THE NATIONAL WILDLAND/URBAN INTERFACE FIRE PROGRAM PRESENTS:

GUIDE TO THE WILDLAND/URBAN INTERFACE

FIREFIGHTER SAFETY SERIES

VIDEO 1:

UNDERSTANDING FIRE BEHAVIOR

IN THE WILDLAND/URBAN INTERFACE

VIDEO 2:

STRUCTURE PROTECTION STRATEGIES

IN THE WILDLAND/URBAN INTERFACE

VIDEO 3:

FIREFIGHTER SAFETY

IN THE WILDLAND/URBAN INTERFACE

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INSTRUCTOR GUIDE

A PUBLICATION OF THE NATIONAL WILDLAND/URBAN INTERFACE FIRE PROGRAM

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Wildland/Urban Interface Working Team

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Bureau of Land Management
Fish and Wildlife Service
National Park Service

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Federal Emergency Management Agency
United States Fire Administration

National Association of State Foresters

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INTRODUCTION TO THE FIREFIGHTER SAFETY SERIES

The Fire Fighter Safety Series is a multipart instructional package from the National Wildland/Urban Interface Fire Program. It was produced to address problems faced by structural and wildland firefighters when fighting fires, especially those threatening structures, in the wildland/urban interface. An important goal is to improve knowledge of firefighter safety and survival issues.

The complete instructional package contains three videos, this instructor guide, a PowerPoint presentation corresponding with each of the videos and this guide, and a set of overhead transparency masters to aid instruction when a computer is not available to run the PowerPoint presentation.

Some of the material in the Fire Fighter Safety Series was originally prepared in the late 1980s and early 1990s in video and print form and published by the National Wildland/Urban Interface Fire Program. That material has been completely updated and new material has been added.

Three videos

The three videos in this series are: Fire Behavior in the Wildland/Urban Interface; Structure Protection Strategies in the Wildland/Urban Interface; and Firefighter Safety in the Wildland/Urban Interface. The videos alone do not constitute a complete coverage of these subjects. Instead, they should be used as an overview of the issues that are being introduced, with the goal being to raise the awareness of structural and wildland firefighters regarding these issues. The lessons and stories contained are always compelling and sometimes emotional. They also show the complexity of the subject matter and why specific instruction is necessary.

Instructor guide

This instructor guide is intended to accompany the three videos and provide supplemental information. As with the videos, this instructor guide cannot provide all of the detailed technical information needed in a complete safety program.

As a follow-up, the instructor should be able to use suggested additional information and resources to help the firefighter student reach a deeper awareness of the issues.

At the end of each video instructor guide section you will find a page labeled "For More Information." These information sources are specific to the content of that particular video. At the end of this publication you will find additional contact information that supplements this entire three-video series, the wildland/urban interface initiative in general, or the specific activities of the sponsoring agencies.

PowerPoint presentation

The key subjects from the video and this text reference guide have been compiled into a computer-based presentation that can be instructor-led in a classroom setting or even self-paced for the individual student. The preferred use is for an instructor to add local knowledge and greater wildland/urban interface firefighting experience to

CONTENTS

VIDEO EXCERPT:

What can happen:

Four Forest Service firefighters were killed after they became entrapped and their fire shelter deployment was burned over in the Thirtymile Fire near Winthrop, Washington, on July 10, 2001. All four deaths were caused by asphyxia due to inhalation of superheated products of combustion.

See page 61

the presentation materials. For self-paced use, the presentation allows an individual student to move through the entire presentation in a linear order or to jump to particular areas of interest for discussion or review.

Overheads

Black-and-white overhead masters contain the same text as the PowerPoint presentation. They can be converted to transparencies that can be used on an overhead projector to eliminate the need for a computer or computer-based projector.

National Wildland/Urban Interface Fire Program

The National Wildland/Urban Interface Fire Program is made up of organizations committed to reducing the toll of structures lost in the wildland/urban interface, and to reducing the toll of firefighter deaths and injuries. Fires in the wildland/urban interface bring together the separate suppression forces of local, state, and federal wildland agencies. Inherent differences in these forces provide challenges in incident command, tactics, communications, and the use of equipment. The message of the sponsoring agencies and of this educational project is to encourage planning and training to occur before the next big emergency and to be more cautious when approaching any interface fire.

The presence of structures in the interface is what causes all of the different forces to have a need to act together during a major fire, and the number of structures in the interface is always increasing. All structural and wildland firefighters feel a special pressure when homes and other structures are threatened by a wildland fire. But this pressure should not become a reason for using unwise and unsafe practices.

So, you as an instructor are encouraged to use the accompanying videos in conjunction with this instructor guide, sources of additional information, and your own experience to better prepare the firefighters under your care.

Origin of the program

It has been a continuous trend in the history of this country for many people to migrate both to the cities where they found economic advantages and also to the less-settled wildlands with their lower population density and scenic beauty.

But changing lifestyles, especially becoming noticeable in the 1980s, accelerated a trend that saw more and more people wanting to escape the crime and crowding of cities and large suburbs. In increasing numbers, they chose to relocate to "safer" areas with the scenic beauty or privacy of wildland areas.

Many of the new residents of the wildlands did not fully understand that fire was a natural part of the ecology. The existing forms of fire protection, in which fire departments trained and equipped to fight structure fires that were common in the cities and suburbs, and natural resource agencies trained and equipped to fight the vegetation fires

found in wildland areas had to make adjustments. The areas where the increasing density of structures were interspersed in the wildland vegetation created a new challenge for the specialized structural and wildland firefighters. By 1985 interface fires reached crisis proportions, consuming record amounts of private structures as well as public and private natural resources.

Early in 1986 representatives from the USDA Forest Service, United States Fire Administration, the National Fire Protection Association, and others met to discuss the issues. They formed what is today the National Wildland/Urban Interface Fire Program. An early focus was on promoting interagency cooperation in fighting the alarming trend. That focus is still important; to it has been added a continuous concern about structure protection and firefighter safety in interface fires. New organizations with similar interests on the national level joined the program, including the National Wildfire Coordinating Group, four agencies of the United States Department of the Interior, the Federal Emergency Management Agency, the National Association of State Foresters, the International Association of Fire Chiefs, the National Emergency Management Association, and the National Association of State Fire Marshals.

Throughout the 1990s the National Wildland/Urban Interface Fire Program expanded its educational outreach efforts to two diverse audiences that would benefit from more communications: the public, especially the homeowners who lived in the interface and faced the real dangers of fire; and the firefighters and their leaders of the separate wildland and structural fire agencies, who needed a better understanding of the special challenges presented by fires in the interface.

In the final Reference Sources section of this guide, you can see, at least through the representative web sites, what the sponsoring organizations have offered in response to the challenges. Much other progress has been made in the form of new research, educational publications and brochures, videos, public meetings, and improved interagency communications and cooperation. But the year 2000 served as a reminder that much still needed to be done. Although the fire fighters were better trained than ever, and fire agencies were better prepared than ever, the natural force of wildland fire proved more powerful than ever.

This video series and instructional materials, including this guide and the accompanying PowerPoint presentation and overhead masters, continue the emphasis on the same three aspects of fire protection in the interface: fire behavior, structure protection, and firefighter safety. It is the same now as it was in the 1980s.

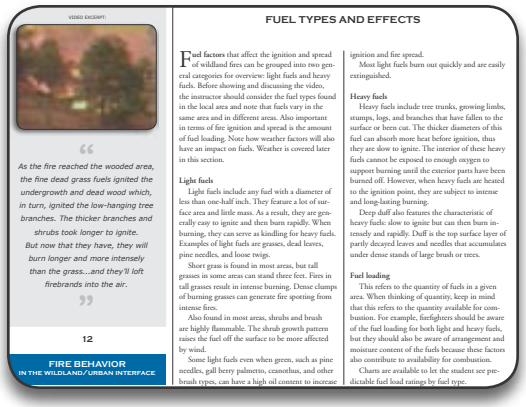
One more critical element is needed, and that is the instructor who can interpret and clarify and expand the message in this video series. Only an experienced instructor can add the relevant local considerations to the general messages of this safety series. Instructors are a welcome part of the fire protection team.

VIDEO EXCERPT:

"This team has been out three times this year. Every time we've been on has been an urban interface fire. Ten years ago in the Southwest you may spend a whole season fighting fires and never get in where structures were involved.."

THE THREE VIDEOS

THIS INSTRUCTOR REFERENCE


VIDEO EXCERPT:

"As the fire reached the wooded area, the fine dead grass fuels ignited the undergrowth and dead wood which, in turn, ignited the low-hanging tree branches. The thicker branches and shrubs took longer to ignite. But now that they have, they will burn longer and more intensely than the grass...and they'll loft firebrands into the air."

12

FIRE BEHAVIOR
IN THE WILDLAND/URBAN INTERFACE

FUEL TYPES AND EFFECTS

Fuel factors that affect the ignition and spread of wildland fires can be grouped into two general categories for overview: light fuels and heavy fuels. Before showing and discussing the video, the instructor should consider the fuel types found in the local area and note that fuels vary in the same area and in different areas. Also important in terms of fire ignition and spread is the amount of fuel loading. Note how weather factors will also have an impact on fuels. Weather is covered later in this section.

Light fuels

Light fuels include any fuel with a diameter of less than one-half inch. They feature a lot of surface area and little mass. As a result, they are generally easy to ignite and then burn rapidly. When burning, they can serve as kindling for heavy fuels. Examples of light fuels are grasses, dead leaves, pine needles, and loose twigs.

Short grass is found in most areas, but tall grasses in some areas can stand three feet. Fires in tall grasses result in intense burning. Dense clumps of burning grasses can generate fire spotting from intense fires.

Also found in most areas, shrubs and brush are highly flammable. The shrub growth pattern raises the fuel off the surface to be more affected by wind.

Some light fuels even when green, such as pine needles, gall berry palmetto, ceanothus, and other brush types, can have a high oil content to increase ignition and fire spread.

Most light fuels burn out quickly and are easily extinguished.

Heavy fuels

Heavy fuels include tree trunks, growing limbs, stumps, logs, and branches that have fallen to the surface or been cut. The thicker diameters of this fuel can absorb more heat before ignition, thus they are slow to ignite. The interior of these heavy fuels cannot be exposed to enough oxygen to support burning until the exterior parts have been burned off. However, when heavy fuels are heated to the ignition point, they are subject to intense and long-lasting burning.

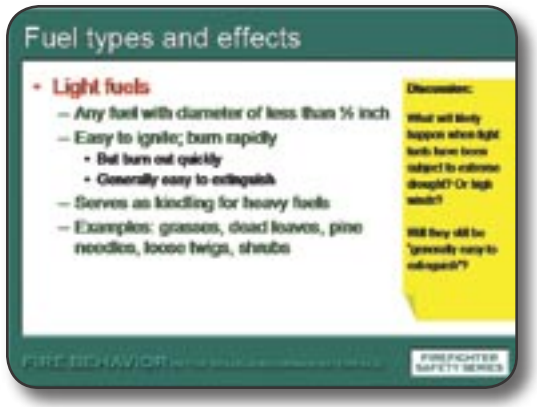
Deep duff also features the characteristic of heavy fuels: slow to ignite but can then burn intensely and rapidly. Duff is the top surface layer of partly decayed leaves and needles that accumulates under dense stands of large brush or trees.

Fuel loading

This refers to the quantity of fuels in a given area. When thinking of quantity, keep in mind that this refers to the quantity available for combustion. For example, firefighters should be aware of the fuel loading for both light and heavy fuels, but they should also be aware of arrangement and moisture content of the fuels because these factors also contribute to availability for combustion.

Charts are available to let the student see predictable fuel load ratings by fuel type.

POWERPOINT PRESENTATION



1-2-3: THE FIREFIGHTER SAFETY SERIES INSTRUCTION PACKAGE

1

The recommended instructional approach is for the instructor to first scan the Read Me First guide material on pages 8, 22, and 36, then preview each video to understand the visual cues, the examples presented, and the underlying messages being conveyed to the audience.

Each video should be presented to a class separately and followed with the related PowerPoint presentation slides, so that the follow-up discussion can stay focused on one subject at a time and result in increased awareness of one subject before moving on to other subjects.

2

Next, after the first review of a particular video, the instructor should read the complete section of this instructor reference guide corresponding to the video subject. The text is merely an introduction, but it gives the instructor focus on the content and allows the instructor to think about local implications for the video message and the reference material.

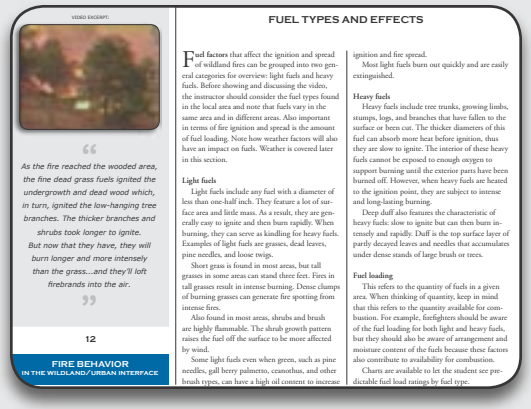
Use the references for additional information at the end of each section and also at the end of the guide. Related materials accessed from the Internet can add detail to the information and provide useful handouts for the class members to keep for future reference.

3

At the third stage, after viewing each video, review the PowerPoint presentation slides in conjunction with the reference text. In the final preparations for providing instruction, the outline bullet items will need to be expanded with not only the reference text but also with additional research information and personal experience. Adding in local aspects of each subject will make each subject seem more relevant, and this can also make the group discussions more valuable for direct application in a local setting.

