire breaks
  - ◆ Any size fire

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When we respond to the scene of a wildland incident, we take in many factors that are going to effect our decision making upon arrival. Once we take in as much of this information that is available, we have to choose a strategy to implement. How we go about implementing this strategy from a tactical sense will be discussed in the next section. For now, we will concentrate on simply the strategy.

The strategy of an incident is the broad application of plans and actions to a problem. Tactics are the details of an action required to solve a problem. With this in mind, we have two choices for strategies - Offensive and Defensive. An Offensive strategy is attacking the problem in an attempt to defeat it, where a Defensive strategy is to protect something or someone from impending danger from the problem.

With this in mind, as first in officer's we must take all of the information in and make the decision to either attack the fire or protect things in its path. This is commonly where structure protection comes into play. First arriving units of a large wildland incident can usually make little or no progress against extinguishing the fire, but they can protect structures from being consumed. This tactic will be discussed later. If there are no structures threatened then an offensive attack should be started no matter how large the incident. This can be accomplished by first in crews directly attacking the fire line or aircraft applying water on the flanks while ground units are in route. The different types of fire attacks will be discussed later.

### **Principles of Backfiring and Burning Out**

Oftentimes, situations at wildland fires are such that actions requiring backfiring or burnout take place. These activities are not rushed into. Many factors must be considered, and extreme caution is the rule.

- All control lines except those directly at the fire edge must be fired out to be effective.
- Favorable conditions for backfiring must be watched for, recognized, and prompt action taken.
- Recognize that backfiring is often justifiable under adverse conditions - little to lose, much to gain. Portions of line held will narrow fire front.
- In backfiring operations, consider these guides:
  - Proper location and construction of lines.
  - Timing operations correctly:
    - ✦ To take advantage of current and predicted weather.
    - ✦ Proper sequence to tie in with other divisions.
    - ✦ Proper speed to meet at designated locations.
    - ✦ Proper speeds to get width of burn necessary to hold.
    - ✦ To complete the job within time limits allowed.
- Take advantage of drafts created by main fire, and by slope and topography.
- Start backfire on higher portion of line so that the operation will proceed downhill.

- Avoid sharp angles in line. If unavoidable, use strip firing.
- In unfavorable weather, use strip firing.
- Stop firing when backfire will not take.
- Use specialized equipment.
- Use dirt or water as aids to hold backfire.
- See that all crews know plan and are in the clear before setting backfire
- When attack is direct or parallel with the control line tied at points to the fire, fuels inside the control line are intentionally burned. The burning of the material between the line and main fire strengthens the line. A line is never complete until burned out. Burning out removes the danger of fuel near the line burning at a later date when no one is around, or when conditions are such that flare-ups near the line would spot across the line.

**Chapter Review Questions**

1. When we choose a defensive strategy, exactly what is it we are attempting to defend?

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2. You have responded to a very large wildland fire as first in. There are no structures threatened. Do you go offensive or defensive and why?

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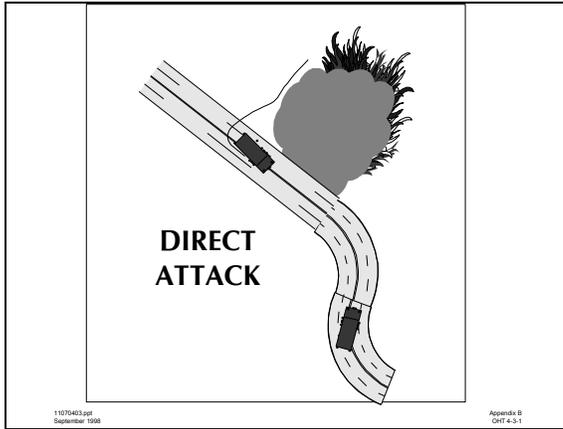
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RETIRED CURRICULUM

## Topic 4-3: Direct and Indirect Attacks

Slide 1



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Slide 2

**USES**

- ◆ Small fires
- ◆ Light fuels
- ◆ Subsurface fuels
  - ◆ Peat, duff
- ◆ Flanks and rear of larger fires
- ◆ Where heat, smoke, burning intensities, and terrain will allow

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Slide 3

**ADVANTAGES**

- ◆ Limits chance for fire to gain momentum or size
- ◆ Eliminates need for backfire
- ◆ Reduces danger of crowning
- ◆ Crew can escape into burned area
- ◆ Takes advantage of burned out area along control line

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Slide 4

**DISADVANTAGES**

- ◆ Working in heat and smoke
- ◆ More mop-up and closer patrol
- ◆ Danger of slop over and spot fires
- ◆ Control line generally follows fire edge
- ◆ Does not take advantage of existing fire barriers

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Slide 5

**DIRECT ATTACK DO'S**

- ◆ Take advantage of wind lulls
- ◆ Coincide with fire entering lighter fuels
- ◆ Conserve water
- ◆ Scatter heavy fuels inside burn
- ◆ Fell snags adjacent to control line

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Slide 6

**DIRECT ATTACK DON'TS**

- ◆ Attack the head of a fast moving or hot fire
- ◆ Waste water
- ◆ Risk safety of personnel and equipment

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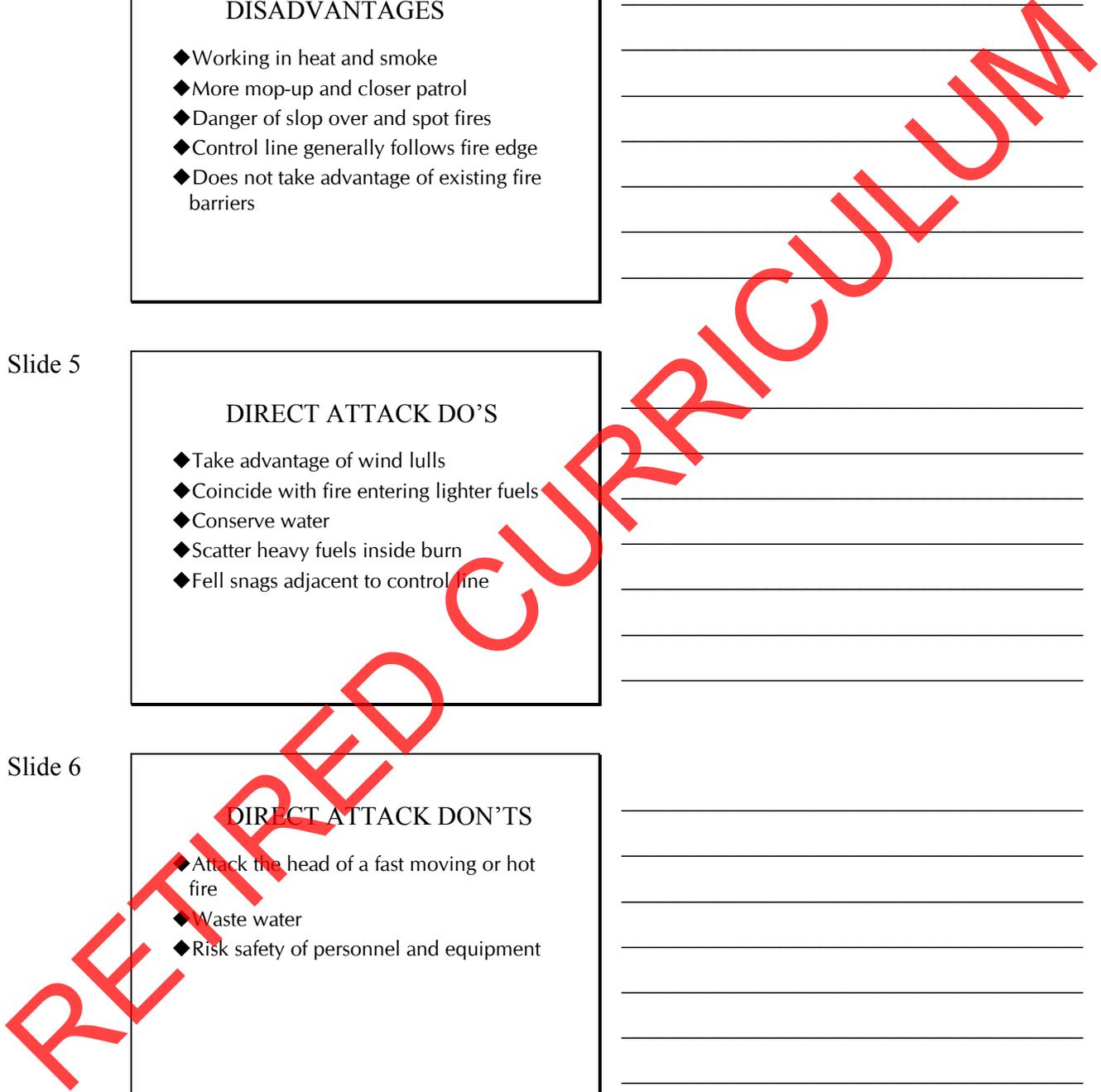
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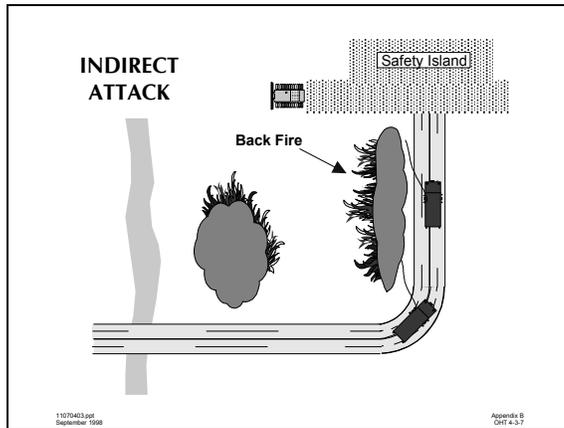
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Slide 7




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Slide 8

- ### USES
- ◆ If there are extremes
    - ◆ Burning intensity
    - ◆ Rate of spread
    - ◆ Working conditions
      - ◆ Heat, smoke, terrain
  - ◆ Insufficient equipment/personnel
  - ◆ If good fire barrier is available
  - ◆ With fast spreading/hot fires
  - ◆ To straighten fire lines across pockets

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Slide 9

- ### ADVANTAGES
- ◆ Not working in heat and smoke
  - ◆ Takes advantage of changes in fuel type
  - ◆ Eliminates line irregularity
  - ◆ Less danger of slop over
  - ◆ Takes advantage of
    - ◆ Tops of ridges, benches, bottoms of slopes, natural barriers

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Slide 10

**DISADVANTAGES**

- ◆ Sacrifices acreage
- ◆ Crew may be flanked by fire
- ◆ Backfires may go out of control
- ◆ Fire may change direction suddenly
- ◆ Personnel held in constant readiness

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Slide 11

**INDIRECT ATTACK DO'S**

- ◆ Establish lines in lighter fuels
- ◆ Make lines straight
- ◆ Keep downed logs and snags outside your line
- ◆ Use natural barriers
- ◆ Clean line down to mineral soil
- ◆ Maintain patrol
- ◆ Set backfires
- ◆ Periodic rest for crew

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Slide 12

**INDIRECT ATTACK DON'TS**

- ◆ Overwork crew
- ◆ Set unwatched backfires
- ◆ Construct a line adjacent to fall fuels
- ◆ Take unnecessary changes with personnel or equipment

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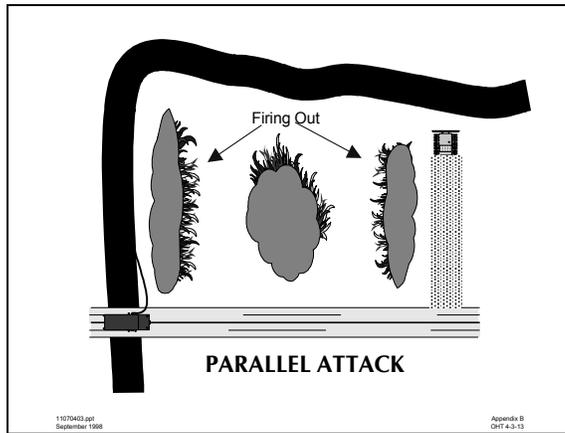
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Slide 13



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Slide 14

**USES**

- ◆ Primarily used by hand crews and dozers
- ◆ Works best in relatively light fuels
- ◆ Works best on relatively small fires
- ◆ Existing natural and man-made barriers are available

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Slide 15

**ADVANTAGES**

- ◆ Crew's work out of heat and smoke
- ◆ Shortens control lines
- ◆ Less danger of slop over
- ◆ Takes advantage of natural and man-made barriers

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Slide 16

**DISADVANTAGES**

- ◆ Requires the use of burning out
- ◆ Unburned fuel between crew and fire
- ◆ Most dangerous attack method

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Slide 17

**PARALLEL ATTACK DO'S**

- ◆ Stay close to fire edge
- ◆ Establish line in lighter fuel
- ◆ Keep line straight
- ◆ Use natural barriers
- ◆ Burn out fuel between line and main fire

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Slide 18

**PARALLEL ATTACK DON'TS**

- ◆ Burn out faster than the line being constructed
- ◆ Construct line in tall fuel
- ◆ Place crew or equipment in danger

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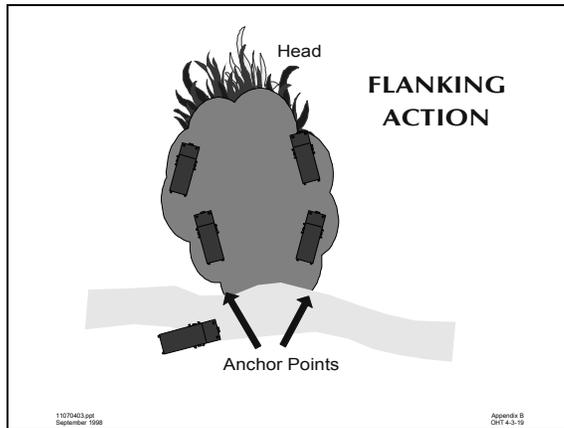
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Slide 19




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Slide 20

**FLANKING ACTION**

- ◆ Action is started from an anchor point
  - ◆ Usually near point of origin/heel
  - ◆ Usually attacking the hottest flank
  - ◆ May use either engine companies or hand crews
  - ◆ If not too hot
    - ◆ Must make sure fire is contained before moving forward so fire does not slop-over