The presentation is available in a color PowerPoint format for computer-based presentation, or in black-and-white overhead master format for making transparencies for use with an overhead projector.

INSTRUCTOR GUIDE CONTENTS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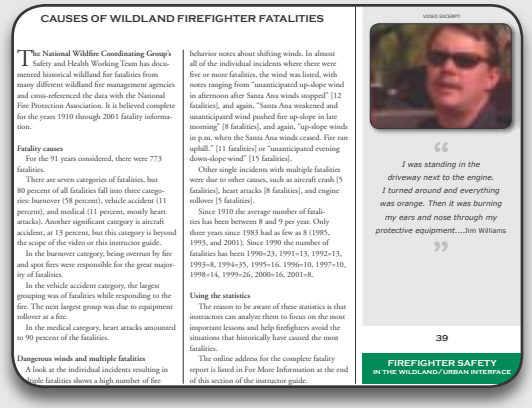

CAUSES OF WILDLAND FIREFIGHTER FATALITIES

The National Wildfire Coordinating Group's Safety and Health Working Team has documented historical wildland fire fatalities from many different wildland fire management agencies and cross-referenced the data with the National Fire Protection Association. It is believed complete for the years 1910 through 2001 fatality information.

Fatality causes

For the 91 years considered, there were 773 fatalities.

There are seven categories of fatalities, but 80 percent of all fatalities fall into three categories: burnover (58 percent), vehicle accident (11 percent), and medical (11 percent, mostly heart attacks). Another significant category is aircraft accident, at 13 percent, but this category is beyond the scope of the video or this instructor guide.

In the burnover category, being overrun by fire and spot fires were responsible for the great majority of fatalities.

In the vehicle accident category, the largest grouping was of fatalities while responding to the fire. The next largest group was due to equipment rollover at a fire.

In the medical category, heart attacks amounted to 90 percent of the fatalities.

Dangerous winds and multiple fatalities

A look at the individual incidents resulting in single fatalities shows a high number of fire behavior notes about shifting winds. In almost all of the individual incidents where there were five or more fatalities, the wind was listed, with notes ranging from "unanticipated up-slope wind in afternoon after Santa Ana winds stopped" [12 fatalities], and again, "Santa Ana weakened and unanticipated wind pushed fire up-slope in late morning" [8 fatalities], and again, "up-slope winds in p.m. when the Santa Ana winds ceased. Fire ran uphill." [11 fatalities] or "unanticipated evening down-slope wind" [15 fatalities].

Other single incidents with multiple fatalities were due to other causes, such as aircraft crash [5 fatalities], heart attacks [8 fatalities], and engine rollover [5 fatalities].

Since 1910 the average number of fatalities has been between 8 and 9 per year. Only three years since 1983 had as few as 8 (1985, 1993, and 2001). Since 1990 the number of fatalities has been 1990=23, 1991=13, 1992=13, 1993=8, 1994=35, 1995=16, 1996=10, 1997=10, 1998=14, 1999=26, 2000=16, 2001=8.

Using the statistics

The reason to be aware of these statistics is that instructors can analyze them to focus on the most important lessons and help firefighters avoid the situations that historically have caused the most fatalities.

The online address for the complete fatality report is listed in For More Information at the end of this section of the instructor guide.

VIDEO EXCERPT:

*I was standing in the driveway next to the engine. I turned around and everything was orange. Then it was burning my ears and nose through my protective equipment....*Jim Williams

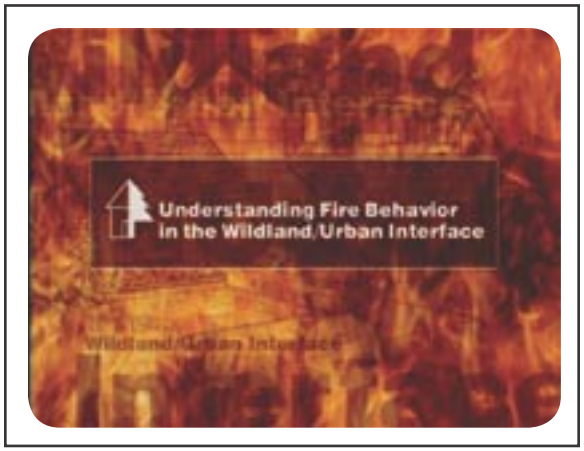
39

FIREFIGHTER SAFETY
IN THE WILDLAND/URBAN INTERFACE

VIDEO 1

UNDERSTANDING FIRE BEHAVIOR

IN THE WILDLAND/URBAN INTERFACE



8

INSTRUCTOR GUIDE

FIRE BEHAVIOR VIDEO: READ ME FIRST

The Fire Behavior video attempts to leave you with this thought: "What I learn about fire behavior will help me fight my next interface fire better, and could even save my life."

The firefighters viewing the video and receiving additional instruction will probably be very knowledgeable about their own type of fire organization. Wildland firefighters will be skilled in how to contain a blaze occurring in vegetation. Structural firefighters will know how to size up and extinguish fire in a home or other building. But fires in the wildland/urban interface get a little more complicated.

Multiple ignitions. Entire neighborhoods involved. A mixture of natural fuels and man-made fuels, with some special hazardous materials included, perhaps. Emotional and demanding occupants. All of this requires a new or better understanding of fire behavior.

As a first step every firefighter, whether wildland or structural oriented, will need to understand the important differences in these two types of fire protection approaches. Despite the differences, large fires in the wildland/urban interface will require these different types of agencies to work together.

A particular fire will present a situation with factors that will have to be understood and dealt with by both types of firefighters at the same time.

It is an oversimplification that we consider only three main aspects of fire behavior, but almost everything that happens at the fire can be considered under the headings of fuel, weather, and topography. Instructors can prepare for these lessons by supplementing the general information provided with details that are specific for your own area, including the types of fuels that dominate your area, the seasonal impact of weather as it impacts fire behavior, and the general topography of your area.

The West Creek Fire

This video presents the fictional community of West Creek Village as it is being threatened by a wildland fire starting some distance away in a remote rolling meadow. Back at West Creek, there are about 30 homes nestled at the base of a small canyon, with some homes intermixed in the wildlands.

Unfortunately for West Creek, recent high temperatures, low rainfall, and current low humidity conditions have dried out the grass and shrubs that are so common to the meadow and the entire area.

The fire moves from the remote meadow into a forested area near the community, where the pine needles are also dried out. The forest fuels allow the fire to grow to extreme conditions before the fire is discovered and a sufficiently large force of firefighters can be assembled.

Something is causing the fire to move relentlessly through the forest and down the canyon wall straight toward West Creek. It's the wind, making the situation worse by gusting up to 30 miles per hour and in a steady direction, putting West Creek in a dangerous position.

The challenge for the instructor is to explain the effects of fuels, weather, and topography both as they apply to the fictional West Creek and also as they apply to the local area. In the video, it is clear that the West Creek fire cannot be contained or even slowed by conventional wildland firefighting methods before it reaches the West Creek residential area. The force of the fire and the location of the homes adjacent to and intermixed with the vegetation fuels lead to the conclusion that firefighters can probably save many of the homes, but not all of them. So the important question becomes, Which homes can be saved? The narrator introduces the term "triaging homes" after he explains that a containment approach is not feasible. Structure triage will be addressed in more detail in the second video, Structure Protection Strategies on the Wildland/Urban Interface.

10 Questions for Students

1. Why do fires in the wildland/urban interface present special problems for both wildland firefighters and structure firefighters?
2. Which two methods of heat transfer are of most consideration in wildland/urban interface fires?
3. What are the main types of fuels found in the wildland/urban interface, and how do they affect fire behavior?
4. How are heat and humidity interrelated, and what effect do they have on the ignition and spread of wildland/urban interface fires?
5. What causes winds and how do they affect fire spread in wildland/urban interface fires?
6. What causes fire spotting, and why is it a danger in wildland/urban interface fires?
7. What is topography and how does it affect fire spread in interface areas?
8. Describe four elements that contribute to extreme fire behavior.
9. List three fuel indicators that can cause extreme fire behavior.
10. List three weather indicators that can cause extreme fire behavior.

VIDEO EXCERPT:

The challenge for the instructor is to explain the effects of fuels, weather, and topography... both as they apply to the fictional West Creek and also as they apply to the instructor's local area.

VIDEO EXCERPT:

STRUCTURAL VS. WILDLAND FIRE OPERATIONS

Large wildland/urban interface fires, by their size, location, and risks, frequently require the coordinated efforts of fire fighting agencies with differing missions, training, and equipment.

Wildland firefighting

Wildland firefighters generally respond to forest and other wildland fires with a mission to protect valuable natural resources that are usually found in remote areas where no piped water supplies are available. There may be a delay in discovering and reporting fires in remote areas; consequently, these fires tend to be larger when firefighters arrive.

Wildland firefighters are trained and equipped to work from the perimeter around the fire and clear the fuel from inside the perimeter so that the fire cannot continue to spread. A large fire's perimeter could extend for miles.

Structural firefighting

Structural firefighters are trained to attack fires in individual buildings. These firefighters usually rely on water systems providing ready access to piped water for direct fire suppression. Fire crews are equipped and located for a response time to each emergency incident of mere minutes, so that a fire might even be contained in one or a just few rooms, and the rest of the structure and contents can be saved.

This separation of missions worked well enough when the natural resources and wildland vegetation were in remote areas, while the structures were in the suburbs and cities. Now it's not that simple. Now the forests and vegetation are mixed with people and their homes and other structures of high value.

When a single fire threatens both vegetation fuels and homes, it becomes a multi-jurisdictional event. Wildland firefighters may be faced with protecting a neighborhood in the path of a large fire. Structural firefighters may be faced with mitigating vegetation factors before the fire arrives in the neighborhood.

Both wildland and structural firefighters in these situations must adjust.

Take time to size up the situation

Because every firefighter may be faced with new fire behavior conditions that were not part of his or her wildland or structural training, it is especially important to take time to size up the fire situation before committing to any action that could put a fire crew in danger. This theme will be further developed in the subsequent two videos.

For now, be sure to emphasize the size-up factors of fuels, weather, and topography. In your local area, you will have added information to share about the history of previous fires and their behavior. Those that developed extreme fire conditions will be important for their safety implications.

METHODS OF HEAT TRANSFER

Most firefighter training includes a simple explanation of the fire triangle as it relates to combustion, and this can be reviewed briefly as foundation for a discussion of heat transfer.

The parts of the fire triangle are fuel to burn, a heat source to start and continue the combustion process, and a supply of oxygen to sustain the flame. Stop the fire by controlling any part of the fire triangle. In an open wildland setting, controlling oxygen often means covering the flames with dirt, but this won't work for long flame lengths. Once the fire starts by human or natural means, a major control factor will be through the fuels.

Heat transfer

Heat transfer is the method of moving heat from one source to another object. For our purposes of instruction, we are talking about combustion and the transfer of enough heat from a burning object to ignite a second object. Awareness of the methods of heat transfer may not allow us to always control a fire, but it will help us to better predict where the fire may go and how fast. For example, we can use principles of heat transfer to help predict which fuels in the fire area will ignite and which will not.

When discussing the following three methods of heat transfer, remember that they are not mutually exclusive but can and do often work together. When this happens, radiant and convected heat can raise the temperature of an object before the conducted heat reaches it. In that case, the conducted heat can cause ignition faster than if the only heat transfer was by conduction alone.

Radiation

Thermal radiation occurs when heat is transferred from one object to a second object through the air without direct contact by the two objects. Think of the sun warming your skin on a sunny day. The heat energy is radiated through space to your skin. Heat energy from a fire can also travel through the air to ignite another fuel. Radiation is important because it allows fuels in a wildland fire to be preheated before actual flames arrive.

Convection

Heat transfers by convection when it moves in a current from a hotter area to a cooler area. A large smoke cloud over a fire, just like heat in a chimney, moves upward in a convection current. If a second object is up-slope in a canyon from a flame heat source, it will be heated by convection. This will reduce the time needed for ignition as the fire moves closer to the second object. Convection also allows fuels to be preheated over a larger area in a wildland fire.

Conduction

When heat energy, such as a flame, comes in direct touching contact with a second object, convection occurs.

VIDEO EXCERPT:

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Fuel loading

This refers to the quantity of fuels in a given area. When thinking of quantity, keep in mind that this refers to the quantity available for combustion. For example, firefighters should be aware of the fuel loading for both light and heavy fuels, but they should also be aware of arrangement and moisture content of the fuels because these factors also contribute to availability for combustion.

FUEL ARRANGEMENT AND EFFECTS

The arrangement of heavy fuels over a certain area affects their rate of ignition and spread. For discussion, we can use the two categories of horizontal continuity and vertical arrangement.

Horizontal continuity

Horizontal continuity describes the arrangement of fuels across the surface in horizontal terms. For size-up and planning purposes, firefighters should consider whether the fuels are uniformly distributed or whether they are patchy.

Uniform fuels describes a thick arrangement where the fuels are in contact with each other and provide a continuous path for fire spread. This term includes both light and heavy fuels. The important consideration of uniform fuels has to do with their continuity, which is associated with faster fire spread.

Patchy fuels are distributed unevenly over a particular area. Interspersed with heavy and light fuels will be open breaks of non-fuel areas, including bare ground, rock outcroppings, and perhaps areas of a specific fuel that is much more resistant to fire ignition and spread.

Vertical arrangement

Vertical arrangement refers to the distribution of fuels in a vertical dimension. This is important because of the methods of heat transfer as previously discussed in this video. Any fuel situated above a burning fuel is subject to strong convection heating as well as to radiant and conduction heating. The progression of vertical fuel arrangement can be described in three categories: ground fuels, surface fuels, and aerial fuels.

Ground fuels include all combustible materials found beneath the surface. Examples are deep duff, roots, rotten buried logs, and other organic material. Although slow to ignite, ground fuels can hide below the surface and be very hard to extinguish completely.

Surface fuels include all materials resting on the surface or immediately above the ground. Examples are pine needles and leaves, grass, downed logs, stumps, large limbs, and low shrubs and brush. Light fuels on the surface can be easy to ignite, but the limited volume of fuel available right at the surface can limit the rate of fire spread.

Aerial fuels include all of the green and dead vegetation that is situated in the upper forest canopy. The distribution of these fuels extends to the height of the forest, so the volume can be extremely high. The vertical dimension allows ready access to sufficient oxygen to support combustion after ignition, and winds can have more effect on elevated fuels. Crown fires in aerial fuels can spread very rapidly and dramatically.

Ladder fuel

Ladder fuel is a term which describes material on or near the ground that will carry fire to the crown of the tree, i.e. bitterbrush, dead down wood and branches, limbs attached to the tree and touching the ground, and dead lower limbs.

VIDEO EXCERPT:

"'Uniform fuels' describes a thick arrangement where the fuels are in contact with each other and provide a continuous path for fire spread. this term includes both light and heavy fuels. The important consideration of uniform fuels has to do with their continuity, which is associated with faster fire spread."

VIDEO EXCERPT:

Temperature, humidity, and precipitation have a direct impact on fuel moisture and the ignitability of fuels. For example, recent low humidity in West Creek has dried out the dead pine needles, grass, and shrubs. And seasonal conditions have pushed the temperatures near 90 degrees.

WEATHER EFFECTS: HEAT AND HUMIDITY

Weather has a strong effect on fire behavior. The categories of effects that the firefighter needs to study for basic awareness are temperature, relative humidity, precipitation, and wind. Green or moist fuels ignite more slowly than dry fuels. Winds contribute both to drying of fuels and to rate of fire spread.

Temperature

Increasing heat combines with other effects, such as wind, to increase fire danger. To start with, fuels preheated by the sun (through radiation, as discussed at "Methods of Heat Transfer") are raised closer to their ignition temperature and burn more rapidly compared to cold fuels.

At the individual firefighter level, heat makes any physical operations more difficult. Increasing temperature also increases the effects of convection currents. But the most important consideration is that heat contributes to the drying of fuels, and dry fuels are easier to ignite than moist fuels.

Precipitation

Precipitation includes all of the moisture that falls from the atmosphere and reaches the earth's surface. But precipitation does not immediately and significantly affect fuel moisture. To understand fuel moisture, the firefighter will need to consider the type (rain vs. snow), amount, and duration of the precipitation. A large amount of rainfall in a short time has less effect on fuel moisture than a lower amount over a longer time.

Light fuels can absorb rainfall within an hour, but heavy fuels absorb rainfall much more slowly.

Relative humidity

Relative humidity is the ratio of the amount of moisture in the air (in the form of water vapor) compared to the amount which the air could hold at the same temperature and pressure if it were saturated. A relative humidity of 95 percent indicates that the air is very saturated with almost all of the moisture it can hold. When the relative humidity is 30 percent, you can compare 30 percent to 100 percent and know that 30 percent means the air is much drier.

Moisture in the air exchanged into or out of nearby objects, including dead and live fuels. For example, low humidity in the air takes moisture out of fuels. Or, high humidity allows more moisture in the air to be absorbed into fuels. When a fuel has more moisture, it is harder to ignite and burn.

The relative humidity of the air changes faster than a fuel can absorb more moisture or dry out. To factor in relative humidity of the air with fuel moisture, remember that light fuels lose moisture quickly with changes in relative humidity. Heavy fuels respond to humidity changes much more slowly. A long drought in an area will result in dry, easier-to-burn heavy fuels as well as light fuels. It is important, therefore, to pay attention to long-term weather and precipitation conditions.

WEATHER EFFECTS: WIND

Wind is one of the most important influences on fire behavior in this way: the stronger the wind, the faster the spread of fire. Wind contributes to combustion in five ways:

- It contributes to drying of fuels
- It moves an ample supply of oxygen to the fire.
- It influences the direction of the fire.
- It causes fire spotting by carrying firebrands ahead of the fire.
- It moves heated air to downwind fuels by convection.

Fires create some of their own wind. Convection currents of heated air rise above a major fire, causing a pressure differential at ground level that results in fresh air rushing in, and that air continues to feed the fire as long as fuels are available to burn and keep the heat flowing in and upwards.

Time-of-day effects

Wind varies according to the time of day. In general, the wind is usually least active from 4:00 in the morning to 7:00 in the morning.

Separate from the fire effects, and occurring as the sun naturally warms the ground, the heated air rises throughout the area. The sun-warmed rising air tends to follow a slope where one exists. This results in a predictable flow of wind up a slope or canyon during the day.

After the sun sets and during the night, the ground cools and the normal convection current reverses direction. The cooling air over the same ground becomes heavier than the air was during the heat of the day and flows downward. This results in a predictable flow of air (wind) down the slopes and canyons in the evening.

Wind patterns determined by the time of day always need to be considered when planning operations for fires around slopes and canyons (see following section on Topography).

Wind speed

The Beaufort Scale of Wind Velocity is a method of estimating wind speeds by visual cues:
- Calm (less than 1 m.p.h.). No movement of leaves of trees or bushes. Smoke rises vertically.
- Very Light (1 to 3 m.p.h.). Small branches, leaves, and grasses sway. Weather vane barely moves.
- Light (4 to 7 m.p.h.). Pole-size trees in the open sway gently. Wind felt distinctly on face. Loose scraps of paper move. Small flags flutter.
- Gentle (8 to 12 m.p.h.). Pole-size trees in the open sway noticeably. Small flag extends. A few crested waves form on lakes.
- Moderate (13 to 18 m.p.h.). Pole-size trees sway violently. Dust is raised on roads. Whole trees in dense stands sway noticeably.
-Fresh (19 to 24 m.p.h.). Branchlets are broken from trees. Walking against wind is inconvenient.
- Strong (25 to 38 m.p.h.). Trees are severely damaged by breaking of tops and branches. Shingles can be blown off structure roofs. Walking progress is impeded.

VIDEO EXCERPT:

"The wind direction is driving the fire's spread from the meadow into the trees, and is now moving it towards the community. Why does wind increase the spread rate of fire? One reason is that the wind increases the supply of oxygen to the fire. But more important, wind speeds up the heating of fuel in front of the flames."

VIDEO EXCERPT:

Our knowledge of fire behavior is based on scientific research. Years of experiments and analysis have given us guidelines to what a fire will, and won't do. But situations are different. And fire is dynamic. Winds can gust and shift direction suddenly. Flames can flare up, increase spread rate, and change direction without warning.

FIRE WEATHER INFORMATION

The importance of fire weather information to the planning of wildland fire operations has long been established. Although some weather features are affected by local conditions such as slopes, many features that can affect fire behavior are regional in scope. These massive weather conditions are best tracked by government agencies, with the expectation that weather conditions affecting a particular crew of firefighters can be monitored locally and communicated.

Some massive weather conditions that can override local conditions and observations include cold fronts and Foehn winds.

Cold front

A cold front describes the line between a cooler air mass as it moves against and replaces a warmer air mass. Four potentially dangerous situations that can occur with a passing cold front include:

- An abrupt change in wind direction.
- A strong southerly wind ahead of the front that can drive fire rapidly to the north or northeast.
- Winds shifting back from the west or northwest after the front passes will drive fire to the east or southeast.
- Rapid drop in relative humidity within 24 hours after the front passes.

Firefighters need a system of communication that can let them know that a cold front is approaching. A strategy that was appropriate in the absence of a cold front can become lethal during and after the shifting wind effects associated with the passage of a front.

However, if no information has been communicated about an approaching cold front, any firefighter can watch for the signs of a cold front passage:

- A line of cumulous clouds may be seen approaching from the west or northwest.
- Large clouds of dust can precede the front's arrival.
- Winds shifting from southeast to south and southwest. Beware an increase in wind velocity before the arrival of the front.
- Winds will continue to shift as the front passes, generally resulting in strong, gusty, cool winds out of the west and northwest.

Foehn winds

Foehn winds are dry winds with a strong downward movement. They are usually warm for the season and strong and steady, frequently 40 to 60 miles per hour. Relative humidity drops with the winds. They can last for days. Foehn winds are usually referred to as other names that vary by region. Common examples are Chinook and Santa Ana winds. The effect on fire behavior is similar to that of other winds of equivalent speeds.

EFFECTS OF TOPOGRAPHY: ASPECT AND SLOPE

Topography refers to the surface features of land, or the lay of the land. It is less changing than weather and fuels, so the influences of topography can be better predicted.

Features of topography that are important for size-up considerations of firefighters include aspect, slope, shape of canyons, elevation, and natural barriers.

Aspect

Aspect describes the direction in which a slope faces. It is considered in relation to the sun, because this implies the amount of heating and the amount and types of fuels that thrive under those conditions.

More direct sunlight generally falls on the south and southwest slopes, with resulting higher temperatures, lower humidity, lower fuel moisture, and sparser and lighter fuels. These areas are critical in terms of wildland fire starts and spread.

North aspects of slopes are more shaded and have more fuels that are heavier. This shady side has lower temperatures, higher humidities, and higher fuel moistures.

Slope

The angle of incline on a hillside is called slope. The importance of this to firefighters is that the steeper the slope, the faster a fire burns. Higher on the slope ahead of the fire, the fuels become heated by radiant and convection heat currents, causing the fuels to reach their ignition point sooner than if a sideways fire reached them by conduction.

Burning material on slopes can also roll downhill to start other ignitions.

A slope that rises at a 45-degree angle is said to have a 100% grade. That means the land rises 100 feet in elevation as you move 100 feet in a straight, level direction. At a 22.5-degree angle, the land rises 50 feet per 100 feet in a straight, level direction, and this is called a 50% grade. If the land has 20 feet of elevation per 100 feet in a straight line, that is a 9-degree slope. Ten feet of elevation per 100 feet in a straight line is a 4.5-degree slope.

Here is the significance of slope: on a 30-percent slope, fire will burn twice as fast as it will on level ground.

Now you can reapply a fire behavior lesson from the effects of winds described earlier in this section: Daytime winds tend to move up the faces of slopes. Nighttime winds tend to move downslope. For firefighters this means that a fire occurring at the bottom of a slope in daytime can be expected to move uphill at a rapid pace because of the usual slope preheating effect and also because of the wind effect. The same fire starting at the top of the slope would not spread as fast because there would be less preheating from below due to radiation and convection.

But a fire at the top of a slope is in danger of running down the slope at night due to the downslope winds. In the video, the community of West Creek was down-slope from the fire, but the fire extended down toward the homes.

VIDEO EXCERPT:

"Canyons like West Creek's exacerbate the situation. Canyons often channel wind, stepping up the wind's speed and increasing the fire's intensity. The good news is that our homes are situated downhill from the fire. So, we won't have to respond to the combined impact of wind and slope. We might have some valuable time to mitigate around the homes."

VIDEO EXCERPT:

Instructors: Discuss whether the fire in the video would behave differently if it had advanced to the top of the slope above West Creek just as nightfall arrived. Explain why winds can change directions on slopes according to the time of day.

EFFECTS OF TOPOGRAPHY: CANYONS AND RIDGES

Shape

The shape of narrow canyons, box canyons, and wide canyons can influence fire behavior. Box canyons are ravines that extend to the ridge top or near the ridge top. Box canyons have no gaps or prominent saddles to let the heated air escape. Fires starting at the bottom of a box canyon or narrow canyon can move up-slope very rapidly due to a chimney-like preheating of the higher-level fuels and up-slope winds. This extreme fire behavior can be dangerous to firefighters.

If a canyon is very narrow, radiant heat can raise the temperature of fuels on the opposite slope closer to their ignition temperature. Then fire spotting can more easily propagate multiple ignitions on the other side.

Wide canyons are not as susceptible to cross-canyon spotting, except in high winds, but wide canyons will have strong differences of fire conditions depending on whether a slope has a north or south aspect.

Ridges

Ridges experience more wind primarily because they are elevated above the surrounding land. When a fire moves up a slope towards a ridge, it gathers speed and intensity.

Fires burning at the ridge of a canyon or hill can exhibit unusual fire behavior. The strong flow of air along the ridge can cause a whirling motion by the fire. As the wind crosses a ridge it usually has a leeward eddy where the wind rolls around and comes up the leeward side, exposing both sides of any structure placed there to maximize the scenic effects of a ridge. There are usually no flat or protected areas on ridges.

Nighttime downward air flow at the top can also cause a fire to drop into the canyon.

Saddles/mountain passes

Winds can increase when blowing through saddles due to the funneling effect of the constricted pass. On the other side, winds spread out again and can result in eddy action.

Elevation

Elevation, or height of the land, can influence the amount and condition of the fuels present. Drying out occurs at lower levels before higher levels. Elevation can affect the amount of precipitation and exposure to winds, so this should also be part of any size-up where mountains are in the local area.

Barriers

Include the presence of any barriers in the size-up of any fire. A barrier to fire spread may be natural or man-made. Rivers, lakes, wet swampy areas, rock outcroppings, and bare ground are examples of natural barriers. Old burns also have the effect of a barrier since fuels have been at least temporarily removed. Roads, highways, and reservoirs are examples of man-made barriers. So is the fireline you build around a fire.