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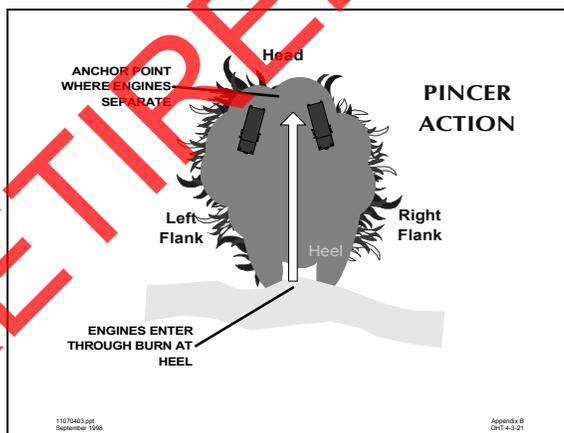
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Slide 21




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Slide 22

**PINCER ACTION**

- ◆ Started from anchor point
  - ◆ Usually point of origin
  - ◆ Action on both flanks
  - ◆ Working toward the head, pinching off fire
  - ◆ Both flanks do not have to be attacked at the same time or extinguished at the same rate
  - ◆ Engines may work on hottest flank while hand crew works the cooler one

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Slide 23



**TANDEM ACTION**

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Slide 24

**TANDEM ATTACK**

- ◆ May be used on a flanking or a pincer attack
- ◆ Must start at anchor point
  - ◆ Usually near point or origin
- ◆ Usually requires two engines on the same flank
- ◆ May use an engine and hand crew
- ◆ Requires good communication and teamwork

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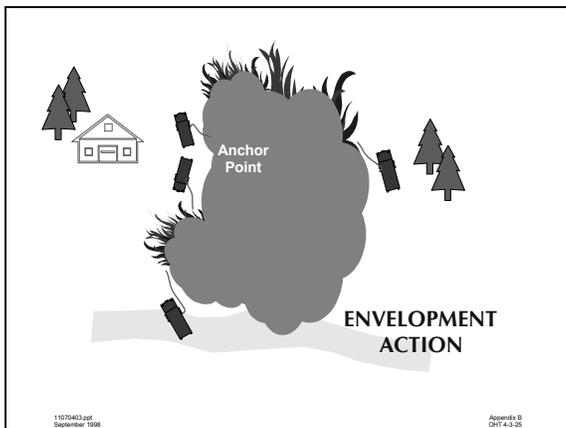
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Slide 25




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Slide 26

**ENVELOPMENT ACTION**

- ◆ Used to attack the fire from several anchor points
- ◆ All actions starts at nearly the same time
- ◆ Good communication and teamwork
- ◆ Can be dangerous
  - ◆ Crews may have unburned fuel between them
  - ◆ Erratic fire behavior

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Slide 27

**BURNING OUT**

- ◆ Usually a defensive action
- ◆ Used to strengthen a control line
- ◆ Used to remove pockets and/or islands of fuel
- ◆ Used to protect structures
- ◆ Must be done with tight control, good communications, and teamwork
- ◆ Always a risk the operation could get out of control

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Slide 28

**BACKFIRING**

- ◆ Usually an offensive action
- ◆ Control line is established as close as possible to the fire
  - ◆ Taking into account the time required to construct and hold control line
  - ◆ Intervening fuel is set on fire to put out the main fire
- ◆ May be initiated only by the Incident Commander
- ◆ Should only be done by an experience crew

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RETIRED CURRICULUM

## Choose Your Method

Now that you have decided on an offensive strategy, it is now time to choose your method of attack. The types of attacks are broken into three areas - Direct, Indirect and Parallel. The direct method is exactly as it sounds - placing some type of extinguishing agent directly on the fire. Direct attacks can be done by fire crews, hand crews or through the air. It is generally used on smaller fires in light fuels, or along the flanks or rear of large fires.

### *Direct Attack*

The advantages of a direct attack includes limiting the growth of the fire, eliminates the need for backfiring, reduces the danger of crowning by extinguishing the ground or surface fires, allows for a safety area within the burned area for crews and takes advantages of the burned out areas along the control line. The disadvantages include working your personnel in the heat and smoke, more mop up and closer patrol are needed, more danger of spot fires and sloop over, the control line is usually irregular and longer and does not take advantage of natural or man made barriers.

When performing direct attacks the crews need to take advantage of wind lulls, conserve water, scatter heavy fuels in the burned area, and fall snags adjacent to the control line. They also need to be careful and not attack the head of fast moving or hot fires, waste water needlessly and risk their safety on fuels that will just grow back the following year.

There are several ways to perform a direct attack on a wildland incident. These are called flanking, pincer, tandem, and envelopment. The flanking attack is the most common and is simply an attack progressing along both flanks of the fire and extinguishing it as forward progress is made. The pincer attack is essentially the same attack as the flanking attack with emphasis being made on "pinching off" the head of the fire quickly to avoid further spread. The tandem attack is where several apparatus use one flank, preferably the hot flank, and the apparatus work their way totally around the fire while they extinguish it. The envelopment attack is where multiple apparatus pick up the fire at different spots in a coordinated attack in order to quickly extinguish the fire and keep it away from structures or other problem areas.

### *Indirect Attack*

The indirect attack is essentially taking the fuel away from around the incident. It is like having a campfire, the fire is in the middle, all around it are areas that will not burn, and thus the fire does not spread. The extreme nature of the fire, rate of spread, heat, smoke, and terrain, number of personnel and the availability of man made fire barriers are all considered as to when to perform indirect attacks. There is no need to put crews in dangerous positions when the incident can be contained using an indirect attack. The advantages of the indirect attack include; personnel are not working in the fire conditions, takes advantage of the different fuel types, makes for regular control lines, minimizes the amount of sloop over, takes advantage of ridge tops, benches, the bottom of slopes and natural barriers such as roads, trails and waterways. The disadvantages of the indirect attack are; it sacrifices acreage, crew may be flanked by the fire, back fires may get out of control, fire may change direction suddenly, personnel must be held in a state of readiness when the fire is due to burn itself out.



## Topic 4-4: Structure Protection and Triage in Wildland Fires

Slide 1

**CHOOSING THE ENGINE**

◆ Equipment Compliment	◆ Wheel Base
◆ Tank Capacity	◆ Weight
◆ Open or Closed Cab	◆ Mechanical Condition
◆ Conventional or 4-Wheel Drive	◆ Pump Type

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Slide 2

**ENGINE PERSONNEL**

- ◆ Order what you need
- ◆ Experience may determine capabilities
- ◆ Fatigue becomes a critical factor

When homes are burning, you may just need the closest engines of any type, right away.

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Slide 3

**TYPE OF ASSIGNMENT**

- ◆ Mobile attack on grass fire
  - ◆ Pump and roll - Shorter wheel base
- ◆ Stationary pumping on hose lay
  - ◆ May need large water tank, pump for high pressure
- ◆ Primarily off-road pumping
  - ◆ Smaller brush engines
- ◆ Structure protection
  - ◆ Water tank size

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Slide 4

**STRIKE TEAM COMPONENTS**

- ◆ Common capability
- ◆ Common communications
- ◆ Common leader

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Slide 5

**EQUIPMENT DEPLOYMENT**

- ◆ Get clear assignment
- ◆ Always have an escape route
- ◆ STL should survey area/check for hazards
- ◆ Keep engines working as a team
- ◆ Keep long hose lays to a minimum

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Slide 6

**WATER - HYDRANT SUPPLY**

- ◆ Extinguish only what is necessary
- ◆ Don't waste water on wood shingle roofs
- ◆ Remove strategic combustibles
- ◆ Let everything burn that is not vital to fire control
- ◆ Take fittings with you if you might be overrun

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Slide 7

**WATER - TANK SUPPLY**

- ◆ Conserve limited supply
- ◆ Use hand tools
- ◆ Always know your tank level
- ◆ Never go below **100** gallons **or 60** seconds worth of water

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Slide 8

**WATER TENDER USE**

- ◆ Order enough to keep ST supplied
  - ◆ Normally 1 or 2
  - ◆ Dependent on travel time and distance
- ◆ Water conservation must still be enforced

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Slide 9

**PROTECTING STRUCTURES**

**COMMON ERRORS**

◆ Laying hose lines too far, excessive hose lays	◆ Unnecessary apparatus
◆ Not meeting fire	◆ Exposing parked equipment
◆ Not maintaining sight or radio contact	◆ Wetting down wood shingle roofs when water is limited
◆ Wasting time/energy on "lost" structures	◆ Using hardlines
	◆ Prewetting vegetation

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Slide 10

**SAFETY**

- ◆ If too hot, retreat
- ◆ Don't face intense fire
- ◆ Keep apparatus mobile
- ◆ Engine
  - ◆ Headlights on
  - ◆ Windows closed
  - ◆ Charged preconnect
- ◆ Park on roadway adjacent to structure
- ◆ Fire fighter watch for spot fires
- ◆ Fire around structures
- ◆ Stay out of saddles and chutes

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Slide 11

**WHAT TO TELL CIVILIANS**

- ◆ Encourage them to leave the area
  - ◆ Police personnel usually will handle an evacuation
- ◆ Inform them of dangers of a moving fire
- ◆ Explain basic protection for those who choose to stay
- ◆ Impress "family" concept

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Slide 12

**STRUCTURE TRIAGE**

General Factors

- ◆ Clearance
- ◆ Fuel Type
- ◆ Terrain
- ◆ Access
- ◆ Roof construction

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Slide 13

**STRUCTURE PROTECTION**

- ◆ Go for the one not well involved
- ◆ Look at type of roof covering
- ◆ Consider personnel safety
- ◆ Consider available personnel
- ◆ Consider water supply
- ◆ Consider values at stake

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RETIRED CURRICULUM

The traditional "American Dream" of owning a house in the country has created a major problem for fire fighters. The idea of moving to the country to get out to the cities because of all of the crime and the lack of good schools is becoming commonplace. The idea of commuting is viewed as a necessity instead of a problem. With this come all of the problems associated with this move. The city dweller does not understand "defensible space" or fire resistant construction and they build the same type home they would build if they had a fire station just down the block. Fortunately, fire agencies that find themselves faced with this dilemma have enacted ordinances that require defensible space, fire resistant roofing, water supply capabilities, proper roadways, and other fire protection measures. This is helping those homes that are recently constructed but does not address the ones that were "grandfathered" in.

The fire agency that has to deal with problems created by homes built in the interface needs to be aware of numerous factors that make these houses, in some cases, unable to be protected. Homes that were built to take advantage of the natural surroundings are usually built at the top of chimneys, on ridge tops, in and around trees, and against steep slopes. Also, they usually have steep, narrow, one-lane driveways that are overgrown with vegetation that limit our access and egress. They are usually constructed of wood with wood shake roofs, wood decks, large windows, and natural landscaping. They will have limited, if any, water supply. These homes as we will discuss later are termed "losers" in structure triage. The bottom line is, as an agency that has to protect these homes, you must preplan them and identify the "winners" and "losers" before a wildland incident in the interface.

### Fire Engine Capabilities and Tactics

Choosing the right engine for the job is an important part of the decision-making process for the first-in company officer. The officer may or may not know all of the capabilities for all of the responding apparatus, but should have some basic knowledge of which capabilities are advantageous in wildland incidents.

Equipment complement is an area of concern. Having the proper amount and type of hose is a major factor. You cannot have an engine do a progressive hose lay if they do not carry the proper equipment. The hose complement should have both single and double-jacketed hose so it is capable of both wildland and structural fire fighting. To meet some of the OES typing requirements for apparatus it must have the following amounts of hose:

- Type 3: 1000' of 1½" with 800' of 1"
- Type 1: 1200' of 2½" with 400' of 1½"

There are many different adapters, clamps, packs, and other tools in addition to hose that are needed to do progressive hose lays correctly. Make sure the "whole package" is available before making an assignment.

Water tank capacity is another factor to be considered when the ability to sustain an attack absent a static source is necessary. This is commonplace in wildland incidents. In most cases, apparatus have more water than what the minimum OES typing requires. For Type 1 and 2, the minimum is 400 gallons and for Type 3, it is 300 gallons. Tenders must have 1000+ gallons. Depending on what you

may need a strike team or a single engine to do may lead you to choosing a Type 1 engine over a Type 3 based on water tank size.

The cab of the apparatus is another consideration. An open cab is very dangerous on wildland fires. There has never been a recorded instance where a fire fighter was burned to death in a closed vehicle, but numerous fire fighters are burned out in the open, on the back of an engine, or attempting to outrun the fire. The hose bed must also be enclosed in a sense. It should be covered preferably with diamond plate.

Does the vehicle have off road capabilities? Depending on the terrain, a 4-wheel drive may be required if traction, climbing ability, or ground clearance is important. Remember 4-wheel drive engines may require longer travel time on the highway and may not be as readily available. Most 4-wheel drive engines are Type 3 or Type 4 engines, so if you are looking for a four-wheel drive vehicle for structure protection, you may not get what you need or it may take awhile to get there. The ability to negotiate narrow roads with short radius or steep climbing turns may become a factor, so wheelbase may also be a concern. Turning radius should be short enough to change directions rapidly when needed.

Weight considerations also come into play. Does the local roadbed or bridges support the apparatus responding? Will you be working over or around septic tanks or other in ground tanks that personnel may not be aware of and would not support the weight of the apparatus? The mechanical condition of the responding apparatus may also be a concern, as sometimes the first out equipment is not sent. Structural type engines may not be equipped with adequate air cleaner protection.

The pump type of the responding apparatus will also be a factor to consider. Some of the responding apparatus may be capable of pump and roll operations. Is there an apparatus that has the capability of high-pressure operations to support a progressive hose lay up the side of a steep hill?

The most important thing to consider is the personnel on the apparatus. Experience of the company officer and crewmembers determine what the capability of an individual engine really is. This can be quickly determined through the company officer as to their capabilities in progressive hose lays, pump and roll operations, water shuttle or relay operations etc. If you are working with unknown crews, be sure and monitor their operations to make sure they are doing what was requested.

Remember that when things are tough and homes are burning, what you may need is just the closest engines of any type right away.

## **Engine and Strike Team Tactics**

Strike teams are assigned at up to five strike teams per division, five divisions per branch. Strike teams are put together with the following in mind:

### **Common Capability**

They have the ability to work together on an assigned task with like equipment. If the assignment is a pump and roll operation then the strike team would be capable of accomplishing the assignment.

### **Common Communications**

They have the ability to talk to each member unit within the strike team on a designated radio channel.

## Common Leader

They only report to a single leader.

## Staging

Strike teams may be dispatched to staging areas or directly to the fire. If you report to a staging area, the strike team leader must check-in with the staging area manager. If you responded directly to the incident, check-in with the division supervisor or the IC if the incident is still small.

If you reported to the staging area, you are under the direct supervision of the Operations Chief. While you are staged, you are considered an available resource and must be able to respond within three minutes. This means no wandering around in the staging area. Keep your units parked together. The strike team leader must report his arrival either by radio or in person to obtain his assignment.