FIRE SPOTTING

During the process of combustion in a wildland fire, a vegetation fuel is reduced to ashes. However, during the decomposition of the fuel and before combustion is complete, particles of varying size (firebrands) break away from the main fuel source and are lofted upwards by heated convection currents. For a definition, spotting is a fire behavior characteristic by which sparks or embers are carried up by the wind and/or convective column and fall into other downwind fuels to ignite additional fires beyond the zone of direct ignition by the main fire.

Multiple ignitions

The danger of fire spotting in wildland fires is that when conditions exist to loft firebrands into the air, the probability exists for multiple subsequent ignitions over a wide area depending on the strength or the convection current and the wind speed and direction. These multiple ignitions can overwhelm any firefighting force.

Fire spotting is one of the major ways that fires spread and homes are lost in wildland/urban interface fires. Firebrands can come down on combustible roofs, on combustible items stored adjacent to homes, or on other nearby combustible fuels and ignite. The resulting spot fires may go unnoticed and unanswered when an area has been evacuated of residents, when firefighters are spread too thin, or when the spot fires are too numerous.

Fire spotting is related to fire danger ratings, which include a word description and a color code (low = green, moderate = blue, high = yellow, very high = orange, and extreme = red). The rating is based on fuel types, fuel moisture content, weather, and elevation; the rating is stated daily. Fire spotting increases with the fire danger rating.

Low. Fuels do not ignite readily from small firebrands. There is little danger of spotting.

Moderate. Fires can start from most accidental causes, but with the exception of lightning fires in some areas, the number of starts is generally low. Short-distance spotting may occur, but is not persistent.

High. All fine dead fuels ignite readily and fires start easily from most causes. Short-distance spotting is common. Fires may become serious and their control difficult.

Very high. Fires start easily from all causes and spread rapidly after ignition and quickly increase in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics, such as long-distance spotting when they burn into heavier fuels.

Extreme. All fires are potentially serious. Long-distance spotting is likely.

The maximum spotting distance in a particular fire varies according to several factors, including overall fire intensity, wind speed, fuel type, initial size of the ember when lofted up, and how rapidly it is burning. Many embers burn up completely before landing, but larger embers of slow-burning fuels can keep burning for up to six minutes and travel for thousands of feet.

VIDEO EXCERPT:

The fire approaching West Creek has escalated into extreme conditions due to the area's fuels, temperature, humidity, and wind. Moreover, the wind is sweeping firebrands ahead of the fire and causing prolific spotting in the base of the canyon.

VIDEO EXCERPT:

"Extreme fire behavior has the greatest potential to put firefighters at risk. This is characterized by a rapid increase in the fire's intensity; high, sustained rate of spread; well-developed convection column; long-distance spotting (over 600 feet); fire whirlwinds or horizontal flame sheeting; sudden calming of the wind."

EXTREME FIRE BEHAVIOR

Problem fire behavior describes fire activity that in some way presents a potential hazard to firefighters. To reduce the hazard, adjust the tactics being used. Being able to size-up a fire scene and predict or anticipate fire behavior is the best way to avoid problem fire behavior.

Extreme fire behavior is the most intense fire behavior and has the greatest potential to put firefighters at risk. This is characterized by rapid fire spread, intense burning, fire spotting, prolific crowning, presence of fire whirls, and a strong convection column. Under these levels of fire behavior characteristics, direct control is no longer possible. Predictability is difficult because such fires often exercise some degree of influence on their environment and behave erratically, sometimes dangerously.

The indicators of extreme fire behavior should put any firefighter on high alert and include fuel indicators, weather indicators, and topography indicators.

Fuel indicators
- Unusually dry fuels
- Great quantity of continuous light fuels
- Fuels exposed to direct sunlight
- Fuels dried by long period of drought
- Ladder fuels are present to allow a surface fire to move into crowns
- Crown foliage dried by surface fire over a large area
- Concentration of snags

Weather indicators
- Strong wind
- Sudden changes in direction and/or velocity of wind as weather front passes through
- High clouds moving fast; watch for surface winds to follow
- Unexpected calm; may indicate winds will shift
- Thunderstorms above or in close proximity to a fire often lead to dangerous downdraft winds
- Unusually high temperatures early in the morning
- Dust devils and whirlwinds developing
- Bent smoke column

Topography indicators
- Steep slopes allow fire to spread faster up-slope
- Chutes, saddles, and box canyons provide conditions for chimney effect to occur
- Narrow canyons increase the possibility for fire to spread by spotting across drainages

Extreme fire behavior knowledge should be applied to firefighter safety. Use the information on this page in conjunction with the third video, Firefighter Safety in the Wildland/Urban Interface.

FIRE BEHAVIOR: FOR MORE INFORMATION

This video on fire behavior can serve only as an introduction to the subject. Instructors are urged to supplement the overview information in the video and in this instructor guide with local information and more detailed information from national and regional sources. Some of the national sources are listed here.

www.firewise.org

This web site contains educational information for people who live or vacation in fire-prone areas of the United States. It was designed to acquaint you with the challenges of living with wildland fire. As you get familiar with various sections of the site, you will learn more about wildland fire protection, whether you are a homeowner or a firefighter.

www.nifc.gov

The web site for the National Interagency Fire Center has information about fire behavior and links to other sites with additional information. There is access to numerous wildfire-related statistics.

www.nwcg.gov

The National Wildfire Coordinating Group has an extensive publications management system with fire behavior information. NWCG also coordinated the development of a certification training program designated as S-190, Introduction to Wildland Fire Behavior. An accompanying PowerPoint presentation is available at www.wildlandfire2.com/ppt/2.

S-290 is the designation for the course on Intermediate Fire Behavior. It is designed to meet the training requirements to work in the Operations section of the Incident Command System.

S-390 is the designation for the course on Introduction to Wildland Fire Behavior Calculations. S-290 is a prerequisite. Students calculate rates of spread, fireline intensity, flame length, area, perimeter growth, and maximum spotting distance.

www.boi.noaa.gov/firewx.htm

Use this link to reach the National Fire Weather page featuring a United States map with links to current local fire weather forecasts, plus 30 to 90-day outlooks on fire weather.

www.fs.fed.us/land/wfas/

The Wildland Fire Assessment System.

www.fs.fed.us/database/feis/welcome.htm

The Fire Effects Information System provides up-to-date information about fire effects on plants and animals. It was developed at the USDA Forest Service Rocky Mountain Research Station's Fire Sciences Laboratory in Missoula, Montana. Under plant species, click on a type of plant, find the species, and get information about the fuel's fire ecology and fire effects.

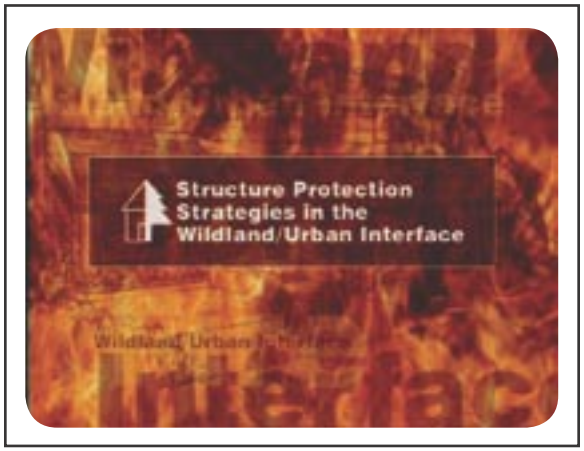
VIDEO EXCERPT:

The Internet provides a vast supply of additional articles, publications, and photos to supplement the material in these videos and in this instructor guide. Even more sources of information are available from using Internet search engines to find specific material not listed here.

VIDEO 2

STRUCTURE PROTECTION STRATEGIES

IN THE WILDLAND/URBAN INTERFACE



STRUCTURE PROTECTION VIDEO: READ ME FIRST

The particular difficulties of protecting homes in the wildland/urban interface is the subject of Video 2. As more homes enter wildland/urban interface areas, the situation becomes more complicated, especially when homeowners are operating under false expectations about the nature of structure protection in wildland/urban interface fires.

Dealing with conflicts

Several conflicts of perception arise when numerous homes are threatened or are burning. Large fires bring different types of fire protection agencies together, but there are significant differences between wildland and structural firefighters. When they must work together, the differences can result in miscommunication and safety lapses from not knowing what to expect from each other. The video draws attention to the need for both types of agencies to understand each other better.

Other conflicts revolve around the dilemma of attacking the fire or committing resources to protecting homes. This puts more pressure on incident commanders who must make these decisions.

Whenever homes are part of the decision-making, emotions increase. But firefighters must not violate safety principles to protect homes at all costs. No home is worth the life of a firefighter. Nevertheless, large incidents bring out large numbers of press and politicians to scrutinize activities. They can develop a scorecard mentality about homes lost, without understanding the realities of the fire's behavior or the resources available. In this distracting, pressure-cooker atmosphere, the incident commander must stay focused on the overall big picture, not on individual homes that may not be saveable even if available resources are used in this way.

Performing triage decisions with structures

The concept of structure triage is introduced, with its difficult and emotional considerations. The video will stress the importance of structure triage when the fire is large and the resources are limited. Firefighters will be reminded that attempting to save a structure under certain conditions is both hopeless and unsafe.

Structures can be placed in three categories that predict the structure's survivability with and without fire protection efforts. It is important that fire fighters, their leaders, the public, the press, and the politicians understand how and why triage decisions are made.

Among the triage considerations are questions such as the following: What is the fuel load around the structure? Is the structure itself highly flammable? Can it be mitigated? Is the structure vulnerable to surface fires?

Then there are resource considerations, such as: Do you have enough personnel? Is the proper equipment available? Do you have access to enough water?

Always there are the safety considerations: Is the structure and surrounding space defensible?

Are adequate safety zones available? Are escape routes available? These questions are addressed in the video and in this instructor guide. In addition, these questions can stimulate much more useful discussion that can serve to raise the awareness of firefighters who may be asked difficult questions by homeowners.

The video emphasizes that the best time to make such critical decisions is long before a fire approaches. If homeowners can better understand the factors in a triage decision, especially when the fire season is not underway, they are more likely to have the time and take the defensive measures that will increase their home's survivability. The Firewise web page can be an important resource for more information and is described at the end of this section and also in the Reference Sources at the end of this guide.

The video will also stress the importance of knowing when to abandon a particular structure that just cannot be protected.

10 Questions for Students

1. Why is it important to plan wildland fire protection strategies and build interagency cooperation during the off season?
2. How can individual firefighters be given more guidance in interface fires on whether to control the wildfire or protect threatened homes?
3. What is the first action an incident commander should consider in deciding on a defensive or offensive strategy?
4. What are the five main functions of the incident command system?
5. Describe the responsibilities of each incident command system function.
6. What are the three operational priorities in an action plan?.
7. Discuss ways that communication messages can be missed or misunderstood during a large fire.
8. Name the three categories of structure triage and describe considerations for each one.
9. What two characteristics determine a home's ignition potential during a wildland fire?
10. What are two reasons for firefighters to abandon a structure during an interface fire?

VIDEO EXCERPT:

"The reality is that few homes are destroyed by intense flames. The vast majority succumb to firebrands or spotting. If crews don't return after the flames pass, these lingering small ignitions may burn unattended for hours and ultimately destroy homes that could have been saved by something as small as a backpack pump."

VIDEO EXCERPT:

A better solution is to spend time in between fire seasons in an effort to plan and implement mitigation efforts that are not hampered by the severe time constraints of an approaching fire.

PLANNING DURING THE OFF SEASON

Whenever firefighters are put into the situation of trying to save homes from an advancing wildland fire through mitigation, they have a major disadvantage of dealing with the element of time.

Mitigation is the attempt to make a condition less severe or less calamitous. For example, a technique of mitigation in front of a wildland fire may be to remove excess combustible materials from around the house in an effort to reduce the fuel load leading up to the house.

Obviously, if the available time is short before the fire front arrives, then an individual home may not be properly prepared, or some homes may be prepared while time runs out before others worth saving can be mitigated.

A better solution is to spend time in between fire seasons in an effort to plan and implement mitigation efforts that are not hampered by the severe time constraints of an approaching fire.

Making a home firewise

There are many ways to make homes safer from fire in the off-season, including cooperative agreements with adjacent or overlapping agencies that might be fighting future fires, interagency training, homeowner education, and firefighter education.

The web site at www.firewise.org presents a variety of educational materials that can be used to better prepare a wildland/urban interface community to survive the next fire season.

Homeowners can access or download for free such publications as Making Your Home Firewise, Firewise Landscaping, Firewise Construction Checklists, Getting Firewise about Fuels, Fire Hazard Assessment in the Wildland/Urban Interface, Peak Fire Seasons, Protecting Your Home From Wildfire, Wildfire Approaching, Outdoor Fire Safety, and a firewise glossary of fire terms.

Firefighters can access or download educational material and wildland fire case study reports including Developing a Cooperative Approach to Wildfire Protection, The Oakland/Berkeley Hills Fire, Black Tiger Fire Case Study, Operation Water, and Firestorm ‘91.

Other sources of off-season planning information

The USDA Forest Service web site also has educational materials for homeowners and firefighters. Check at www.fs.fed.us/fire/prev_ed/prevention/index.html for links to a variety of documents, some even intended to make kids more aware.

Many of the guides are customized for specific local conditions. For example, there is a link to “Living With Fire,” a web site tailored for homeowners in the Sierra Front of Nevada. A link to the “Wildfire Primer” site provides basic information about wildland fire in South Carolina. Yet another link is titled “Florida Fuels Reduction.”

CONTROL WILDFIRE VS. PROTECTING HOMES

When large fires threaten homes and entire neighborhoods in the wildland/urban interface, the pressure on wildland and on structural firefighting agencies can become intense. And the problem is only getting worse as more and more homes are being built in wildland areas.

As the number of communities jeopardized by fire increases dramatically, so does the intense political pressure to save homes at all costs. Fire instructors can help firefighters be better prepared for the political realities of these fires and the pressure that comes with them.

In addition to the political pressure, media coverage of these fires becomes intense, bringing a scorecard mentality of firefighting success and failure being related only to the number of homes lost or saved.

Rethinking priorities

Priorities can get confused, and objectives become blurred for firefighters. With fires rapidly spreading and numerous homes put at risk, what are the limited number of firefighters to do? Are they supposed to extinguish the fire? To save individual homes? Or can they only prevent the blaze from getting even more out of control?

Here is another complication: major fires spread across jurisdictions, bringing multiple agencies together to combat fires. Once again, wildland firefighters and structural firefighters are working the same fire.

The result can be wasted resources, miscommunication and safety lapses. That is why many initial attack commanders and first-response firefighters are rethinking the way they respond to fires in the interface.

From two approaches to one strategy

The temptation when fires threaten both homes and valuable natural resources in the interface is to react immediately. But the result can be that wildland firefighters react one way, and structural firefighters react another way.

Both sides must fight the impulse to jump into action in an automatic way. Instead, they must realize that the best strategy involves a new approach. And they must develop the right strategy before sending crews into dangerous situations.

Incident commanders will need to remember that the number one priority is to protect the fire crews while saving the lives of civilians. The second priority is to save property and structures based on whether or not they can be saved. Then the third priority is to conserve firefighting resources so that you can continue to fight the major fire until the job is done.

Therefore, proper incident command means that the choice is not simply whether to control the wildfire or to protect the homes. The challenge is to devise a strategy that will use the available resources to accomplish as much as is possible.

That may mean making unpopular choices, but choices that have the best outlook for the most number of people.

VIDEO EXCERPT:

"With fires rapidly spreading and numerous homes put at risk, what are the limited number of firefighters to do? Are they supposed to extinguish the fire? To save individual homes? Or can they only prevent the blaze from getting even more out of control?"

VIDEO EXCERPT:

The incident commander's first job is to size-up the situation. He or she takes the time to analyze the behavior of the fire in order to anticipate what it will do. The crew's resources are figured in and then a safety plan is developed, along with an initial attack strategy.

COMMAND DECISION: OFFENSE OR DEFENSE?

Wildland firefighters should not make unilateral decisions at fires involving structures, nor should structural firefighters. Rather, there should be a unified incident command system that takes all interests into account before making decisions to commit resources.

Offense or defense?

Once the incident commander completes a size-up of the fire behavior factors of fuels, weather, and topography, and considers all of the priorities, the decision must be made on whether to adopt an offensive strategy or a defensive strategy.

If the assessment of the fire and the available resources indicate that the position is strong, there is plenty of time, and ample resources are available, the choice may be to send crews in an offensive attempt to halt the fire before it reaches the community.

This may mean employing a wildland strategy of suppressing the fire by containing it. This involves establishing firelines or even the use of air support if necessary.

On the other hand, if the incident commander concludes that little can be done to contain the fire due to its already large size, then a defensive approach to protecting the homes of the community may be the best choice.

A defensive position means trying to save homes through mitigation. In the time available this may mean removing combustible furniture and storage from around a home or under a deck, or it may mean closing windows to help keep out burning embers.

Mitigation doesn't necessarily mean that it is possible to save every home. In fact, the incident commander may have to be willing to abandon some homes in order to preserve the rest of the neighborhood.

Measuring success

Success, then, should not be measured simply by the number of homes saved, but by whether or not the fire was stopped from becoming a bigger, full-blown disaster.

Sometimes the incident commander just doesn't have a chance to either contain the fire or save homes in the initial path of the fire. For example, in the 1990 Painted Cave fire in Santa Barbara, California, 479 homes were destroyed, most of them within two hours of the initial fire report. In the July 2000 Cerro Grande Fire, 239 homes burned. Faced with such intense fire conditions, the incident commander doesn't have the choice of an offensive attack or saving homes.

The challenge might become that only the incident commander may see the big picture of fire size, time, available resources. Making those monumental decisions can be a lonely job.

THE INCIDENT COMMAND SYSTEM

The National Interagency Incident Management System (NIIMS) evolved from wildland firefighting lessons learned in the 1970s and before. Large, rapidly moving fires that crossed jurisdictional lines resulted in too many people reporting to one supervisor. Different agencies had different emergency response organizational structures. Communications were often incompatible and inadequate. There was no good structure for coordinated planning, and lines of authority were not clear. A standardized emergency management system was sought to remedy these problems. A basic incident command system (ICS) operating guideline is that the one person in charge of an incident at any one time holds responsibility until the authority is delegated to another person. The reason for delegating authority may be that the fire has grown to the point that a person with higher qualifications is needed in command.

Major divisions of delegated activity

The incident command system used most often today for large incidents has five main functions: command, operations, planning, logistics, and finance/administration.

Command This section of ICS sets all objectives and priorities and has overall responsibility at the incident, no matter what the size or complexity. Also assigned here would be the information officer, liaison officer, and safety officer.

Operations This section conducts the tactical operations to carry out the plan (see Planning) and develops the tactical objectives. All resources are directed by the Operations Section.

Planning This section develops the action plan to accomplish the objectives of the incident commander and maintains a status report on resources. First the Planning Section must collect and evaluate available information about the fire and resources.

Logistics This section provides support to meet the needs of the incident, including resources and all other services, such as food.

Finance/administration This section monitors costs related to the incident and provides accounting as necessary. Not all ICS incidents need this section, but the point is that the system organization allows for implementing this section if and when it is needed.

Subdivisions of delegated authority

The sections described above are designed to be used when necessary according to the complexity of the incident. At more complex interagency incidents, the sections are designed to be subdivided.

For example, the Logistics section may be run by one person at a small incident, but as an incident grows this section may be subdivided into a Services Branch and a Support Branch.

Then as needed the Services Branch can be subdivided with a Communications Unit, a Medical Unit, and a Food Unit. And the Support Branch can be subdivided into a Supply Unit, Facilities Unit, and a Ground Support Unit.

VIDEO EXCERPT:

A basic ICS operating guideline is that the one person in charge of an incident at any one time holds responsibility until the authority is delegated to another person. The reason for delegating authority may be that the fire has grown to the point that a person with higher qualifications is needed in command.

VIDEO EXCERPT:

The action plan will consider the three operational priorities of life safety (resident, bystanders, and fire crews), incident stabilization (implementing an offensive or defensive strategy), and property conservation, which may include moving in rapidly after a fire front passes to mop up remaining spot fires, especially around homes that are saveable.

DEVELOPING AN ACTION PLAN

The action plan for a particular incident will need to consider many factors. The following includes some of the questions that an incident commander will need to ask before the plan can be completed. Remember that firefighter safety must be a constant consideration in any action plan.

What are the details of the fire behavior factors of fuels, weather, and topography? Refer to Video 1 as a refresher.

How many structures are at risk? How many will need to have combustible materials moved away from the structure?

Is access open for emergency vehicles and evacuation? Related questions are: Are roads narrow and winding? Are many homes at the end of long driveways? Are cul-de-sacs wide enough for a big truck to turn around quickly?

If evacuation will be necessary, are there safety areas outside of the fire areas that can handle the number of people being evacuated?

Is there a water supply for use in fire suppression? How reliable is the supply?

What is the history of local fire behavior? Have there been recent extreme fire behavior incidents?

What is the fire doing now? How fast is it moving? What are the intervening fuels? Are spot fires likely to break out around structures before the main fire arrives?

What resources do you have at the present time? What additional resources can be expected, and when will they arrive? Are the arriving firefighters cross-trained for wildland and structural duties?

Is it understood that fire conditions are subject to rapid change that could adversely affect fire crew safety and control strategies, and that size-up is an ongoing process?

Three operational priorities

The action plan will consider the three operational priorities of life safety (including residents, bystanders, and fire crews), incident stabilization (committing to an offensive or defensive strategy), and property conservation, which may include moving in rapidly after a fire front passes to mop up remaining spot fires, especially around homes that are saveable.

After stating operational priorities, the action plan should also break down the goals and objectives into specific tasks.

Remember again that the action plan starts with firefighter safety and ends at the task level with firefighter safety.

PLAN FOR COMMUNICATIONS

A well-thought-out action plan should have the additional consideration to make sure that it is clearly communicated and fully understood.

Communication problems at large wildland fires can occur in four types of situations: a message from the incident commander down through the ranks to the fire crews may be missed or misunderstood due to a lack of clarity; a message up from the fire crews to the incident commander may be missed, cut off, or misunderstood due to a lack of clarity; or a message between different fire crews or different agencies may be missed due to technical reasons related to location or different types of equipment.

Note that missed messages can be from human factors related to lack of understanding or from technical difficulties such as radio problems Radio problems can originate from different frequencies in the field or from location factors, such as mountains, that can cause blocked signals. Make sure the problem is not traced back to something as simple as depleted batteries.

Communications from the top

Miscommunications with fire crews can create coordination confusion, and at worse can be life-threatening, such as if a fire crew missed a critical message about fire behavior or an order to evacuate. Each person in the chain must make sure that any message to be passed downward is clearly understood. Training in active listening may also be part of the solution.

Communications from the bottom

Confusion or tragedy can also occur from miscommunication coming from the fire crews up to the incident commander. If the fire crews are trying to report a change in fire behavior and the message can't get through to the top, the whole operation loses efficiency.

It is not possible for a single individual to manage the scene, ensure accountability, make strategic and tactical decisions, and monitor one or more radio channels. The incident commander and section chiefs should be provided with aides early in the incident to help them manage communications.

Communications between crews/agencies

Miscommunication between fire crews or agencies is usually due to an equipment problem, such as radios on different frequencies, too many people trying to communicate at one time over limited frequencies, or terrain-related problems where radio signals are blocked.

Many communication problems can be addressed between fire seasons by the development of standard operating procedures and multiagency training to practice using different types of communication equipment.

Increased emphasis on effective communications is the key to preventing unexpected, negative outcomes.

VIDEO EXCERPT:

"The way you communicate your orders is just as important as the strategy you develop."

VIDEO EXCERPT:

Triaging a home requires making several key calculations about the structure, the fuels available to the fire, and your resources. Your attempt to save structures should be based on if you can save them, not upon their financial value, political considerations, the pleading of residents, or other external or emotional yardsticks.

DIFFICULT BUT NECESSARY: STRUCTURE TRIAGE

Considering the desire of more and more people to move to scenic wildlands, more and more wildland fires will include some threat to homes and other structures, including storage buildings, power lines, and communication towers.

In addition to the three categories of triage introduced below, the main message of any lesson on triage should that the best time to think about the survivability of any home is before the fire approaches, when there is still time to take action for better protection, such as clearing a defensible space.

Structure Triage

Structure triage is classifying structures into three groups based on how successfully and safely they can be defended. As applied to structure protection in wildland fires, triage acknowledges that in bad situations decisions must be made on how to use the available resources to protect the greatest amount of property. When the broad scale of a wildland fire means that there are fewer firefighters available than are needed, and there are many structures in need of protection, someone must decide which homes can be protected. That means some homes will not or cannot be protected.

The reality that firefighters must sometimes make conscious decisions to leave homes unprotected is contrary to the basic firefighter philosophy. Nevertheless, the firefighter must make the necessary adjustment to understand that in some cases not all structures can be defended. To make matters worse, these emotional decisions must be made under the duress of actual fire conditions.

During triage, the three categories of structure priorities will be:

1. Structure needs little or no protection for now.
2. Structure needs protection but can be saved.
3. Structure is hopeless and cannot be saved.

These categories alone do not allow a decision to be made about placing a home in a category. In an emergency, decisions will be made according to what a particular fire is doing at the moment, what it is expected to do and how fast, what resources are available before the fire arrives in the community, and what the homeowner has done to improve a particular home's survivability.

The following list indicates some of the factors on which a decision will be made:

Fire behavior
The lay of the land
Construction of structure and roof
Fuel loading around structure
Hazardous materials storage
Available firefighting personnel
Available water supplies
Available fire apparatus
Vehicle access to structure

Fire behavior

The triage process assumes that the fire behavior is at a level to give some reason for attempting to save at least some homes in the fire's path. Keep in mind that if fire conditions change and become more severe after a triage decision has been made, an otherwise defensible home may no longer be saveable. Wind conditions will be a main determinant. Strong winds can overcome positive factors in the rest of this list.

The lay of the land

In many cases the most important factor will be the slope of the ground where a home is situated and from where the fire will be approaching. If the home is up-slope from the fire, it is in a dangerous location because fires usually move much faster uphill, and convection currents and radiation will allow the structure and adjacent fuels to be preheated.

Construction of structure and roof

The most vulnerable part of a structure is the roof. Embers carried ahead of the fire are likely to land on roofs. Combustible roofs will compromise the survivability of any home and lower the triage rating. A roof of fire-resistive material, without any openings and in good repair, will improve a structure's triage rating. Some studies have shown that a fire-resistant roofed structure is three times more likely to survive, assuming flames can be kept at least 30 feet away.