## Assignment

Once your group is assigned to an incident, it is imperative that you get a clear assignment from your supervisor. Then as you arrive in your area of responsibility you need to consider always having an escape route, if possible back your equipment in, use buildings or natural barriers for protection, don't park at top of draws or natural funnels, don't park under power lines. As the company officer, you need to exercise tight control in these situations. This is not a time for the committee approach. Your crew should be solicited for ideas, but you should make the decision and determine the plan of operation. .

Before being deployed, assure that your personnel are in proper full protective equipment, the water tank is full, the engine has adequate fuel, and that all radios work.

Once you are at your assignment and the above issue have been discussed it is time to prepare the structure so you can protect it properly. You should discuss the use of water. It should be understood that unless you are on a static supply that water conservation is a must.

Split the crew into two groups – one inside and one outside. The outside group is to scout out the area and determine where the fire will most likely approach the structure, what items around the home will add to the fuel loading, and what will need to be done to minimize the impact. Things like woodpiles, decks, patio furniture, plants, trees, shrubs, topography, propane tanks, vehicles, and out buildings should all be taken into consideration. Having these items around a home you are assigned to protect does not give you permission to "clear cut" the area or destroy parts of the home. Make sure any needed action is planned out and that it can be done before the fire hitting the home. These decisions are difficult as you don't want to wait too long and not get things accomplished, but at the same time you don't want to cut down all of the shrubs or cut a deck off a house and the fire not even threaten the home! Park your engine behind the building the fire will hit first.

The inside group needs to secure all of the openings to the structure. Place ladders in the garage and tools to pull ceilings inside the structure. If you are not making a stand outside, then SCBAs and structural protective clothing must be inside the home, as you are not going to be fighting a wildland incident if the structure is involved. Heavy drapes should be closed, light drapes removed. Make sure the attic is accessible and can be visually monitored. If you still have power, turn the lights on.

After the fire hits the home get out and check your engine out. Extinguish all remaining fire in and around the structure. Completely check the attic for any blown in embers. We do not want to save a structure and then return several hours later because of an undetected attic fire. Stay alert as the fire may burn back over the same area again. Check in with your immediate supervisor and advise them of your status as well as your estimated time needed to secure the structure you are working on. If it suffered too much damage, you may want to abandon it and request a new assignment. If you made a save, leave a business card so the owner will know whom to thank afterwards.

### Common Errors

The following is a list of common errors made when protecting structures at working wildland incidents:

- Laying hose lines too far away from the structure, using too much hose and tiring out the fire fighters, and laying unnecessary line.
- Not meeting the fire where an easier stand can be made.
- Not maintaining sight or radio contact with other engines in the strike team.
- Wasting time and energy on structures that will be lost no matter what your effort is.
- Employing unnecessary apparatus, where less will do. Clogging roadways.
- Parking equipment where it is unnecessarily exposed to direct fire
- Keeping apparatus mobile, at a fast moving fire, your operations may dictate that personnel position their apparatus in key positions for withdrawal. Run not in fear but because it is the best decision.

### What to Tell Civilians about the Dangers

This is obviously a very emotional time for the civilians involved in this incident. They may need to be reminded, sometimes forcefully, that fire department activities can be dangerous to them and that it would be safer to just leave the area. This may be easier said than done. If necessary turn the problem over to law enforcement because evacuation is primarily a law enforcement problem, leaving the fire department free to control the incident. They should be informed that it is dangerous to run up hills, in canyons, or in draws ahead of a moving fire. Explain that in almost all instances, a person is safe in a well-built structure when a fire sweeps past, even though it may eventually be destroyed.

If civilians are determined to stay with their homes, explain the value of removing any exposures (furniture, shrubs, woodpiles, etc.), and how to protect themselves and handle a garden hose.

Try to impress the mother or father with the importance of keeping the family together; this reasoning sometimes assists the evacuation effort.

## Structure Protection Triage

Company Officers, strike team leaders, division supervisors, and operations chiefs must be capable of making one of the most difficult decisions on a wildland fire, which homes to try and save and which ones to write off. Some of the general factors to consider are:

- Clearance
  - Does it have adequate defensible space?
- Fuel type
  - What type of fuel type surrounds it?
- Terrain
  - Is the topography advantageous to protecting the structure? Is it at the top of a chimney or ridge?
- Access
  - Does it have multiple ways in or out? Is the driveway wide enough for fire apparatus?
- Roof construction
  - Is it wood or fire-resistive roofing materials?
- Water supply
  - Is a static supply available or is it just domestic?

As with all operations the safety of your crew is first, the safety of crews near your operation is second, the safety of the civilians is third, the protection of your equipment is fourth, and the protection of the structure is last. Sometimes nothing you try will be enough, and at other times, the rewards and thanks will be great.

## Chapter Review Questions

1. What three things are common to strike teams?

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2. Name some of the items the "outside group" should consider when preparing a structure to be protected? Why are these important?

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3. Name some of the common errors made when protecting structures on wildland incidents.

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RETIRED CURRICULUM

RETIRED CURRICULUM

## Topic 4-5: Wildland Fire Safety

Slide 1

**10 STANDARD ORDERS**

- ◆ Four Categories
  - Behavior
  - Safety
  - Operations control
  - Ultimate Goal

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Slide 2

**FF ORDER #1**

Keep informed of  
weather conditions and forecasts

- ◆ Major factor in fire behavior
- ◆ Constant monitoring required
- ◆ Use your senses as guides
  - ◆ Feel, see, hear

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Slide 3

**FF ORDER #2**

Know what your fire is doing at all time,  
observe personally or use scouts

- ◆ Observe from vantage point
- ◆ Scout ahead
- ◆ Use helicopter or other aircraft info
- ◆ Make sure findings are made known

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Slide 4

**FF ORDER #3**

Base all actions on the current and expected fire behavior

- ◆What is the fire doing now? and later?
- ◆What action is being taken now?
- ◆What is the weather now? and later?
- ◆What type of fuel is burning now?
- ◆What type of fuel is the fire heading for?

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Slide 5

**FF ORDER #4**

Have escape routes for everyone and make them known

- ◆The burned area if close enough
- ◆Cutting an escape line
- ◆Natural barriers
- ◆Avoid areas where canopy is intact

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Slide 6

**FF ORDER #5**

Post a lookout when there is possible danger

- ◆When the head is not visible
- ◆When felling snags or debris falling
- ◆When personnel/equipment working closely together
- ◆Fire starting outside of control line

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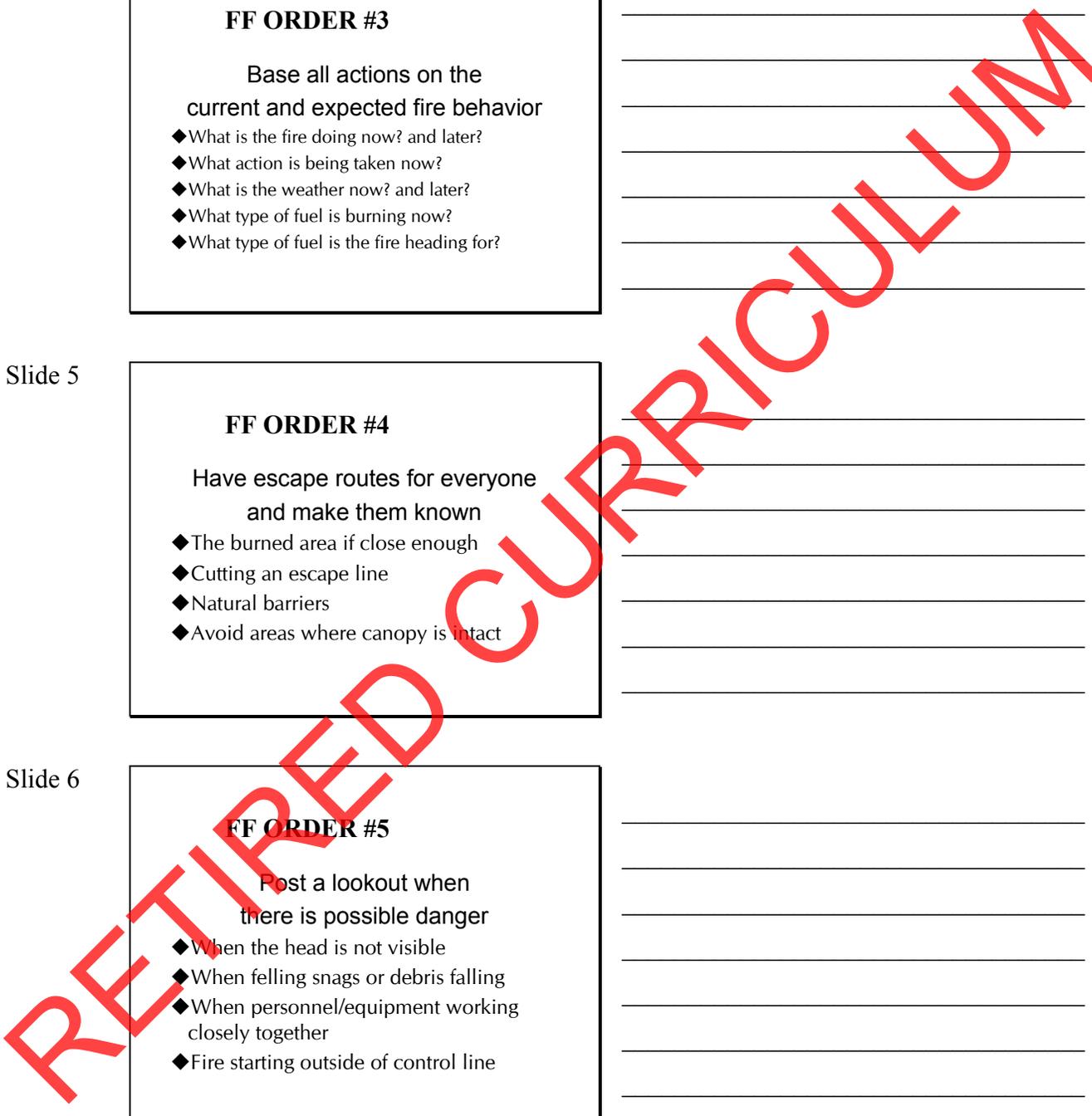
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Slide 7

**FF ORDER #6**

Be alert, keep calm,  
think clearly, act decisively

- ◆ Panic can injure or kill
- ◆ After evaluating situation, you can make a better, more accurate decision

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Slide 8

**FF ORDER #7**

Maintain prompt communications with  
personnel, supervisor, adjoining forces

- ◆ Radio communication
- ◆ Line of sight with visual aids or hand signals

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Slide 9

**FF ORDER #8**

Give clear instructions and  
be sure they are understood

- ◆ What to do and where to go
- ◆ When and where to finish
- ◆ With whom to tie in
- ◆ Expected duration of attack
- ◆ Who will relieve you - supervise you

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Slide 10

**FF ORDER #9**

Maintain control of personnel  
at all times

- ◆ Communication maintains control
- ◆ Coordination of available equipment
- ◆ Provision of safety equipment

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Slide 11

**FF ORDER #10**

Fight fire aggressively,  
but provide safety first

- ◆ Key to suppression
- ◆ Don't short cut or violate any safety rule
- ◆ Take another look and apply accepted practices

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Slide 12

**AIR TANKER DROPS**

- ◆ Split
  - ◆ Single drop from one door at a time
- ◆ Trail
  - ◆ Overlapping series of drops from 2-8
- ◆ Salvo
  - ◆ The total load at one time

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Slide 13

**HERE IT COMES!**

- ◆ Move out of the target area
- ◆ Stay away from large trees
- ◆ Never stand up in the path of an air drop
- ◆ The most dangerous area is in the center
  - ◆ 15-20 feet of the pattern
- ◆ Grab something solid and get behind it

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Slide 14

**HELICOPTER USES**

- ◆ Reconnaissance
- ◆ Ferrying personnel and supplies
- ◆ Evacuation
- ◆ Retardant, water, or foam drops
- ◆ Search and rescue

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Slide 15

**HELICOPTERS**

- ◆ Safety Precautions
  - ◆ Approach and departure
  - ◆ Working around the helibase
  - ◆ In-flight safety

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Slide 16

**THE HELIBASE**

- ◆ Stay at least 100 feet away from helicopter
  - ◆ Unless you have specific job
- ◆ Do not face a landing helicopter
  - ◆ Without goggles
- ◆ Do not remain under flight path
- ◆ No smoking within 50 feet
- ◆ Learn and use standard hand signals

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Slide 17

**IN-FLIGHT SAFETY**

- ◆ No smoking
- ◆ Use seat belt
- ◆ Secure loose gear, helmets, maps, papers
- ◆ Never slam doors
- ◆ Stay away from pilot and controls
- ◆ Never throw anything out
- ◆ Do not talk during takeoff

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Slide 18

**WILDLAND FIRE SAFETY**

If something does happen

- ◆ Escape from the area of danger
- ◆ Take refuge in a structure
- ◆ Take refuge in a vehicle
- ◆ Take refuge in a "safe" area
- ◆ Deploy fire shelter
  - ◆ Your last resort

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Slide 19

**STRUCTURES for REFUGE**

If time to prepare

- ◆ Advise STL, Supervisor, or IC of situation
- ◆ Close windows
- ◆ Remove combustibles away
- ◆ Remove gas combustibles away from LPG tank
- ◆ Bring protection equipment inside

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Slide 20

**STRUCTURES for REFUGE**

If fire is imminent

- ◆ Advise STL, Supervisor, or IC of situation
- ◆ Close windows and any heavy drapes
- ◆ Bring protection equipment inside

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Slide 21

**VEHICLES for REFUGE**

Before responding to a fire

- ◆ Check vehicle door and window seals
- ◆ Cover any holes in floorboard
- ◆ Practice getting crew into cab while wearing PPE
- ◆ Check condition of fire blankets or drapes
- ◆ Pack an extra fire shelter