Eaves are also part of the roof consideration. Eaves can be vulnerable if the underside vents are not screened with metal (1/8-inch mesh); otherwise, winds can blow embers into the vents. A fire starting this way can remain undetected until it is too late. Also consider other vents at roof ends and vents for laundry dryers and gas-fired water heaters. All should be screened with metal. Unusually deep eaves may also trap heat, which can allow preheating.

A buildup of leaf and small branch litter on a low-angle roof or in gutters creates a disadvantage. Even on a fire-resistive roof, burning debris on a roof and in gutters can transmit heat (conduction) to the underlying structure. Also consider that overhanging branches can fall from wind or fire and break skylights or damage the roof itself.

Radiant heat from an approaching fire can also ignite walls. As with the roof, the use of combustible materials vs. noncombustible materials will affect a triage rating.

Wood decks are of course combustible, but if a deck is open underneath it also allows embers to be blown in and ignite any combustible storage. A deck tied into even noncombustible stucco walls can allow flame to spread within the wall.

Windows are a weak link in the chain of structure fire protection. Standard single-pane windows transmit radiant heat without much resistance. In addition, they will not stand much heat before cracking and failing. Typical frames of wood, aluminum, or plastic also fail easily when heated

VIDEO EXCERPT:

"This storage under the deck is a great avenue for fire to get up underneath. It's all wood. Combustibles here. All sorts of areas for fire to get in here and just push, so we would have to write this one off, and say there's just no way to do it."

VIDEO EXCERPT:

"The most important consideration is safety. Can your crews safely defend the structure? Are adequate safety zones and escape routes available and accessible?" If the home is up-slope from the fire, it is in a dangerous location because fires usually move much faster uphill, and convection currents and radiation will allow the structure and adjacent fuels to be preheated."

from an approaching fire. Metal blinds or shutters, on the other hand, will increase a home's triage rating. Window size is a factor. Larger windows are more dangerous in a fire protection sense, and this gets much worse when the structure is at the top of a slope.

Fuel loading around structure

An important consideration here is to have an open defensible space around a home. This keeps flames farther away if adjacent fuels are burning, and it gives firefighters room in which to work. Air is a reasonably good insulator, if the approaching flames are not too intense. A 30-foot ring of clear space is considered to be a desirable compromise for safety, in conjunction with other good protection features described in this section. Always consider that the larger the defensible area, the better the protection.

In one analysis of a wildland fire that burned homes (see the Cerro Grande Fire reference at For More Information at the end of this section for access information for the article) even small measures to reduce fuel around a structure can be important. The author's examination of structures that burned and those that survived showed that "the abundance and ubiquity of pine needles, dead leaves, cured vegetation, flammable shrubs, wood piles, etc. adjacent to, touching, and/or covering the homes principally contributed to the residential losses."

In the same analysis, the author further said "An examination of surviving homes in areas of home destruction indicated that a low intensity surface fire in pine needles could burn to a home and ignite its wood siding. In several cases, a scratch line removed pine needles from the base of a wood wall and kept the house from igniting."

A final note from the same fire analysis: "That portion of the Cerro Grande Fire that burned into the community generally spread as a relatively low-intensity surface fire, not as a high-intensity crown fire."

Outbuildings are generally not included in a home structure triage decision. Outbuildings will generally be written off. However, their proximity to the home and the type of storage in them could be negative factors in triage.

During evacuation of residents in a major fire incident, not all of the family vehicles will be removed, and remaining vehicles become fuel load in the vicinity. This is more of a negative factor if they are within 30 feet of the structure.

Hazardous materials storage

The normal household today contains hazardous materials that may be used for agriculture, cleaning, pest control, and fuel for yard equipment. However, excessive amounts for whatever reason will reduce a triage rating in consideration of firefighter safety.

Available firefighting personnel and apparatus

The difference in a home that can be protected

and one that is rated as "cannot be saved" might only be in the number of available firefighters. If firefighters are not on the scene as a triage rating is determined, but are expected, it must be known with certainty when they and their equipment will arrive. Firefighters on foot can help defend a home rated "needs protection but can be saved," but a fire crew with fire apparatus and the typical equipment carried on the vehicle obviously allow extra protection.

Available water supplies

For firefighters to actively defend a home rated "needs protection but can be saved" it is assumed that a reliable water supply is available along with a pump to distribute the water. Water supplies carried on pumping fire apparatus will generally not be sufficient to protect a home and provide a safety factor for the fire crew.

Vehicle access to structure

If fire crews are needed to provide critical extra protection for a triaged home, they must be able to move their fire apparatus close to the home and also be able to rapidly evacuate if conditions deteriorate. These things will be negative access factors in determining a triage rating: narrow, winding access roads; long driveways; cul-de-sacs without enough room for apparatus to turn around; and driveways or access roads with adjacent wooden fences, flammable vegetation, or propane storage tanks.

Photo examples

Instructors may wish to prepare for a class in structure protection and triage by making photographs of area homes that can generally be used to illustrate the three priorities of structure triage, even without having real fire conditions and resource availability to factor in. The intent of the photographs would be to show clear-cut examples of homes that have features that contribute to their needing little extra protection, or homes that would probably survive with extra protection, and that probably would not survive a nearby fire even if protection resources were available.

Final actions by homeowners

If firefighters are asked for advice on the final actions homeowners can take on the approach of a threatening wildfire, three important considerations include shutting off any natural gas supply or fuel oil supply at a point as far away from the structure as the plumbing will allow, making certain that all water is shut off except that supplying external hose bibs to be used for firefighting; and evacuating everyone to a safe place.

VIDEO EXCERPT:

'Cannot be saved' is the triage designation given to structures for which no amount of mitigation or active firefighting efforts would likely save them. Attempts to protect them only increase firefighter safety risks.

VIDEO EXCERPT:

If you are spending all of your time and resources trying to fight the unwinnable situation, everybody is going to suffer. Your crew is going to be in danger. And you are going to lose a lot more than you're gaining. Abandoning a structure can be the right thing to do even though it may feel like admitting defeat

...Capt. Robert Stibbard

IF NECESSARY: ABANDON THE STRUCTURE

There are two reasons to make a conscious decision to abandon a structure to an approaching fire: first, when a size-up of the situation leads to a triage rating of "cannot be saved"; and second, when efforts to protect the structure are still overcome by fire behavior factors to the point that additional time and effort will still not alter the outcome but will decrease the safety of firefighters.

Triage analysis

The triage analysis was discussed in the previous pages. Some of the triage factors were dictated by the fire, but some were determined by actions, or rather lack of actions, by the homeowner before the fire was ignited. From research conducted by Jack Cohen at the Rocky Mountain Research Station, USDA Forest Service and reported in the article "What is the Wildland Fire Threat to Homes?" (see reference to availability at For More Information at the end of this section), Cohen concluded that "the characteristics of a home and its immediate surroundings determine a home's ignition potential during a wildland fire."

Cohen indicated who he thought was most in control of the home and the immediate surroundings when he wrote, "Thus, the home should not be considered a victim of wildland fire, but rather a potential participant in the continuation of the wildland fire. Home ignitability, i.e., the potential for W/UI home fire loss, is a homeowner and community choice and responsibility."

Added Cohen: "...home ignitability ultimately implies the necessity for a change in the relationship between homeowners and the fire services. Instead of all presuppression and fire protection responsibilities residing with fire agencies, homeowners should take the principal responsibility for assuring low home ignitability."

When protection efforts do not succeed

Even when an attempt is made to protect a home or a neighborhood, conditions can change to the point that the battle is no longer winnable. Then the structure must be abandoned if further efforts only place firefighters at risk of harm.

For example, a wind change can produce larger flame lengths near the home than were predicted, or fire spotting may become worse than expected. Or an equipment malfunction may wipe out the intent to provide protection to a home.

Spot fires are especially dangerous. If they are occurring around the structure or on the roof faster than you can put them out, it is obviously time to consider retreating to a safer area. If the fire gains hold on the roof and involves more than a fourth of it in windy conditions, it is time to consider leaving. If fire gains an interior room in windy conditions, it is time to leave. If your escape route is about to be blocked, leave!

STRUCTURE PROTECTION: FOR MORE INFORMATION

www.firewise.org

The Firewise web site has specific materials on structure triage available for download, including videos. Other items related to structure protection include Protecting Your Home from Wildfire, Wildland Home Fire Risk Meter, Before Wildfire Hits Your Home: Home Protection Guide, Firescape: Landscaping to Reduce Fire Hazard, Preparing a Home for Wildfire Season, and many more similar titles. They are useful for both firefighters and homeowners.

At the Firewise site, use the following address to access an interactive home rating scale: www.firewise.org/www98/ratinghomez.htm.

Book

Fire Engineering Books offers a book titled Structure Protection in the I-Zone (referring to the interface), by retired San Jose, California, fire captain George Bradford. More information is at store.yahoo.com/pennwell/strucprotini.html.

Reports

A good review of structure loss in an actual fire, titled "Examination of Home Destruction in Los Alamos Associated with the Cerro Grande Fire, July 10, 2000," by Jack Cohen, USDA Forest Service, can be downloaded at www.firelab.org/pdf/fbp/cohen/losalamos.pdf.

Another article by the same author is "What is the Wildland Fire Threat to Homes?" It is available for free download at www.nps.gov/fire/fireplan/home_ignition_lecture.pdf.

The National Fire Academy web site offers a research paper for online viewing or free downloading titled "Structure Triage During Wildland/Urban Interface/Intermix Fires." The research project analyzed the factors that influence the survivability of structures located in wildland/urban interface and intermix zones. The purpose of the project was to produce a short, simple checklist fire officers can use to do structure triage during a wildland conflagration. This paper is at www.usfa.fema.gov/pdf/tr_94kb.pdf.

For more online reports and checklists for use with structure triage, perform a search on the term "structure triage."

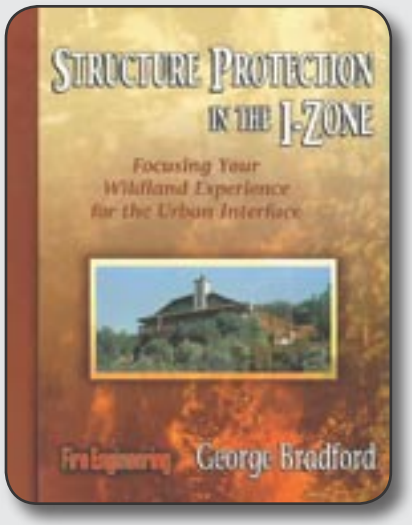
For more online information, other search terms that produce excellent results include "structure loss in wildfires" and "wildfire structure protection."

Incident Command System

The USDA Forest Service site for the National Interagency Incident Management System is at www.fs.fed.us/fire/operations/niims.shtml.

A document titled "Incident Command Systems: A Perspective on Strategic and Tactical Applications" is at www.allhandsconsulting.com/toolbox/Incident%20Command%20Systems.doc.

The National Fire Academy has numerous courses on incident command at www.usfa.fema.gov/dhtml/fire-service/nfa.cfm.

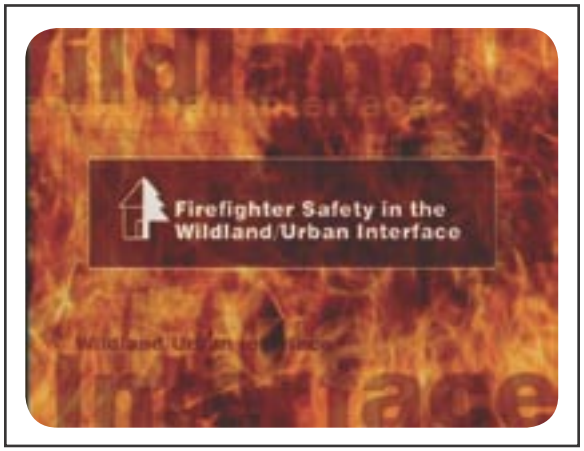


"The amount of research on structure protection and survivability of homes in the wildland/urban interface is constantly increasing."

VIDEO 3

FIREFIGHTER SAFETY

IN THE WILDLAND/URBAN INTERFACE



This video on firefighter safety attempts to motivate firefighters to stop and think to themselves, "I can die fighting fires. I need to take fire seriously and learn as much as I can about it. A little knowledge can save my life."

The stories presented in the video are real, and they are emotional. Taken together, the stories show firefighters describing situations that threatened their lives. What happened to them is a chilling reminder of the importance of safety, because these things can happen to any firefighter. What mistakes were made and what lessons were learned should be of interest to all firefighters.

Timber Weller

A Florida firefighter, Timber Weller was in his work center when a call came in around noon. Someone reported seeing flames in the woods near some homes. Weller later said, "It was a pretty nondescript, low-activity fire. I reported to the dispatcher that I could handle it without backup."

At the time in Florida, it wasn't uncommon for a single tractor plow to be called in to control a small wildfire. Weller sized-up what seemed to be a perfectly routine fire and began plowing a fireline.

Continued Weller: "I hadn't been operating the tractor perhaps five minutes on the fire when I noticed the flame length began to increase, and the fire really started to kick up."

The situation got worse, but at first Weller couldn't believe the behavior of this fire: "Within a matter of seconds, the sky above me had already turned orange. My first thought was 'you can't do that. A little two-foot flame in turkey oak fuel does not ignite the crowns in pine trees. It simply doesn't happen."

But it was happening, and Weller turned his tractor to flee. Too late. There was no time and no clear spot to deploy his fire shelter. He huddled into his cab and covered his face. Then he said he "took a deep breath as the fire was getting ready to hit me, and because the fire was moving so fast, I was able to hold my breath long enough that the superheated gases had mostly passed by the time I had to inhale again."