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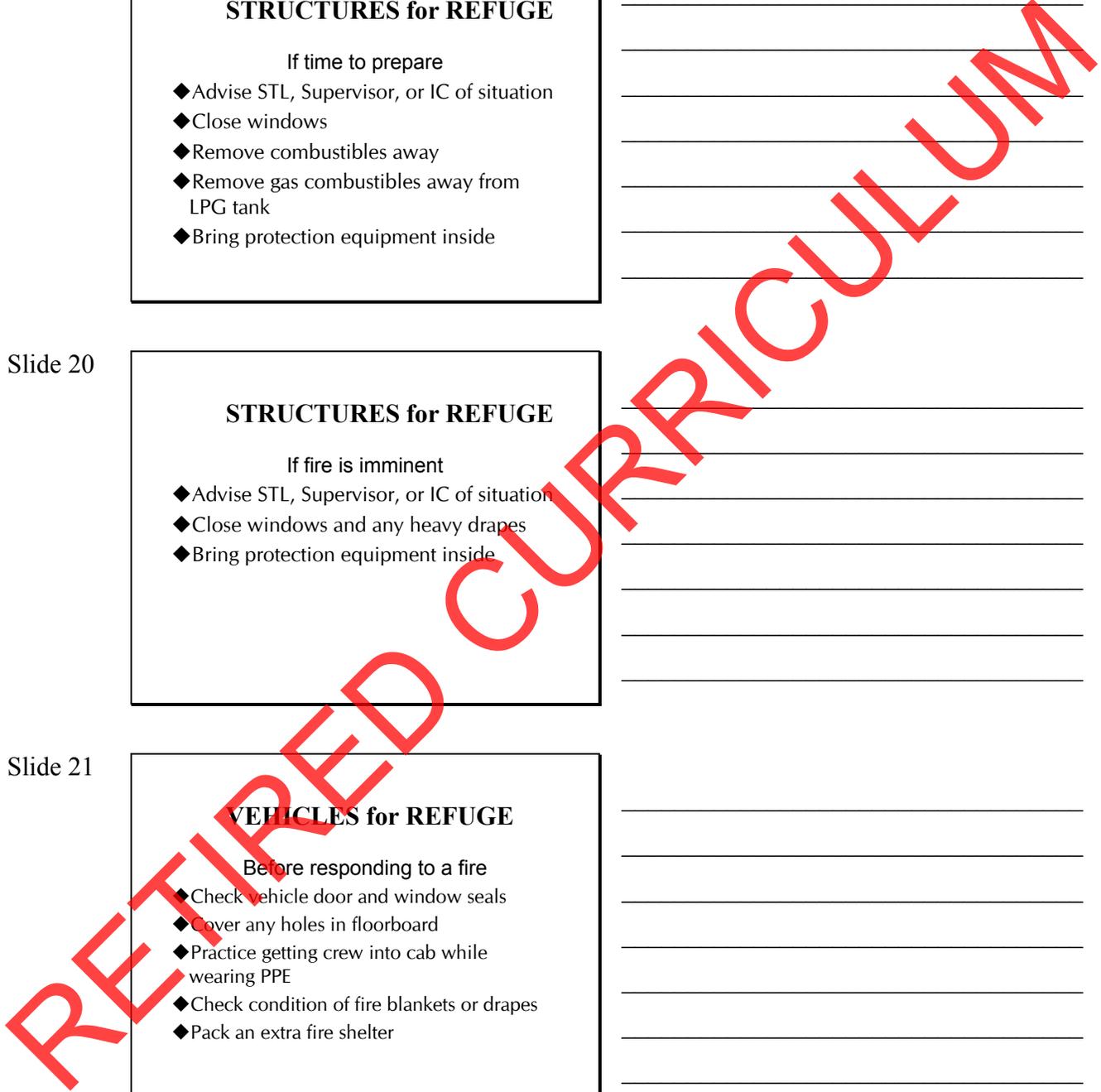
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Slide 22

**VEHICLES for REFUGE**

If fire is imminent

- ◆ Call for help
- ◆ Park in best location possible & set brake
  - ◆ Away from fuel and power lines
  - ◆ Behind structure
  - ◆ Out of saddles and draws
  - ◆ In direction of escape
- ◆ Fire out around apparatus if time

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Slide 23

**VEHICLES for REFUGE**

When fire hits

- ◆ Roll up windows and shut doors
- ◆ Cover windows with fire blanket/shelter
- ◆ Stay low, cover up with turnouts
- ◆ Keep engine running with RPMs up
- ◆ Keep calm, take shallow breaths, use SCBA

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Slide 24

**VEHICLES for REFUGE**

What to expect

- ◆ Temperature may reach 200 degrees F
- ◆ Plastic parts may start to melt and release gas
- ◆ Exposed skin will burn

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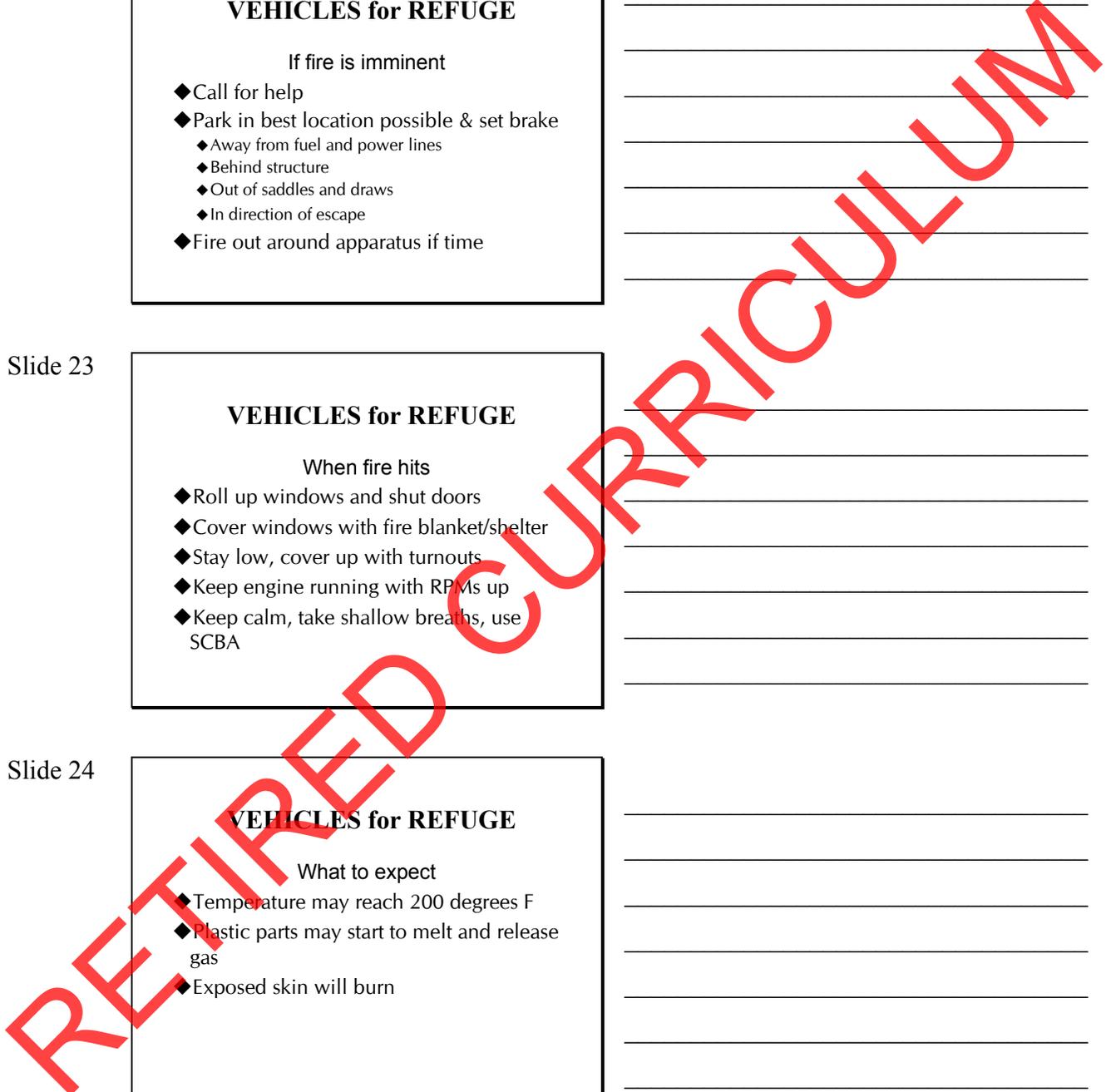
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Slide 25

**VEHICLES for REFUGE**

If vehicle catches fire  
and you have to exit

- ◆ Deploy fire shelter in cab
- ◆ Step out
- ◆ Wrap shelter around you
- ◆ Stay low and move away from vehicle
- ◆ Deploy shelter in safe area

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Slide 26

**VEHICLES for REFUGE**

After fire passes

- ◆ Check for injuries and treat if possible
- ◆ Exit cab with fire shelter
- ◆ Put out any fire on apparatus
- ◆ Be cautious of fire coming back through
- ◆ If apparatus can't be safe, move to another safe area

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RETIRED CURRICULUM

Wildland fire safety is something that does not come easily for urban-based fire crews. In the urban environment, most of the safety concerns are right in front of you and the area of concern is relatively small. In the wildland incident, there is much more to look after and the area of concern is quite large. This chapter provides some proven rules that all crews involved in wildland fire fighting need to be aware of and follow.

## **10 Standard Fire Fighting Orders**

To help in learning the wildland fire safety rules, they have been arranged into the "10 Standard Fire Fighting Orders." Rules 1-3 revolve around the behavior of your fire. Rules 4-6 are specific safety factors. Rules 7-9 concern operations control. And Rule 10 is your ultimate goal. Each category and rule brings with it something to be incorporate in your wildland incident.

### **Rule #1 - Keep Informed on Fire Weather Conditions and Forecasts**

As we learned earlier, the weather has many effects on the fire. Because of this, we need to be up to date on the current weather conditions. In order to do this you can check with the local citizens as to what to expect throughout the day, you can visualize and feel changes in the weather. Belt weather kits may also be available to get accurate weather conditions for your exact position.

### **Rule #2 - Know What Your Fire Is Doing At All Times**

This is something that can be observed from a vantage point, by scouting ahead, or by the use of aircraft. Share this information with your crew(s).

### **Rule # 3 - Base All Actions on the Current and Expected Behavior of the Fire**

This speaks for itself. As long as you know what the fire is currently doing, you can be prepared to deal with it. At the same time, you can plan for changes in the fire's behavior based on weather, topography, and different fuel types. If this is thought out ahead of time, then it will not be a surprise when you encounter it.

### **Rule #4 - Plan Escape Routes for Everyone and Make Them Known**

This should be common knowledge for your crew to be constantly looking for escape routes. As the officer, you need to make sure everyone knows where to go in the event the need to evacuate come about suddenly. This is not an area for debate, once the escape route is determined then all personnel should be aware of its and use it when the need arises. Concerns about the escape route should be raised and discussed before the need to use them. Things to consider are the use of natural barriers like bodies of water, dry riverbeds, and rock ledges or slide areas. Avoid areas with the canopy intact.

### **Rule #5 - Post A Look Out Where There Is Possible Danger**

This should be done when the head of the fire is not visible, when your crew is falling snags, when personnel and equipment are working in close proximity, and any other time the crew leader feels it is necessary.

### **Rule #6 - Be Alert, Keep Calm, Think Clearly, and Act Decisively**

This rule by itself says it all. This one rule will keep many a fire crew from getting into the wrong position and hurting or killing someone.

### **Rule #7 - Maintain Prompt Communications with Your Boss and Adjoining Forces**

This is easily accomplished with a radio in most cases. If the radio is not able to do terrain then you need to go face to face with those crews in close proximity and with your supervisor. Adopting the attitude that "no news is good news" could be a deadly mistake.

### **Rule #8 - Give Clear Instructions and Be Sure They Are Understood**

This goes for all emergency scene operations. This also includes making sure you totally understand orders given to your crew by a supervisor. Examples of what you need to know are: what exactly are we going to be doing, where will we be doing it at, where and when will the job be finished, who are we working with, who will be our relief and who are we working for. As you gather this information from your supervisor, you must then pass it down to your crew.

### **Rule #9 - Maintain Control of Your Crewmembers at All Times**

This can be the hardest rule to maintain. When crews get involved in long, tedious assignments, as is often the case in wildland incidents, the crew can start looking for ways out. This is especially true for urban crews that find themselves doing hand crew work or progressive hose lays. Making sure your crew knows exactly why the job is being undertaken, and making sure they get proper rest periods, will go along way to maintaining control of them.

### **Rule #10 - Fight the Fire Aggressively, But Provide for Safety First**

All fire fighters enjoy the challenge of a working incident. The challenge for the supervisor is to not allow them to feel as if they were bullet proof and get somebody seriously injured or killed. As any athlete will tell you, going full speed is much safer than playing at a reduced level. This also applies to fire fighting as long as the safety of the crew is considered.

### **Fire Orders**

- F** Fight fire aggressively, but provide for safety first.
- I** Initiate all actions based on current and expected fire behavior.
- R** Recognize current weather condition and obtain forecasts.
- E** Ensure instructions are given and understood.
  
- O** Obtain current information on fire status.
- R** Remain in communication with crewmembers, your supervisor, and adjoining forces.
- D** Determine safety zones and escape routes.
- E** Establish lookouts in potentially hazardous situations.
- R** Retain control at all times.
- S** Stay alert and act decisively.

## Identifications of Common Denominators of Fire Behavior on Tragedy Fires

- Most incidents happen on the smaller fires or on isolated sectors of larger fires.
- Most fires are innocent in appearance before the "flare-ups" or "blow-ups." In some cases, tragedies occur in the mop-up stage.
- Flare-ups generally occur in deceptively light fuels.
- Fires run uphill surprisingly fast in chimneys, gullies, and on steep slopes.
- Some suppression tools, such as helicopters or air tankers, can adversely affect fire behavior. The blasts of air from low flying helicopters and air tankers have been known to cause flare-ups.

### BE ALERT. WATCH OUT FOR:

LIGHT FUELS

WIND SHIFTS

STEEP SLOPES AND CHIMNEY

## Wildland Fire Situations That Shout, "Watch Out!"

Although primarily designed for hand crew personnel, the "18 Watch Out Situations" have definite application to all fire fighters engaged in brush and/or wildland fire suppression.

- 1. You are building a line downhill toward a fire.** You need to make sure you have escape routes established because this is an extremely dangerous situation. You need to stay with your crew and post lookouts as necessary, be alert to changing conditions. You need to be aware that advanced fuels on upslope are preheated, will rapidly burn, and that spot fires on the upslope can be expected. The fire may generate momentum upslope and jump over hose lays or constructed hand lines.
- 2. You are on a hillside - rolling fire can ignite below you.** You need to properly construct trenches on slopes to hold rolling material. Have established escape routes and know where they are. You need to cut your way into spot fire areas; do not just waltz through the green. Post lookouts as necessary.
- 3. You feel the weather getting hotter and drier.** There will be a decrease in fuel moisture and humidity. The forest fuels will burn faster. You will need to keep a look out for an increase in hot spots appearing on the fire line. Be more alert to changes in fire behavior.
- 4. You notice a wind change.** The fire may begin to spread in a different direction. Your method of attacking and approach may need to be reevaluated. Be alert; post lookouts as necessary. Look for changes in fire behavior.

5. **You are in heavy cover with unburned fuel between you and the fire.** You are in an extremely dangerous situation. Always requires that lookouts be posted at strategic points for constant observation. Line should be turned out behind you as it is being constructed. Be in constant communication with your fire line supervisor. Be prepared to use escape routes immediately.
6. **You are in an area where terrain and/or cover make travel slow and difficult.** You need to know where the fire is at all times and know where you are going. Stay as close to the burn as possible. Do not bunch up, spread out, and be alert for rolling rocks toward crew below.
7. **You are in country you have not seen in daylight.** Attempt to not get lost, stay with your crew. It is a good idea to deploy advanced scouting, observe for sheer drop-offs, shafts, rockslides, etc. Make sure your crew is outfitted with headlamps for all night activities. Maintain communications with your fire line supervisor. Stay close to fire line.
8. **You are in an area where you are unfamiliar with local factors influencing fire behavior.** You need to be alert, observe for changes in fire behavior. Watch for nature's danger signals like wind increases, thunder etc. If possible, keep informed on local weather forecasts. Maintain communications with your fire line supervisor.
9. **You are attempting a frontal assault on a fire with engines/air tankers.** Watch for and suppress spot fires across road or line. Make sure you have established escape routes. Do not wander into the green at an oncoming fire, wait until it gets to where you are suppose to attack it. Follow orders. Be alert.
10. **You are getting frequent spot fire over your line.** This is an indication fire conditions and weather are changing. Make sure you do not become trapped between two fires. If spot fires are taking off, this indicates lower fuel moisture. Be alert to what is happening around you.
11. **You cannot see the main fire and you are not in communication with anyone who can.** Post a lookout or lookouts as necessary. Area should be thoroughly scouted. This is a dangerous situation at any time. Be weather alert. Obey your supervisor.
12. **You have been given an assignment and/or instructions are not clear to you.** Write it down, repeat them back, until you clearly understand the order. Communicate with your supervisor; keep him or her posted on your progress.
13. **You feel like taking a little nap near the fire line.** Try to sleep in shifts if necessary. Sleep as a group and only with permission. Stay together. Never sleep in the green. Post a lookout.
14. **Fire not scouted and sized up.** IC or competent, experienced fire fighter needs to get this accomplished
15. **Safety zones and escape routes not identified.** Look for areas void of vegetation or removed that are large enough to accommodate all crew personnel and can be used to deploy fire shelter with high chance for survival.
16. **Uninformed on strategy, tactics, and hazards.** Make sure you are aware of the overall plan to achieve the fire suppression objectives. Attempt to attend a briefing or contact your immediate supervisor for information concerning this area.

17. **Constructing line without a safe anchor point.** Make sure this is a point or location that is not currently or likely in the future to be threatened by fire spread. It should be a place to begin your fire line where you are likely to hold your line.
18. **Terrain and fuels make escape to safety zones difficult.** Take the time needed to clear routes to safety zones. Clearly mark the terrain to define the route.

### **Safety Precautions to Be Used Around Aircraft**

The use of aircraft, both fixed and rotary wing, has become a main component in fighting wildland fires. As this resource becomes more readily available, the ground based fire crew needs to become more aware of the hazards these resources create.

The use of air tankers on a wildland incident should not be just taken for granted by ground crews. The Air Attack Supervisor, who is in contact with the Incident Commander, coordinates the drops being made. They will make one of three different types of drops. These are a split drop, trail drop, or salvo drop. The split drop is from one door at a time. The trail drop is an overlapping drop from 2 to 8 doors. The salvo drop is the aircraft's total load all at one time. The use of aircraft is most effective when they are making fast initial attack on small fires and when they are followed up by fast aggressive ground actions.

Because of these different drops and the close proximity of ground crews to the fire line, the possibility of being dropped on becomes a reality. In most cases, the pilot will make a pass over the fire line before dropping in an attempt to warn the ground crews. If possible, you need to move out of the immediate area, stay away from large old trees, take cover in your apparatus, and never stand up in the path of a drop. The most dangerous place in the drop area is the center 15' - 20' of the pattern. If possible, grab something solid and get behind it. Lie down on your stomach cover your face, put your helmet and goggles on, spread feet apart, and dig in and face the oncoming drop with any tools you are holding out to your side. After the drop, watch your footing because if it was a retardant it will be slippery, and wipe off your tools, especially the handles. If the retardant got on your apparatus wash it off as soon as possible.

In most cases, the use of rotary wing aircraft (helicopter) will be to do water/retardant drops, reconnaissance, ferrying personnel, evacuation and search and rescue. The use of helicopters creates a much more hazardous area around them because they can land almost anywhere and controlling what goes on around them is much more difficult than around a fixed wing aircraft at an airport. When working around helicopters you need to get the pilots attention before approaching the helicopter and always approach in the crouched position while holding your helmet. Never approach or depart a helicopter from ground that is up slope from the main rotor. You need to keep clear of the main and tail rotors at all times. If you are carrying long-handled tools, carry them in a manner so that the handles will not be inadvertently raised in the rotor path.

If your crew is assigned to a helibase, you need to be aware of the safety requirements. You will need to stay at least 100' from the helicopters unless you have a specific job. Do not face the helicopter unless you are wearing goggles. You cannot smoke within 50' of the helicopter or fueling area. If you are assigned to the helibase and will be working with the pilots, you need to inquire as to their hand

signals and learn them. As you are aware, the noise created by a helicopter is unbelievable and the ability to communicate with the pilot by hand signals will greatly improve the safety of your operations. If you receive an assignment to actually fly in the helicopter, there are rules that govern this also. Most of them are common sense items like wearing your seat belt, holding loose items so they will not be lost, keeping your gear out of the way of the pilot, never throw anything out of the helicopter and do not smoke. Others include shutting the doors under control instead of slamming them. They do not have springs and need to be latched each time. If you find yourself working in or around a helicopter, this, for most of us, would not be our normal operation, so make sure you become aware of your surroundings and stay alert for items you may not be used to.

## **Fundamentals of Fire Shelters**

Since mandatory carrying of the fire shelter on the fire line has been adopted, it has saved the lives of more than 140 fire fighters. At the same time, it has prevented countless serious injuries and illnesses from burns and smoke inhalation.

### **A Proven Lifesaver**

The fire shelter saves lives by reflecting radiant heat. This means two things: 1) there's a supply of more breathable air inside the shelter, and 2) the shelter gives you a means to protect airways and lungs from flames and hot gases, the two leading killers in an entrapment.

But the shelter is not fail-safe. Direct flame contact can destroy the shelter's protective properties. Never go into a more dangerous area or situation because you are carrying the fire shelter.

If entrapment seems likely, attempt proven escape procedures first. If escape plans fail or become impossible to execute, then use your shelter.

### **Designed To Protect**

Because the fire shelter protects primarily by reflecting radiant heat, the instructions stress deploying the shelter as far as possible from fuel concentrations. Set up the shelter well away from both natural fuels and flammable equipment.

The shelter is aluminum foil bonded to fiberglass cloth with a nontoxic, high temperature adhesive. These are the best lightweight materials available for maintaining structural integrity in heat and high wind.

The pup-tent shape lets you lie flat against the ground. This exposes less of the body to radiant heat and more to ground cooling. With your face pressed to the ground, you are in the best position to breathe cooler, cleaner air. The shelter's low profile exposes it to less turbulence and flame contact, while providing better cooling. The foil reflects away 95 percent of a flame front's radiant heat. The remaining five percent are absorbed. This gradually makes it hotter inside the shelter. With prolonged exposure, temperatures can reach over 150° F. You can survive such temperatures, dry saunas often reach 190° F. Stay calm and stay in your shelter.

The foil/cloth laminate may emit some smoke during prolonged exposure to heat. But it will be minimal, and it is nontoxic. Do not panic. The shelter will still protect you.

The shelter hold-down straps and perimeter skirt make it unlikely the shelter can be blown away if buffeted by high winds. The skirt also helps keep smoke and heat out.

## **A Final Word**

Remember, once you commit yourself to the shelter, stay there. No matter how bad it gets inside, it is worse outside. If you panic and leave the shelter, one breath of hot gases could scorch your lungs. Suffocation will follow. Most fire fighters that perish, die from heat-damaged airways and lungs not external burns. Protect your airways and lungs at all costs by staying in your shelter.

Many fire fighters once thought of the fire shelter as just excess baggage. Then they were trapped by wildfire...and survived thanks to their shelters. Now, they consider the fire shelter a vital safety item, and treat it that way. Do the same.

## **Structures and Vehicles as a Refuge**

### **YOU'RE IN YOUR CAR AND SURROUNDED BY FLAMES: DON'T PANIC!**

*By N.P. Cheney (Excerpt from Fire Management)  
N.P. Cheney is with the Forestry and Timber Bureau, Department of National Development, Canberra*

If you find yourself in a position where you need to take refuge in a structure, you need to first notify your supervisor. This could be a group leader, strike team leader, or the Incident Commander.

A number of popular misconceptions, such as death from lack of oxygen if you are trapped in a fire or that a car gas tank will explode if exposed to naked flame, cause many people to panic and sometimes flee a safe refuge. This does not have to be.

Over several years, studies in and around Canberra, Australia by officers of the Forestry and Timber Bureau have produced information to aid human survival in brush fires. This article is based on their findings.

#### **Car Shield**

To study the performance of a car as a shield against radiation, cars were subjected to intense radiant heat from windows and burning pine slash.

The car windows cut down the radiation inside to around half of that received outside at the peak of the fire but a person inside would have suffered severe burns to any bare skin.

Although air temperature inside the car did not rise to hazardous levels, smoke from smoldering plastic and rubber materials used in interior linings caused severe discomfort. However, as already mentioned, the period of intense heat in the tests exceed that which would be experienced in most forest situations and was far greater than would ever be experienced in grass fires.

Furthermore, research has shown that the standard gas tank is quite difficult to explode. When a tank contains gas, the space above the liquid contains a mixture that is too rich in gas vapor for an explosion to occur.

### **Radiant Heat Kills**

In grass fires, the main cause of death is heat stroke in an extreme form because of excessive radiation. Even severe burns to the body are not an immediate cause of death unless accompanied by heat stroke.

Most of the heat felt from a brush fire is radiant heat, and though it can reach high intensity, it lasts only a relatively short time.

Radiant heat, like light, travels in straight lines; does not penetrate solid substances; and is easily reflected, physical principles basic to survival procedures.

Even in severe fires, the temperature near the ground remains cool as hot combustion gases are rapidly carried away by convection. Measurements have shown that air temperatures within a few feet of the ground and within a few feet of flames up to 35 feet high are less than 120° Fahrenheit. While air at this temperature may be unpleasant, it can be breathed. Brush fires in the open do not deplete the oxygen concentration in the air outside the actual zone where combustion is taking place.

### **Be Careful**

In spite of warnings and precautions, situations will probably continue to develop in which fires threaten houses and trap car travelers. The Forestry and Timber Bureau offers the following advise:

- Do not drive a motor vehicle blindly through heavy smoke. Switch on headlights and park adjacent to bare areas beside the road as far away as possible from the leading edge of the fire, or park where roadside grass is shortest.
- Wind up all windows and shelter yourself from radiation beneath the dashboard with a rug or some other article (such as a floor mat) covering your body. Remain calm and have confidence that the gas tank will not explode, and that even in the worst situations, it will be some minutes before the vehicle catches fire. If the vehicle does catch fire, you can leave it, but keep your skin covered as much as possible.
- Remain calm and do not run blindly from the fire. If you become exhausted you are much more prone to heat stroke and you can easily overlook a safe refuge. Consider an alternative course of action.

Behind all these instructions are three basic principles that must be remembered at all times:

- Select an area where there is the least amount of combustible material.
- Use every means to protect yourself from radiation from the flames.
- Remain calm and do not panic.

Finding yourself in a position where you need to take refuge in a structure or vehicle is something that, in most cases, can be avoided. The "Standard Fire Fighting Orders" and "Situations that Shout, Watch Out!" will usually keep you from finding yourself in this situation. But, as we know in the fire service, anything can happen. Contact the Incident Commander or even your dispatch if you are first in and things happen too quickly to make any type of attack and you are trapped. After securing the outside of combustible furniture on decks or near the house, wood piles, and secure the utilities, you need to make entry.

Bring with you your structure turnouts, if you have them, SCBAs, extinguisher, attic ladder, and tools to pull ceilings and such. If you have time, place your engine's extension and roof ladders in the garage or in the house for use later. Remember you may be involved in a structure fire and not a wildland fire, so think accordingly. Depending on the magnitude of the fire front that hit the structure, your engine may be destroyed also, so the ability to control small fires may save this house. Make entry by pulling a lock or breaking out a small window near the front door to access the lock mechanism. This is no time to show your crew your ability to kick the front door across the living room, as you will have to figure out how to cover that opening later! After getting inside make sure all of the openings to the outside are closed, this included pet doors. Remove light curtains from the windows, heavy drapes should be closed. Put on your structure clothing.

After the fire passes, you must check places where the fire may have entered the structure. Crew should be split to check both the inside and the outside. The attic is one place that should be checked immediately and can be monitored while the fire is hitting the house. The outside crew should split up and check the engine and the roof area. If the engine is operable, do what you can based on structure triage and the amount of fire in the structure. Report to your supervisor your condition and where the fire is heading. Secure the structure as best as possible, if you were able to save it, and leave a business card for the owner to contact you later.

If you have to use your vehicle then you must do the following first. Before the wildland season, vehicles must be checked for good window seals, and any holes in firewalls or floorboards must be sealed. Crews need to practice getting in the vehicle with all of their protective clothing and SCBA' on. If the vehicle is equipped with drapes, then they must also be checked.

If you find yourself in a position where you are going to be over run, you must call in your location as best as you know it. In a wildland setting, this may not be as easy as it sounds, so look for landmarks that can be seen from the air so the air tankers can assist.

Park the apparatus away from the fuel as much as possible and clear an area around the vehicle by the use of hand tools or by firing out, if there is time. Set the parking brake and point the vehicle in the direction of planned egress. Make sure you are not under any power lines. Get in the vehicle with your protective clothing on and have access to the SCBAs. Cover the windows with fire shelters and stay as low as possible in the vehicle. Keep the engine running at high RPMs and keep calm. The temperatures in the vehicle could climb to upwards of 200°F; the plastic parts of the interior could start to melt.

After the fire passes, assess the damage and put out any fire on the vehicle. Radio your condition and be prepared to do it all over again as the fire could change directions and burn over you again. If the vehicle is drivable, then get to a safe area and radio that new position. If the vehicle catches fire, then take the shelters down and wrap them around you.