He was alive, but only barely. Doctors gave him no chance to live. He had suffered burns over 70 percent of his body. But he did survive, after two months in intensive care and after 13 surgeries.

Can you analyze this incident and think of issues that affected what happened to Timber Weller? The rest of this section provides additional information on firefighter safety to consider.

Jim Brown, Jim Williams, and Rick Lebel

In Doud's Landing in Northern California, this crew knew a major fire was coming. They had been called in to protect a home above a fire burning near the Stanislaus River. They were together as a team, and they had time to prepare. They had mitigated the structure days before. But things still went very wrong.

Soon the fire began spotting in. The plan was to let the fire blow by. What wasn't expected was how

fast the fire was coming, and how much fire was coming.

Jim Brown described what happened as "First it was one spot, then it was five spots, and then the whole thing was on fire. It went from (us) having a few seconds to spare to no time at all." He added, "I didn't have time to be scared. There was just entirely too much to do."

"I was standing in the driveway next to the engine," said Jim Williams, "I turned around and everything was orange." Soon the fire was burning Williams' nose and ears through his protective clothing.

The increasing spot fires started to close off their escape route. Then, according to Rick Lebel, "All of a sudden I hear this jet engine firing up. And I come towards the front of the house to find out what is was and realize it's the propane tank."

The propane tank was right beside the driveway. When it began venting and threatened to explode from the heat of the fire, it completely blocked their escape route.

Meanwhile, the fire engine was parked next to a wooden fence which ignited. Then the fire engine caught fire. Their water supply ran out. Their options were running out fast. A final option, the best one remaining, was to make the house their safety zone. For three hours the crew battled to save the house...and themselves. They all survived.

What actions contributed to their situation and becoming trapped? What lessons can be learned from this incident?

Robert Stibbard

Robert Stibbard's crew was also called in to protect homes threatened by a wildfire, but this incident occurred at the Cerro Grande Fire near Los Alamos, New Mexico.

"We first got there, we didn't know what the fire behavior was doing," said Stibbard. "We couldn't see the main body of the fire. We had large volumes of smoke blowing straight at us."

Even though they couldn't see the fire, Stibbard's crew thought it was prepared. They had sized up the situation and decided to triage all of the structures, and later put out any spot fires. But before they started, they held a safety briefing.

"The safety briefing concentrated on crew integrity," said Stibbard, "making sure that the company officers knew where everybody was at. We were adamant about having a lookout. We talked about escape routes, where we were going to go, where we were going to meet up. We had constant communications with everybody in the crew. Throughout, we had an accountability system. We had a secure water supply."

Stibbard modeled his strategy on LCES, which will be discussed in this section. The lookout was Lieutenant Burrows, who positioned himself a quarter of a mile away, just over the ridge. Then Burrows couldn't see the fire, but he could hear it coming. The sound was intense; he knew the fire was coming fast. So he radioed the crew. Because of the speed of the fire, the crew had exactly four minutes to get to safety. That's not really much

VIDEO EXCERPT:

"*I hadn't been operating the tractor perhaps five minutes on the fire when I noticed the flame length began to increase, and the fire really started to kick up.*

...Timber Weller. He was burned over 70% of his body..."

VIDEO EXCERPT:

First it was one spot, then it was five spots, and then the whole thing was on fire. It went from having a few seconds to spare, to no time at all. I didn't have time to be scared. There was entirely too much to do

...Jim Brown

time, and the firefighters hadn't noticed how much the winds had picked up. Suddenly, the flames were reaching 120 feet in the air and crowning in.

Stibbard had identified two streets as escape routes, and he had a safety zone a quarter of a mile down the road.

"I couldn't get the trucks out of the way fast enough," Stibbard said. "I couldn't get the people moved down the street fast enough. I couldn't move fast enough myself. I remember running down the streets, looking back over my shoulder, how high those flames were, and how fast they were moving." Fortunately, they reached their safety zone in time and began a head count.

Instructors are encouraged to share any personal story about firefighter safety lessons learned, and solicit similar stories from students in the class. Such personal stories add relevance to this important subject.

10 Questions for Students

1. What are the three main categories of causes of firefighter fatalities in the wildland?
2. Why do so many incidents with multiple firefighter fatalities include high or unanticipated winds?
3. What are two causes of wildland firefighter fatalities that are thought of as personal responsibilities, rather than fire management responsibilities?
4. How can firefighter fatalities be reduced in vehicle accidents on the way to the fire?
5. What are the two basic guidelines required to make L-C-E-S an effective tool at a wildland/urban interface fire?
6. Name at least three responsibilities of lookouts under the L-C-E-S system.
7. Describe the communications method recommended for giving a quality briefing.
8. Name at least three escape route considerations under the L-C-E-S system.
9. Name at least three safety zone considerations under the L-C-E-S system.
10. What are the two different types of crew cohesion, and describe an incident where poor crew cohesion contributed toward firefighter injuries.

CAUSES OF WILDLAND FIREFIGHTER FATALITIES

The National Wildfire Coordinating Group's Safety and Health Working Team has documented historical wildland fire fatalities from many different wildland fire management agencies and cross-referenced the data with the National Fire Protection Association. It is believed complete for the years 1910 through 2001 fatality information.

Fatality causes

For the 91 years considered, there were 773 fatalities.

There are seven categories of fatalities, but 80 percent of all fatalities fall into three categories: burnover (58 percent), vehicle accident (11 percent), and medical (11 percent, mostly heart attacks). Another significant category is aircraft accident, at 13 percent, but this category is beyond the scope of the video or this instructor guide.

In the burnover category, being overrun by fire and spot fires were responsible for the great majority of fatalities.

In the vehicle accident category, the largest grouping was of fatalities while responding to the fire. The next largest group was due to equipment rollover at a fire.

In the medical category, heart attacks amounted to 90 percent of the fatalities.

Dangerous winds and multiple fatalities

A look at the individual incidents resulting in multiple fatalities shows a high number of fire behavior notes about shifting winds. In almost all of the individual incidents where there were five or more fatalities, the wind was listed, with notes ranging from "unanticipated up-slope wind in afternoon after Santa Ana winds stopped" [12 fatalities], and again, "Santa Ana weakened and unanticipated wind pushed fire up-slope in late morning" [8 fatalities], and again, "up-slope winds in p.m. when the Santa Ana winds ceased. Fire ran uphill." [11 fatalities] or "unanticipated evening down-slope wind" [15 fatalities].

Other single incidents with multiple fatalities were due to other causes, such as aircraft crash [5 fatalities], heart attacks [8 fatalities], and engine rollover [5 fatalities].

Since 1910 the average number of fatalities has been between 8 and 9 per year. Only three years since 1983 had as few as 8 (1985, 1993, and 2001). Since 1990 the number of fatalities has been 1990=23, 1991=13, 1992=13, 1993=8, 1994=35, 1995=16. 1996=10, 1997=10, 1998=14, 1999=26, 2000=16, 2001=8.

Using the statistics

The reason to be aware of these statistics is that instructors can analyze them to focus on the most important lessons and help firefighters avoid the situations that historically have caused the most fatalities.

The online address for the complete fatality report is listed in For More Information at the end of this section of the instructor guide.

VIDEO EXCERPT:

*I was standing in the driveway next to the engine. I turned around and everything was orange. Then it was burning my ears and nose through my protective equipment....*Jim Williams

VIDEO EXCERPT:

Too many firefighters are killed in vehicle accidents even before they get to the scene of the fire. Drivers should take personal responsibility to assure that they are trained to operate big vehicles in the safest manner possible. Physical fitness is also a personal responsibility.

SAFETY AS A PERSONAL RESPONSIBILITY

The USDA Forest Service publication Wildland Fire Fatalities in the United States, 1990 to 1998, by Richard Mangan, states that all firefighters are ultimately responsible for their own safety and well being. Several areas are totally within the individual's control, and two will be discussed as background for instructional efforts. Other safety considerations will be featured throughout this video guide, but these two issues are particularly affected by individual decisions.

Physical fitness

Fire fighting is widely acknowledged to be one of the most physically demanding and hazardous of all civilian occupations. Fire fighting activities are strenuous and often require fire fighters to work at near maximal heart rates for long periods. The increase in heart rate has been shown to begin with responding to the initial alarm and persist through the course of fire suppression activities. Epidemiologic studies, as reported by the National Institute of Occupational Safety and Health (NIOSH), have found that heavy physical exertion sometimes immediately precedes and triggers the onset of acute heart attacks.

During the period of the Mangan study, 21 percent of the deaths associated with wildland fire operations resulted from heart attacks. Mangan continues: "A large volume of medical literature details the relationship between physical fitness and cardiac health. Regular exercise programs have a demonstrated record of reducing heart attacks. This is especially important to individuals who are over 40 years old and who may not live an active lifestyle until called on for fire suppression."

When a firefighter makes a personal choice not to exercise, therefore, he or she should be reminded that their choice increases their own mortality and puts other nearby firefighters in danger when the heart attack occurs under emergency conditions.

Safe driving on the way to the fire

Vehicle accidents amounted to 18 percent of firefighter fatalities in the Mangan report. Many of those deaths were unrelated to fire behavior at the time of the accident, but occurred as a result of unsafe driving on the way to a fire due to an incorrect assumption of the need for haste, proving that undue haste was often detrimental to the intent of the firefighter. This decision was entirely within the control of the firefighters driving the vehicles.

Volunteer firefighters were responsible for 72 percent of the vehicle-related deaths, with at least half of those occurring in the South. This may be due to a lack of commitment to training in that region, but it is the individual who makes a personal decision to operate a heavy piece of equipment without adequate training and experience. Instructors can be influential in reminding firefighters of their personal responsibility for safe driving. That responsibility can have an effect not only on the driver making the decisions, but also on each firefighter riding on the same equipment.

RECIPE FOR SURVIVAL: L+C+E+S

LCES is a safety planning concept that should be part of any fire action plan. It focuses attention on the following four considerations for safer operations:

L = Lookout
C = Communications
E = Escape Route
S = Safety Zone

The LCES system enhances and focuses the Ten Standard Fire Orders (page 48), the 18 Situations That Shout Watch Out (page 49), and other safety aids for wildland firefighters. Structural firefighters operating at wildland/urban interface fires must be aware of the same concepts.

LCES originated with Paul Gleason while he was superintendent of the Zigzag Hotshot Crew. LCES course materials state that "On June 26, 1990, during transition to a Type I Incident Management Team, the Dude Fire, on the Tonto National Forest made a spectacular and tragic run. The Perryville Type II Crew was burned over, and six people lost their lives." The LCES approach evolved from the lessons learned in that fire. LCES is distributed as a workshop in three parts delivered in from five to eight hours. The workshop material and PowerPoint presentation can be downloaded for free. See For More Information at the end of this section.

In order for LCES to be useful enough to be efficient and flexible enough to be effective, the concept is built on two basic guidelines:

1. Before safety is threatened, each firefighter must know the LCES system will be used.

2. LCES must be continuously reevaluated as fire conditions change.

The four parts of LCES

LCES should be established before fighting the fire: Select lookouts, set up a communications system; choose escape routes; and select safety zones.

LCES functions sequentially; it is a self-triggering mechanism. Lookouts assess...and reassess...the fire environment. They Communicate threats to safety. Firefighters use preplanned Escape Routes to reach preplanned Safety Zones. All firefighters should be alert to changes in the fire environment and have the authority to initiate communication.

VIDEO EXCERPT:

"The safety briefing concentrated on crew integrity, making sure that the company officers knew where everybody was at. We were adamant about having a lookout. We talked about the escape routes, where we were going to go, where we were going to meet up. We had constant communications with everybody in the crew."

...Capt. Robert Stibbard

VIDEO EXCERPT:

"Lookouts keep an eye out for such things as sudden wind shifts or gusts, blow-ups, spotting behind the crew that might entrap them, or low-lying smoke that night hinder visibility. The moment the lookout senses danger, he or she notifies the crew immediately."

LCES: LOOKOUT

Effective use of a lookout in the LCES system requires that the lookout be properly trained. For example, train lookouts on how to observe the wildland fire environment and to anticipate and recognize fire behavior changes.

Lookouts should have the following responsibilities:

Individuals chosen for this assignment are to be alert, thinking clearly, and knowledgeable. They must be good communicators and have good command of the radio system (frequency management).

Lookout knows where Escape Routes/Safety Zones are in relation to crew safety.

Achieves a view of the fire scene.

Monitors the fire and fire behavior.

Maintains communications with everyone in his/her area. This needs to be an active process.

Receives briefing on strategy and tactics.

Accounts for everyone's location, including small groups and individuals. The use of signal mirrors (headlamps at night) is encouraged.

Monitors weather and tracks weather trends.

Anticipates and thinks ahead. Provides an overview on progress and the completeness of monitored communications.

Provides communications link to the outside world.

May be asked to handle logistics for remote operations.

Uses a lookout checklist compiled from this LCES course.

Maintains a supply of extra batteries.

Keeps in mind the limits of their view, and informs firefighters when they are moving out of that area.

Stays in position until replaced, or the hazard is otherwise mitigated, or ordered out by supervisor. It is important that everyone counting on you as a lookout knows of any break in your service.

Establishes their own LCES plan, and knows how they fit into the chain of command, i.e., where their communications link is.

The lookout is not always an individual perched on an adjacent ridge, nor will the person looking out be able to see the entire scene. A Crew Boss or IC may serve as a lookout by being heads up (as opposed to digging), and by staying mobile.