As you exit the vehicle, stay as low as possible and move away from the vehicle to a safe place where you can deploy the shelter and get under it. Obviously, this sounds much easier than it would be. The vehicle and, if that fails, the shelter can save your life in this situation, if you think through this problem and stay calm.

**Chapter Review Questions**

1. What are the 10 Standard Fire Fighting Orders?

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2. What categories are the 10 Standard Fire Fighting Orders separated into?

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3. What questions do we ask ourselves about the fire situation?

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4. How many situations shout "Watch Out?" List 50% of them.

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5. What is the most dangerous portion of a drop from an air tanker?

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6. Why are hand signals so important when around helicopters?

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## Case Study #4-1: Auto Fire That Starts a Wildland Fire

### Facts Known Prior to the Emergency

Canyon Road and the surrounding area are in a critical fire danger time of year, "Red Flag." There has been no rain for two months.

### Information Upon Dispatch

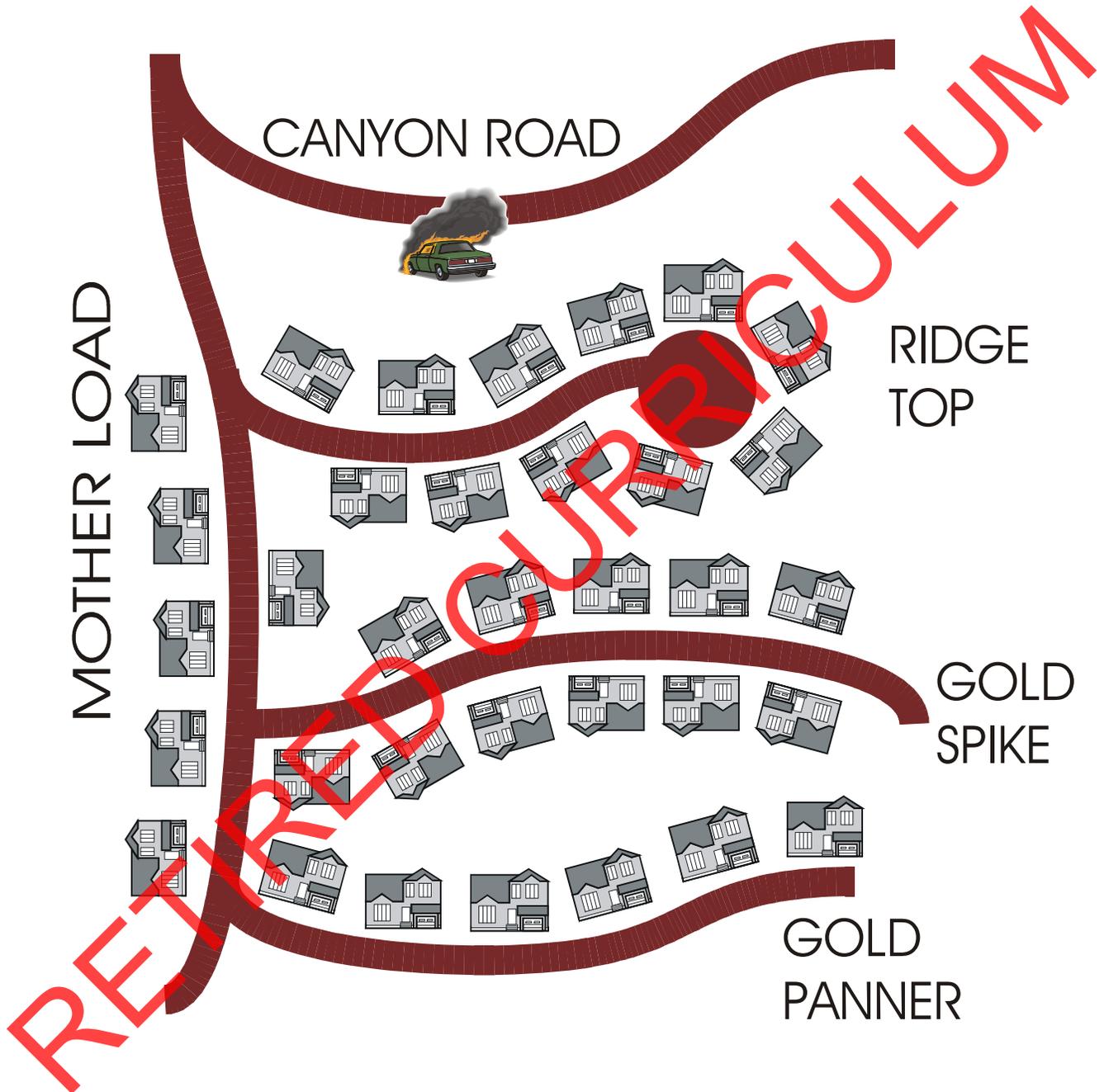
Emergency is reported as an auto fire on Canyon Road. Residents on the ridge top report smelling smoke. The time is 1500 hours on August 20. Temperature is in the mid 90's, with 10 mph wind.

### Observed Upon Arrival

Upon arrival, you find a fully involved passenger car with fire spreading to the hillside. Canyon Road is 300 feet below the ridge top. The hillside is covered with grass and manzanita and is too steep to climb. Fire spread is moderate.

*How Would You Solve This Problem?*

RETIRED CURRICULUM



## Case Study #4-2: Wildland Interface Fire

### Facts Known Prior to the Emergency

The wildland area has moderate to heavy brush. Crest Drive follows the canyon bottom sloping upward to a ridge at Skyline Drive. The area between Mountain Drive and Skyline Drive contains a large number of single-family dwellings with wood shingle roof coverings. Three wood frame condominiums are under construction on the north side of Skyline Drive (presently in the framing stage).

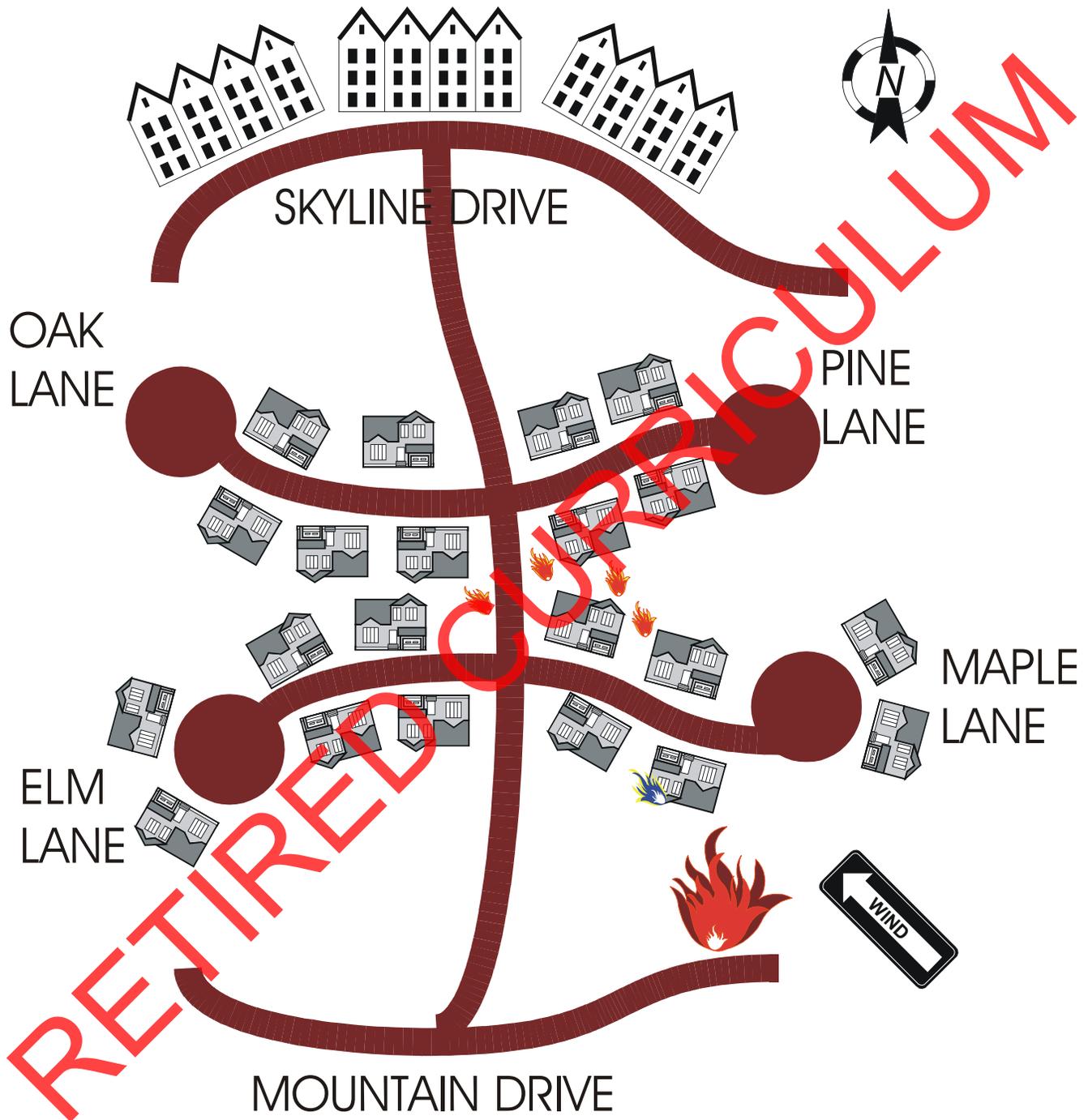
### Information Upon Dispatch

The emergency is reported as a vegetation fire with structures threatened. The temperature is 86°F. The humidity is 22%. The wind is from the southeast at 15-18 mph. The time is 1300 hours. Initial dispatch is two Type 3 engines, one Type 1 engine, and 1 Chief Officer.

### Observed Upon Arrival

Upon arrival, the first-in engine reports that there is fire on the north side of Mountain Drive above Maple Lane. There is also a roof of a structure on fire on Maple Lane. A second report states that flying brands have also ignited brush on the north side of Maple Lane and the west side of Crest Drive, south of Oak Lane.

*How Would You Solve This Problem?*



## Case Study #4-3: Wildland Fire in a County Park

### Facts Known Prior to the Emergency

Ottoman Park is a 64-acre county facility used by families and groups year round. The park contains a small railroad, petting zoo, horseback riding area for children, and a small pond for fishing.

### Information Upon Dispatch

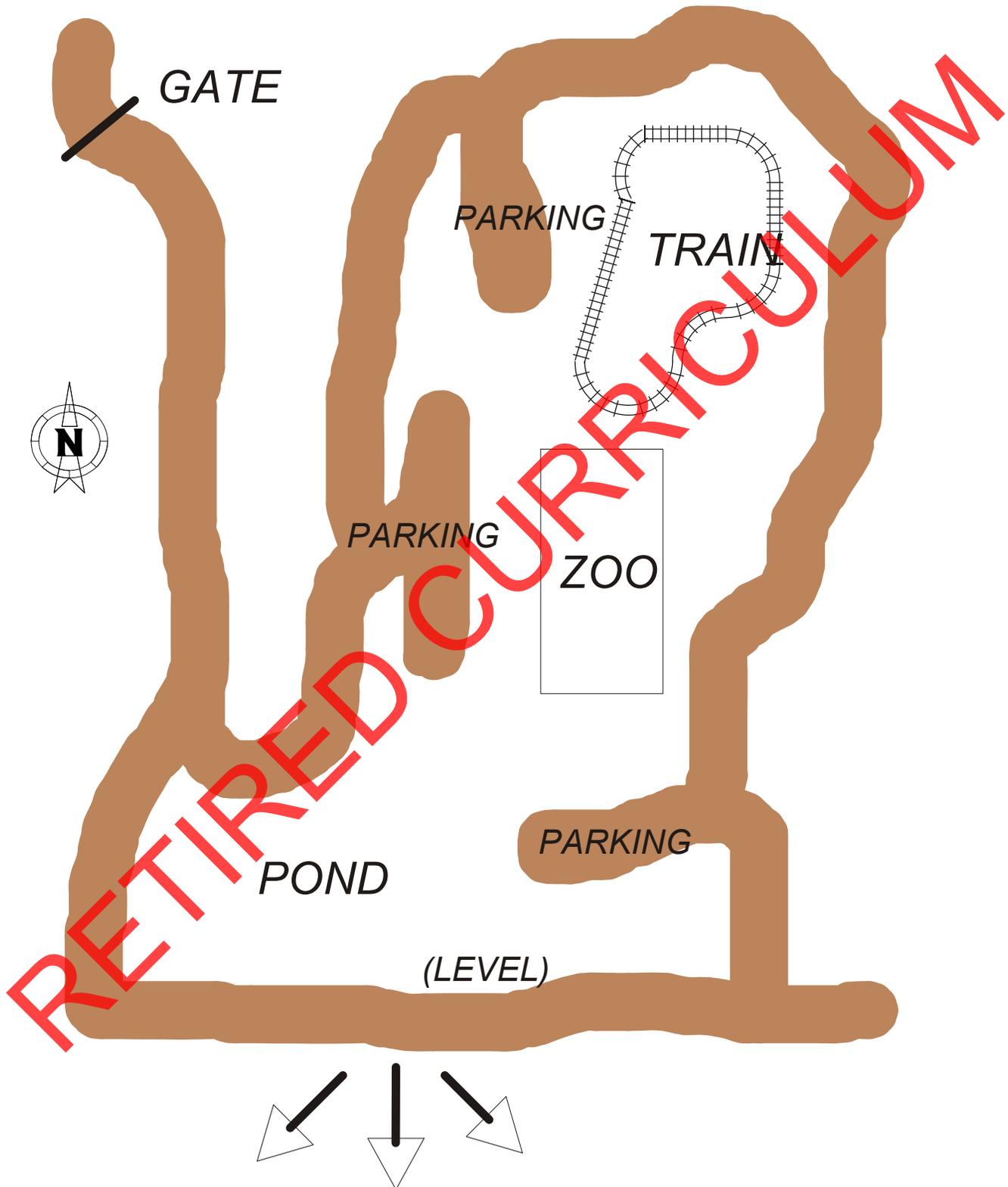
The emergency is reported as a small brush fire on a hill near the southern border of the park. Evacuation is in progress, but not going well. It is a summer day, 90°F with no wind. The time is 1400 hours.

### Observed Upon Arrival

A large number of people exiting the park are making travel very difficult. Following the smoke column, the first-in engine finds a 1½-acre fire in light to medium fuel moving from the park road up the hill slowly.

*How Would You Solve This Problem?*

RETIRED CURRICULUM



## Case Study #4-4: Wildland Fire on a Hillside Ranch

### Facts Known Prior to the Emergency

Santa Ana winds have been blowing for two days. The ranch is owned by a very nice family and employs a number of ranch hands in small houses around the property. The terrain is hilly.

### Information Upon Dispatch

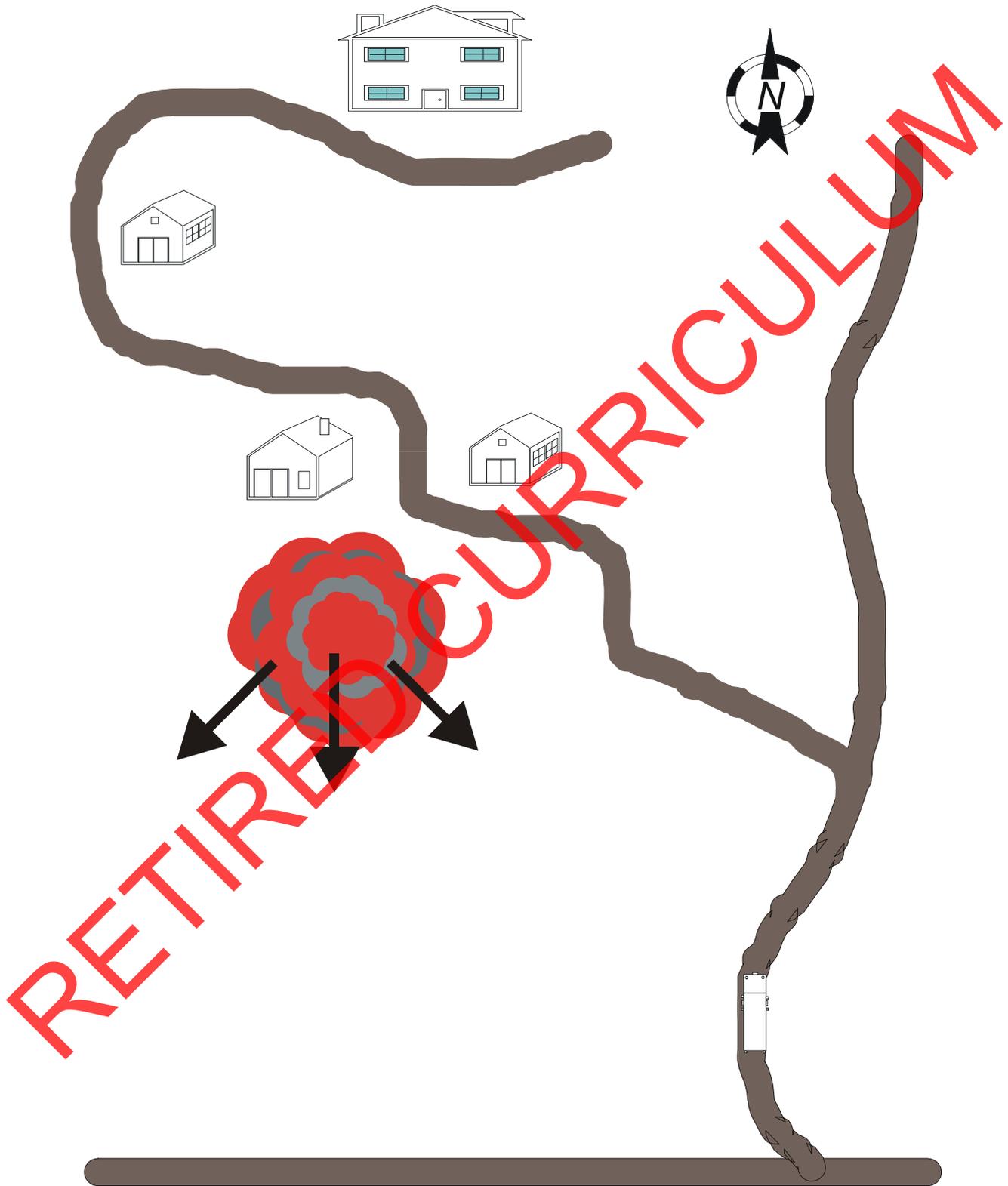
The emergency is reported by a passerby who came to station and told you of a "glow" in the vicinity of this ranch. The humidity is low and the temperature is in the 80s. The time is 2300.

### Observed Upon Arrival

As you pull onto the ranch, you see a brush fire burning with 5' flames in front of one of the small houses that belongs to a ranch hand. The fire is running, with the wind toward you, downhill from the structure. The fire appears to be about  $\frac{3}{4}$  of an acre in light/medium fuels. You know that when this fire reaches the foot of the hill in about 15 minutes, it will really run fast and may not be stopped for some time.

*How Would You Solve This Problem?*

RETIRED CURRICULUM



RETIRED CURRICULUM

## Appendix A: Glossary of Terms

- Acute** ..... Exposure over a long period of time. Usually of a small dose and low concentration.
- Adiabatic (process)** ..... A thermodynamic change of state of a system in which there is no transfer of heat or mass, i.e., compression result in warming, expansion in cooling.
- Affirms** ..... Administrative and Forest Fire Information Retrieval and Management System. It is a user-oriented computer program that permits entry of fire weather observations, forecasts, and it performs the computation of fire danger indexes.
- Air tanker** ..... Any fixed wing aircraft certified by the FAA as being capable of transport and delivery of fire retardant solutions.
- Anchor point**..... The point where fire attack crews tie into a barrier to start fire attack.
- AQMD**..... Air Quality Management District
- Area ignition**..... Ignition of a number individual fires throughout an area either simultaneously or in quick succession. Spaced so that they influence and support each other. Produces fast, hot spread of fire through the area.
- Aspects** ..... The direction a slope is facing; its exposure in relation to the sun.
- Asphyxiant chemical**..... This substance inhibits the uptake of oxygen in the blood system. Such as the action of carbon monoxide, which binds to the hemoglobin in the blood, thus inhibiting the transfer of oxygen.
- Asphyxiant simple**..... This substance actually displaces the oxygen in an area. Such as the action of natural gas.
- Available fuel energy** ..... Energy released by the fuel that actually burns.
- Available fuels** ..... Those fuels that will burn during a passage of a flaming front under specific burning conditions.
- Backfiring** ..... When attack is indirect, intentionally setting fire to fuels inside the control line to contain a rapidly spreading fire. Backfiring is a tactic that makes possible a strategy of locating control lines at places where the fire can be fought on the fire fighter's terms. Except for rare circumstances meeting specified criteria, backfiring is executed on command decision made through line channels of authority.

- Barrier** ..... Any obstruction to the spread of fire; typically an area or strip devoid of flammable fuel.
- Blowup** ..... Sudden increase in fire intensity or rate of spread sufficient to preclude direct control or to upset existing control plans. Often accompanied by boiling convection and may have other characteristics of a firestorm.
- Boiling point** ..... The temperature at which the vapor pressure is equal to atmospheric pressure.
- Burn** ..... The burned area inside the fire perimeter.
- Burn index** ..... Number taken from an arithmetic scale determined by fuel moisture content, wind speed, and other select factors affecting burning rate.
- Burning out**..... When attack is direct, or parallel with the control line tied at points of the fire, intentionally setting fire to fuels inside the control line to strengthen the line. The control line is complete when there is no fuel between the fire and the line.
- Calculation of probabilities**..... Evaluation of all existing factors pertinent to probable future behavior of a going fire and of the potential ability of available forces to carry out control operations on a given time schedule.
- Canopy** ..... The stratum containing crowns of tallest vegetation (living or dead) usually above 20 feet.
- CHP** ..... California Highway Patrol
- Chronic** ..... Exposure over a long period. Usually of a small dose and low concentration.
- Cold front** ..... The leading edge of a relatively cold air mass that displaces warmer air. The heavier cold air may cause some of the warm air to be lifted. If the lifted air contains enough moisture, cloudiness, precipitation and even thunderstorms may result. In cases where both air masses are dry, there may be no cloud formation. Following a cold front passage, westerly winds of 10 to 20 mph, or more, often continue for 12 to 24 hours. Heavier cold air may cause some of the warm air to be lifted.
- Cold trailing** ..... A method of controlling a partly dead fire edge by carefully inspecting and feeling with the hand to detect any fire, digging out every live spot, and trenching any live edge.
- Combustion period** ..... Total time required for a specified fuel component to be completely burned.

- Compactness (porosity)** ..... The spacing between fuel particles. This can be especially important in the surface layer of fuels where the amount of air circulation affects the rate of drying or the rate of combustion, etc.
- Conflagration** ..... A raging, destructive fire. Often used to connote such fire with a moving front as distinguished from a firestorm.
- Continuity** ..... The distribution of fuel particles or extent of the fuel bed, thus affecting a fire's ability to sustain combustion and spread. This applies to aerial fuels as well as surface fuels.
- Convergence** ..... Net horizontal inflow of air into a layer, if at the surface, vertical motion results. Associated with low pressure system.
- Convection column** ..... The thermally produced ascending column of gases, smoke, and debris produced by a fire. Note On multiple-headed fires, more than one convection column may be present.
- Copter** ..... A rotary winged aircraft.
- Counter fire** ..... Fire set between main fire and backfire to hasten spread of backfire. Also called draft fire. The act of setting counter fires is sometimes called front firing or strip firing.
- Creeping** ..... Fire burning with a low flame and spreading slowly.
- Critical burnout time** ..... Total time a fuel can burn and continue to feed energy to the base of a forward traveling convection column.
- Crown fire** ..... A fire that advances from top to top of trees or shrubs more or less independently of the surface fire.
- Crowning out** ..... Fire burning principally as a surface fire that intermittently ignites the crowns of trees or shrubs as it advances.
- Cumulonimbus** ..... The ultimate growth of a cumulus cloud into a mushroom shape, with considerable vertical growth, usually fibrous ice crystal tops, and probably accompanied by lightning, thunder, hail, and storm winds.
- Cumulus** ..... A principal low cloud type in the form of individual cells of sharp non-fibrous outline, and vertical development.
- Depth of Slash** ..... The vertical distance from the litter surface to the highest slash particle in a sampling plot. A fuels inventory measures the fuel loading of dead and downed woody materials.

- Dew point**.....The temperature to which a parcel of air must be cooled to reach saturation.
- Direct attack**.....A method of suppression that treats the fire as a whole, or all its burning edge, by wetting, cooling, smothering, or chemically quenching the fire or by mechanically separating the fire from unburned fuel.
- Diurnal**.....Daily, especially pertaining to daily cycles of temperature, relative humidity, and wind.
- DOHS**.....Department of Health Services
- DOT**.....Department of Transportation
- Energy release rate** .....The rate of heat release (BTU per second) per unit area (square foot) within the flaming front at the head of a moving fire.
- Envelopment action** .....Fire is attacked from several points in a coordinated effort.
- EPA** .....Environmental Protection Agency
- Equilibrium moisture content** .....The level where dead fuels neither gain nor lose moisture with time, under constant weather conditions. The water vapor pressure in the air is equal to the vapor pressure in the fuel.
- Extreme fire behavior**.....In this case, "Extreme" implies a level of wildfire behavior characteristics that ordinarily precludes methods of direct control action. One or more of the following is usually involved high rates-of-spread, prolific crowning and/or spotting, presence of fire whirls, a strong convection column. Predictability is difficult because such fires often exercise some degree of influence on their environment, behaving erratically, sometimes dangerously.
- F&G** .....California State Fish & Game (Fins & Feathers)
- Fine fuel moisture** .....The probable moisture content of fast drying fuels that has a time lag constant of one hour or less.
- Fine fuels**.....Fuels such as grass, leaves, draped pine needles, fern, tree moss, and some kinds of slash that ignite readily and are consumed rapidly when dry. Also called flash fuels.
- Fingers** .....Narrow strips extending out from the main fire. Occur when fire hits both light and heavy fuels. Lighter fuels burn quicker, making fingers.

- Firebrand**.....Any source of heat, natural or manmade, which is capable of igniting wildland fuels. Flaming or glowing fuel particles can be carried naturally by wind, convection currents, or by gravity into unburned fuels.
- Firebreak** .....A natural or constructed barrier utilized to stop or check fires that may occur or to provide a control line from which to work. Sometimes called a fire lane.
- Fire danger rating**.....The integration of fuel, site, weather, and risk factors that affect the inception and behavior of wildfires.
- Fire line**.....The part of a control line that is scraped or dug to mineral soil. Sometimes called fire trail.
- Fire point** .....The temperature of a substance at which a liquid fuel produces enough vapors to support combustion once ignited.
- Fire retardant**.....Any substance that, by chemical or physical action, reduces flammability of combustibles.
- Firestorm** .....Violent convection caused by a large continuous area of intense fire. Often characterized by destructively violent surface in drafts near and beyond the perimeter, and sometimes by tornado-like whirls.
- Fire whirl** .....A spinning, moving column of ascending air rising from a vortex and carrying aloft smoke, debris, and flames. These range from a foot or two in diameter to small tornadoes in size and intensity.
- Flame length**.....The length of flames measured along their axis at the fire front. Flame length is an indicator of fire intensity.
- Flaming front** .....That zone of a moving fire within which the combustion is primarily flaming. Behind this flaming zone, combustion is primarily glowing. Light fuels typically have a shallow flaming front, whereas heavy fuels have a deeper front.
- Flammability range** .....The percentage of gas or vapor in air that will burn if ignited.
- Flanking**.....Attacking a fire by working along the flanks either simultaneously or successively from a less active or anchor point and endeavoring to connect the two lines at the head.
- Flanks of a fire** .....The parts of a fire's perimeter that are roughly parallel to the main direction of spread. Looking from the rear towards the head, identify as left and right flanks.

- Flare-up** ..... Any sudden acceleration of fire spread or intensification of the fire. Unlike blowup, a flare-up is of relatively short duration and does not radically change exiting control plans.
- Flashover** ..... Rapid combustion and/or explosion of unburned gases trapped at some distance from the main fire front. Usually occurs in poorly ventilated topography. More commonly associated with structural fire behavior.
- Flash point** ..... The minimum temperature at which a liquid fuel gives off sufficient vapors to form an ignitable mixture with air near the surface. At this point, the ignited vapors will flash, but will not continue to burn.
- Foehn** ..... A dry wind with strong downward component, characteristic of mountainous regions. It is usually, but not always, warm for the season. Locally called by various names such as Santa Ana, Mono, and Chinook.
- Free air** ..... That portion of the atmosphere that is not modified by local influence. It normally applies to all levels above 60 feet and is out of the range of surface recording instruments.
- Free burning** ..... The condition of a fire or part of a fire that has not been checked by natural barriers or by control measures.
- Friction layer** ..... The layer of the atmosphere in which the frictional force of the earth's surface exercises an appreciable influence on the winds. Gradient winds are modified by the irregular surface of the earth and are a component of surface winds.
- Front** ..... A transition zone between two air masses of different density.
- Fuel energy available for convection** ..... Fuel energy that is actually fed into the base of the convection column.
- Fuel loading** ..... The oven-dry weight of all existing fuels in a given area. Loading is further analyzed by fuel size (time lag categories, etc.) Loading or mass per unit area is usually expressed in tons/acre.
- Fuel model** ..... A simulated fuel complex for which all the fuel descriptors required for the solution of the mathematical fire spread model have been specified. Usually associated with NFDR System.
- Fuel moisture content** ..... The quantity of moisture in fuel expressed as a percentage of the weight when thoroughly dried at 212°F.

- Fuel type** ..... An identifiable association of fuel elements of distinctive species, form, size, arrangement, or other characteristics that will cause a predictable rate of fire spread or difficulty of control under specified weather conditions.
- General wind** ..... Free air or large-scale wind caused by high and low pressure systems.
- Gradient wind** ..... A wind that flows parallel to the isobars or contours and has a velocity such that the pressure gradient, Coriolis and centrifugal forces acting on the air are in balance. It does not occur at the earth's surface due to frictional influence but is realized at a height of roughly 1,500 feet above mean terrain height
- Green** ..... The unburned area outside the fire perimeter.
- Head** ..... The area where the fire is burning the fastest or hottest. There can be more than one head.
- Helibase** ..... A location within the general area of the incident used for parking, fueling, maintaining, and loading helicopters.
- Helibase Manager** ..... Manages resources and supplies dispatched to the helibase.
- Helicopter** ..... A rotary winged aircraft.
- Helicopter Coordinator** ..... Responsible for coordinating tactical or logistical missions at an incident.
- Helispot** ..... A location where a helicopter can take off and land.
- Helitack crew** ..... Individuals assigned to operations using a helicopter.
- Helitack mobile service unit** ..... Helicopter support unit.
- Hot spots** ..... Spots along the fire's perimeter. Burns more vigorously than the rest of the fire.
- Hot spotting** ..... Checking the spread of fire at points of more rapid spread or special threat. Usually the initial step in prompt control. Emphasis on first priorities.
- Ignition temperature** ..... The minimum temperature to which the fuel in the air must be heated to initiate self-sustained combustion without help from a heat source.
- Immediately dangerous to life and health (IDLH)** ..... Maximum level from which a worker could escape without suffering any irreversible health effects.

- Indirect attack**.....Constructing a line in unburned fuel at a considerable distance from the fire line. Utilized for defensive operations.
- Island**.....An unburned area inside the fire's perimeter.
- Lapse rate**.....The rate of change of temperature with height. Normal lapse rate is 3.5°F per 1,000 feet. The dry lapse rate is 5.5°F per 1,000 feet.
- LCL**.....Lethal Concentration, Low. That concentration of a substance, that when inhaled, caused the first of the test population to die.
- LC50**.....Lethal Concentration, 50%. The concentration of a substance, that when inhaled, caused death in 50% of the test population. Usually given in reference sources as LC 50 inhaled and measured in milligrams per cubic centimeter (mg/cm<sup>3</sup>) or in parts per million (ppm).
- LDL**.....Lethal Dose, Low. That amount of a substance, when ingested, was the first of the test population to die.
- LD50**.....Lethal Dose, 50%. The amount of a substance that causes death in 50% of the test population. Usually given in reference sources as LD50 Oral or LD50 Dermal and measured in milligrams per kilogram of body weight.
- Line firing**.....Setting fire to only the border fuel immediately adjacent to the control line.
- Local winds**.....Winds over a small area, which might differ from those appropriate to the general pressure distribution.
- Long-range spotting**.....Large glowing firebrands can be carried high into the convection column, then fall out down wind beyond the main fire. Such spotting can easily occur one-quarter mile or more.
- Low pressure trough**.....An elongated area of relatively low atmospheric pressure. The opposite is a ridge. If the term aloft or upper level is not used, reference is to a surface trough. As in the case of a surface low, rising air often causes cloudiness in a trough area. While a Surface Low can be assumed to have a complete (closed) counter-clockwise circulation around it, a trough may be open at one end. That is, a trough may be an elongated portion of a larger low-pressure system. If a Front extends out of a low-pressure center, the accompanying constant pressure lines usually form a trough along the front.
- Main rotor**.....Blades of a helicopter.

- Methods** ..... Individual evolutions conducted to accomplish the tactical objectives.
- Microclimate** ..... A small site or habitat with essentially uniform climate, fuel characteristics, and burning conditions.
- Middle clouds** ..... Clouds of the altocumulus family, usually between 10,000-20,000 feet.
- Mg/cm<sup>2</sup>** ..... Milligram per square centimeter. That dosage which, when applied to the skin, elicits a response in an organism.
- Mg/kg** ..... Milligram per kilogram. That dosage, taken orally, which elicits a response in an organism.
- Multi-casualty** ..... More than five victims requiring first aid.
- Mutual aid** ..... The sharing of resources or aiding another jurisdiction with your own resources.
- NRC**..... National Response Center
- OES** ..... Office of Emergency Services
- Orographic** ..... Of, pertaining to, or caused by mountains.
- Packing ratio** ..... The fraction of a fuel bed occupied by fuels; or the fuel volume divided by bed volume.
- Perfusion**..... The circulatory systems ability to move blood into areas of the body.
- Pincer action**..... Attacking the fire from both flanks, not necessarily at same time. Object is to "pinch" fire off at head. Very similar to flanking action.
- Pocket**..... An area of unburned fuel between two fingers. An area between a finger and the main fire perimeter.
- PPM**..... Parts per million. PPM is used to describe either an airborne concentration or concentrations in water.
- Radiational cooling**..... The cooling of the earth's surface suffers a net loss of heat due to terrestrial cooling.
- Rate of spread** ..... The relative activity of fire in extending its horizontal dimensions. This can be expressed in chains/hour of forward spread, chains/hour of perimeter increase, etc.

- Rate of spread factor** ..... A factor, usually in a scale of 1 to 100, which represents a relative rate of forward spread for a specific fuel condition and fixed weather conditions (or fuel model). Factors can be used as multipliers, arguments for entering tables, or provide a ratio of values between two fuels.
- Rear** ..... May also be known as the heel or point of origin. Usually burns slowly and quietly. Good spot for an anchor point.
- Reburn** ..... Subsequent burning of an area in which fire has previously burned but has left flammable fuel that ignites when burning conditions are more favorable. For example, a surface fire might dry the aerial fuels but not ignite them during early hours. When temperature and winds increase later in the day fire might carry through the crowds of the same area.
- RECEO** ..... An acronym meaning rescue, exposures, confinement, extinguishment, and overhaul.
- Red flag warning** ..... A term used by fire-weather forecasters to call attention to weather of particular importance to fire behavior. The purpose is to call attention, to forecast users to special conditions of limited duration that may result in extreme burning conditions. In addition to being used when extreme burning conditions are expected, the terms may be employed when a rapid weather change is expected to cause an important increase in danger without actually reaching the extreme stage.
- Relative humidity** ..... The ratio of the actual amount of water vapor in the air to the possible amount the air could hold at that temperature.
- Resistance to control** ..... The relative difficulty of constructing and holding a control line as affected by resistance to line construction and by fire behavior.
- Respiration** ..... Breathing. The intake and exhalation process.
- Retardant line** ..... Fire line that results from a retardant drop. Must be followed up by ground suppression activities.
- Rigid tank (bucket)** ..... Apparatus used to carry retardant or water.
- Routes of exposure** ..... Inhalation or respiratory, Ingestion or eating, absorption (through the skin), injection.
- Running** ..... Behavior of a fire spreading rapidly with a well-defined head.

- Safety island** ..... An area for escape in the event the line is outflanked, or in case a spot fire causes fuels outside the control line to render the line unsafe. In firing operations, crew's progress to maintain a safety island nearby, allowing the fuels inside the control line to be consumed before going ahead.
- Salvage** ..... The saving of property from harm. As in covering a table where water was dripping on it.
- Scratch lines** ..... An unfinished preliminary control line. Established or constructed as an emergency measure to check the spread of fire.
- Short-range spotting**..... A fire producing sparks or embers that are carried by surface winds to start new fires beyond the zone of direct ignition by the main fire. The range of such spotting is usually less than one-quarter mile.
- Size and shape** ..... Fuel characteristics that affect the fuel moisture time lag, the amount of heat required for ignition, and to sustain combustion and the burnout time of fuels. The surface area to volume ratio is a representation of size and shape.
- Size-up**..... The mental evaluation made by the officer in charge of a fire or other emergency that enables him to determine the best course of action.
- Skids** ..... Helicopter landing gear.
- Solubility**..... Refers to the ability of a liquid to mix with a particular host or solvent. Water solubility refers to a liquid's ability to mix with water. Alcohol solubility refers to the ability of a liquid to mix with alcohol and so on.
- Specific gravity**..... Refers to the weight of a solid or liquid compared to an equal volume of water. Terms greater than one will sink, terms less than one will float unless the material is miscible in water in which case they will mix.
- Spread index**..... A number related to the relative rate of forward movement of surface fires.
- Slash** ..... Branches, bark, tops, chunks, cull logs, uprooted stumps, and broken or uprooted trees left on the ground after logging, also debris resulting from thinning, wind, or fire.
- Slope** ..... The natural incline of the ground, usually measured in percent of rise (vertical rise divided by horizontal distance).
- Smoldering**..... Behavior of a fire burning without flame and barely spreading.

- Snag**.....A standing dead tree or part of a dead tree from which at least the leaves and smaller branches have fallen. Often called stub, if less than 20 feet tall.
- Spot fires**.....Fires that start outside the fire's main perimeter. Ignited by hot embers from the main fire. Can be indicators for changing fire behavior.
- Spot weather forecast**.....A special forecast issued to fit the time, topography, and weather of each specific fire. These forecasts are issued upon request of the user agency and are more detailed, timely, and specific than zone forecasts.
- Squall line**.....A nonfrontal line; usually a narrow band of thunderstorms extending across the horizon. Of importance to fire behavior due to accompanying strong gusty winds and due to possibility of such a line passing between regular weather observation stations without being reported. (Used by some authorities interchangeably with "Line Squall"; the latter, however, is most frequently used to denote thunderstorms along a typical front.)
- Staging**.....A collection point for emergency resources. Can be equipment or personnel.
- START**.....Simple Triage and Rapid Treatment. Used in multiple victim incidents to sort and treat the injured.
- Storm center**.....The center of an individual disturbance with a complex of pressure, wind, clouds, and precipitation. Usually refers to widespread low-pressure system that has intensified sufficiently to produce destructive or unpleasant weather. This definition does not include such local features (storms) as individual thunderstorms or rainsqualls; however, such individual features may be part of a larger storm system.
- Strategy**.....A basic plan that identifies major goals and prioritizes objectives.
- Strip firing**.....Setting fire to more than one strip of fuel and providing for the strips to burn together. Frequently done in backfiring against a wind where inner strips are fired first to create drafts that pull flames and sparks away from the control line.
- Subsidence**.....A descending motion of air in the atmosphere, of particular importance due to the heating and drying of the air as it contracts.
- Surface fire**.....A fire that burns surface litter, debris, and small vegetation.

<b>Tactics</b> .....	Specific individual objectives that must be completed to accomplish the overall goal or strategy.
<b>Tandem action</b> .....	May be used on flanking or pincer. Two units work together to extinguish a flank of the fire. First unit aggressive fire suppression, second unit cleans up what was missed.
<b>Thermal belt</b> .....	An area of mountainous slope that typically experiences the least variation of diurnal temperatures, has the highest average temperatures, and thus, the lowest average relative humidity.
<b>Threshold limit</b> .....	Cannot be exceeded at any time, even instantaneously.
<b>value-ceiling (TLV-C)</b>	
<b>Threshold limit</b> .....	A 15-minute exposure (excursion) repeated not more than once per hour, and not more than four times per day.
<b>value short-term exposure limit (TLV-STEL)</b>	
<b>Threshold limit</b> .....	A term describing exposure limits set in the work place. It represents a condition where nearly all workers may be repeatedly exposed day after day without adverse effects.
<b>values (TLV)</b>	
<b>Threshold limit</b> .....	The average concentration of a chemical, which a worker may be exposed to during a 40-hour week/8 hour per day without showing any adverse effects.
<b>value-time weighted average (TLV-TWA)</b>	
<b>Time lag</b> .....	The time necessary for a fuel particle to lose approximately 62 percent of the difference between its initial moisture content and its equilibrium moisture content. Fuels are usually grouped into 1-hour, 10-hour, 100-hour, or greater time lag categories.
<b>Tinder</b> .....	Low density, commonly amorphous solids or aggregates of particles; includes duff, peat, and rotten wood.
<b>Topography</b> .....	The configuration of the earth's surface including its relief and the position of its natural and manmade features.
<b>Triage</b> .....	"Sorting" out wounded victims by injury category.
<b>Triage tag</b> .....	A record of injury level found on a victim. A small paper tag of information as to rescuer's findings.
<b>TSDF</b> .....	Transfer, Storage, and Disposal Facility
<b>Unified command</b> .....	When an incident involves more than one jurisdiction. Each agency involved shares command.
<b>USCG</b> .....	United States Coast Guard (Pacific Strike Team)

- Vapor pressure**.....The pressure exerted by escaping vapor against the sides of the container at equilibrium, the state at which the vapor pressure has stabilized and is no longer rising or falling.
- Vertical arrangement** .....The relative heights of fuels above the ground and their vertical continuity, which influences fire reaching various levels or strata. Surface fuels vs. aerial fuels, etc.
- Vertical development of column**.....Depending on fire intensity and atmospheric conditions, the smoke or convection column might rise a hundred feet or many thousands of feet. A low intensity fire with a low smoke column might be termed "two-dimensional," whereas, a high intensity fire with a well-developed convection column rising thousands of feet into the atmosphere can be termed a "three-dimensional" fire.
- Virga**.....Water or ice particles falling out of a cloud but evaporating before reaching the ground. Stage 4.
- Vortex**.....Air turbulence caused by air slipping off the wing tips of an aircraft in flight and the action of rotor blades of helicopters.
- Walking wounded** .....Injured victims who are capable of moving themselves when asked.
- Wildfire**.....An unplanned fire usually requiring suppression action or a free-burning fire unaffected by fire suppression measures.
- Zone weather forecast** .....A weather forecast issued specifically to fit the requirements of fire management needs (i.e., time, areas, and weather elements) issued on a regular basis during the normal fire season. These zones or areas are a combination of administrative and climatological areas, usually nearly the size of an individual forest or district.