LCES: COMMUNICATIONS

The communications considerations below are from the LCES Workshop:

Pass on all pertinent information. Free flow of information is good management practice, gets things done, and saves lives. If people fail to pass along information, fail to listen attentively, and fail to elicit information actively, that's bad management and unsafe management.

Any glitch in communications, whether a radio problem, or an individual's unwillingness to communicate, should have us questioning our safety.

Listening is the biggest part of effective communications.

Non-verbal clues are critical for accurate communications.

Items that must be communicated

Known safety concerns
Fire behavior
LCES
Weather
Topography
Strategy and tactics
Job assignments (duties)
Duration of assignment
Political considerations
Radio frequencies, and how to
Gut feelings about the situation, the assignment, or individuals
Contingency planning such as medivac, etc.

Communications are accomplished but not limited to:

1. Briefings. Dispatch briefings, morning briefings, and initial line briefings at assignment location.
2. Ongoing radio messages to supervisors, subordinates, adjacent forces and air resources.
3. Lookouts.

Briefings

Briefings need to be given and received so that everyone gets all the information they need to accomplish their job safely. They should be direct, concise, and informative.

If you don't receive a good briefing, ask for one, insist that you get it, and ask questions about any item that's not clear. As the situation develops, additional briefings may be necessary.

A quality briefing will include the following: Here's what I think we face. Here's what I think we shoulddo.Here'swhy.Here'swhatweshouldkeepour eye on (this should include an LCES plan). Now, talk to me.

Final thoughts

Radio transmissions should be thought out and concise. Don't allow overwhelming duties and communications distract you from accurately monitoring the big picture, when incremental changes add up to an unsafe situation.

VIDEO EXCERPT:

"Without good communications, the best-laid plans can collapse and turn deadly in an instant. Some of the worst tragedies occur when communications break down. Make sure that radio frequencies are established and declared."

VIDEO EXCERPT:

Unfortunately, the venting propane tank was only the beginning of the crew's problems. The crew had counted on their engine as an emergency shelter. But they had parked the engine next to a flammable fence. It caught fire... How are we going to get home now?

...Rick Lebel

LCES: ESCAPE ROUTES

The escape route considerations below are from the LCES Workshop. Escape routes are the travel paths used to reach safety zones.

Escape routes are to be identified and announced as any crew moves into and through an area.

Establish at least two escape routes and make them known. (In the 1976 Battlement Creek Fire, three firefighters lost their lives after their only escape route was cut off by the advancing fire.)

Alternative escape routes are encouraged.

Barriers to clean escapes are to be cleared or otherwise mitigated. Barriers encountered in the past include bluffs, brush, downfall, steep slopes, etc.

An individual will be assigned to walk out the escape route, identify barriers and get a realistic idea of the time needed to reach a safety area.

Timing. Some people think it should be LCEST.

New escape routes need to be identified as people move through new areas. If the black at the anchor point of the fire is the original safety area, the time required to reach that safety area will increase as the line is extended.

In wildland firefighting, LCES is designed to provide a wide safety margin. A 'wide margin' is an alternative to the image of the desperate dash to the safety zone. A trained eye will recognize the critical factors such as changes in air mass, increased fire behavior, and inherently hazardous situations and recognize the fire 'posturing' to make a run. Properly used, LCES should allow us to walk, not run, to a safety zone.

Set trigger points and thresholds to avoid the trap of incremental changes.

90% of the time, the fireline is the escape route.

LCES: SAFETY ZONE

The safety zone considerations below are from the LCES Workshop. If changing fire behavior produces extreme fire behavior and increased danger to firefighters, it is time to move to the safety zone. A safety zone is defined as a pre-planned area of sufficient size and suitable location that is expected to prevent injury to fire personnel from known hazards without using fire shelters.

Survival zones are not safety zones. The use of a fire shelter should not be necessary in a safety zone.

Safety zones will be identified and discussed before work begins.

'Keep One Foot in the Black' or 'Bring the Black with You' is our first and most common safety practice.

Take advantage of the aerial overview whenever possible. Make sketches or mark maps in the aircraft. Consider the use of Polaroid or digital photography.

Safety zones can be created by burning out light fuels, or irrigation; however, the time these actions require must be factored into the LCES formula.

Firelines located to include open meadows will eliminate the need of some last minute firing.

When a blackened area is used as a safety zone, the crown must also be absent. Be heads-up for falling trees that have burned, rolling rocks, and re-burnable brush.

New safety zones must be scouted and announced as people move into new areas.

Help less experienced people scrutinize safety zones. Help build the slide library with examples of good and poor safety zones.

90% of the time the black is the safety zone. It must be cool enough to stand in, big enough to eliminate radiant and convective heat, and have no re-burn potential.

Each individual must be constantly engaged in the LCES process, evaluating and reevaluating as locations and situations change.

The selection of a safety zone is influenced by the nature of the approaching fire that is threatening safety. The safety zone needs to be big enough to provide enough separation from flames and heat. Considerations include judging or anticipating flame height from the approaching fire and available fuels. The safety zone separation should be four times the flame height, on all sides if the fire may surround the zone.

VIDEO EXCERPT:

"The lookout saved our lives. Having a quick escape route saved our lives. Without them the fire would have caught us. Our mistake was being too optimistic about what we could do and not gauging how fast the fire was coming"

...Capt. Robert Stibbard

VIDEO EXCERPT:

Experts who have studied why people died fighting wildfires have long noted a connection between fire crew cohesion and fatalities. Accidents in field crews were inversely correlated with the cohesion of the crews. In other words, the greater the crew cohesion, the fewer the accidents

...Jon Driessan

THE IMPORTANCE OF CREW COHESION

Crew cohesion refers to the ability or tendency of a wildland fire crew to stick tightly together and work effectively together as a group, especially in a deteriorating safety emergency where decisions can mean the difference between life and death.

Cohesion goes beyond just working together. It means the extra "chemistry" that makes the members closely identify with each other. They have an extra strength that becomes more important in extreme emergencies. Think of the marine tradition.

Connection between crew cohesion and fatalities

A new report on crew cohesion by Jon Driessan, USDA Forest Service Technology and Development Program, titled "Crew Cohesion, Wildland Fire Transition, and Fatalities," was completed in 2002. In it the author states, "Experts who have studied why people died fighting wildfires have long noted a connection between fire crew cohesion and fatalities."

Explained Driessan: "Accidents in field crews were inversely correlated with the cohesion of the crews. In other words, the greater the crew cohesion, the fewer the accidents."

Two types of cohesion

The report defines two types of crew cohesion: intracrew cohesion and intercrew cohesion. When there is a lack of cohesion, there can be problems with both types. Intracrew cohesion refers to the holding together of the individual members of a single crew. Intercrew cohesion refers to the cohesion of separate crews working in the same vicinity of the same fire.

The report found crew cohesion problems with three multiple-fatality incidents: the Mann Gulch Fire of 1949 where 13 died; the South Canyon Fire of 1994 where 14 died; and the Thirtymile Fire of 2001 where 4 died.

The Mann Gulch Fire is described as an example of firefighters not being a crew at all (a lack of intracrew cohesion). Instead, they were merely "loosely coupled" without any intracrew cohesion. But fire management techniques and training have advanced since then.

Nevertheless, the South Canyon Fire had crews with very strong intracrew cohesion but lacking intracrew cohesion for the three separate crews working in the same area.

The Thirtymile Fire featured problems with both intracrew and intercrew cohesion. But there were other observations about some successful intracrew cohesion. Driessan was part of the investigation of the Thirtymile Fire and noted, "In this tragic incident, intracrew cohesion probably saved the lives of the Lake Leavenworth crew. They 'hung together' and deployed their shelters on the road. However, the same intracrew cohesion spelled doom for the Natches crew."

Cohesion provides more protection

As Driessan began studying crew cohesion, he

saw that people working in cohesive field crews "were fully aware that their cohesion helped protect them from dangers inherent in their work."

Cohesion takes time, however. Driessan saw that it takes from 6 to 8 weeks for individual seasonal workers to bond into cohesive crews with pride in and trust for one another.

"Crew cohesion is 'made' by individual workers themselves," said Driessan in what he called his most important discovery in these studies, "when they establish agreements about the rules that govern a host of their day-to-day work practices."

Cohesion and transition fires

The report points to transition fires as the time of maximum safety risk to fire crews, and the time when crew cohesion is critical.

The time of transition is the time when a fire has grown beyond the initial attack stage. The incident commander (IC) recognizes that additional resources are needed or are en route. The IC has to begin the transition to the extended attack stage; during this time the IC begins to withdraw from direct fireline supervision and prepare for the different requirements of extended attack.

During transition, the resources, tactics, strategies, and organizational structures are not in place to operate the extended attack.

"This is when the firefighters are often involved in independent action," wrote Dick Mangan in the study Wildfire Fatalities in the United States, "either as members of a small crew, an engine, or even as individuals. The higher levels of incident management teams are not on the scene, communication may be confused, fire weather and behavior conditions may not be widely known or recognized, and the chain of command may not be well established."

Intracrew cohesion is put under more pressure. Intercrew cohesion is also put under more pressure. The lesson of this is that the transition is a time to be especially safety conscious.

How to increase crew cohesion

Driessan says that it is unrealistic to expect different fire crews and fire managers to smoothly and automatically blend together into cohesive units during stressful times. The time to develop this cohesion can be reduced with special training.

He adds that if up to 72 percent of all fire fatalities in the wildland occur during fires in transition, that is also where to direct future studies and training. A special goal of training may be to find out who does or does not have the ability to identify types of transition fires and to give those individuals more practice in the actions that increase crew cohesion at the critical time of transition.

See For More Information on page 51 for the web address for downloading a copy of the report.

VIDEO EXCERPT:

"The report points to transition fires as the time of maximum safety risk to fire crews, and the time when crew cohesion is critical. The time of transition is the time when a fire has grown beyond the initial attack stage. During transition, the resources, tactics, strategies, and organizational structures are not in place to operate the extended attack."

VIDEO EXCERPT:

Too many firefighters are needlessly injured and killed fighting fires in the wildland/urban interface. That's why it is absolutely critical to take the time to train for safety, and to learn the fire orders and the watch out rules until safety becomes second nature.

10 STANDARD FIRE ORDERS

The Ten Standard Fire Orders were developed in 1957 by a task force studying ways to prevent firefighter injuries and fatalities. At the May 2002 meeting, the National Wildfire Coordinating Group adopted a change in wording and order. The list below represents the 2002 wording and order. As taught to wildland firefighters: "The 10 Standard Fire Orders are firm. We don't break them; we don't bend them. All firefighters have a right to a safe assignment."

This list routinely taught to wildland firefighters, but instructors should use the list to make structural firefighters equally aware of these important safety considerations.

THE TEN STANDARD FIRE ORDERS

Fire Behavior:

1. Keep informed on fire weather conditions and forecasts.
2. Know what your fire is doing at all times.
3. Base all actions on current and expected behavior of the fire.

Fireline Safety:

4. Identify escape routes and make them known.
5. Post lookouts when there is possible danger.
6. Be alert. Keep calm. Think clearly. Act decisively.

Organizational Control:

7. Maintain prompt communications with your forces, your supervisor, and adjoining forces.
8. Give clear instructions and ensure they are understood.
9. Maintain control of your forces at all times.

If 1 through 9 are considered, then...

10. Fight fire aggressively, having provided for safety first.

18 SITUATIONS THAT SHOUT WATCH OUT

1. The fire is not scouted and sized up.
2. You're in country not seen in daylight.
3. Your safety zones and escape routes are not identified.
4. You're unfamiliar with weather and local factors influencing fire behavior.
5. You're uninformed on strategy, tactics, and hazards.
6. Instructions and assignments are not clear.
7. You have no communication link with crew members or supervisor.
8. You're constructing a line without a safe anchor point.
9. You're building a fireline downhill, with fire below.
10. You're attempting a frontal assault on the fire.
11. There is unburned fuel between you and the fire.
12. You cannot see the main fire, and you're not in contact with someone who can.
13. You're on a hillside where rolling material can ignite fuel below.
14. The weather is becoming hotter and drier.
15. The wind increases and/or changes direction.
16. You're getting frequent spot fires across the fireline.
17. The terrain and fuels make escape to safety zones difficult.
18. You feel like taking a nap near the fireline.

VIDEO EXCERPT:

Nine WUI "Watchout" Situations

1. Wooden construction and wood shake roofs
2. Poor access and narrow congested one-way roads
3. Inadequate water supply
4. Natural fuels closer than 30 feet to structures
5. Extreme fire behavior
6. Strong winds
7. Need to evacuate the public
8. Structures located in chimneys, box or narrow canyons, or on steep slopes in flashy fuels
9. Inadequate bridge load limits

...from Fireline Safety Reference, NPS Branch of Fire Mgt.
3056 Elder St. #A Boise ID 83705

VIDEO EXCERPT:

“Sometimes municipal firefighters show up in full turnout gear for an interface fire. This equipment is ideal for fighting structural fires, but it is far too cumbersome in the interface, and has caused preventable heat stress and exhaustion injuries.”

STAY SAFE FOR THE LONG HAUL

The size of many fires in the wildland/urban interface means that they may take days or weeks to be controlled and more days before complete extinguishment. During extended fire attack, everyone must be especially conscious of the effects of fatigue.

Incident commanders are challenged to wisely use the limited available resources, yet not forget about the safety factors of fatigue. Fighting fires in the interface is a lot like running a marathon, with an occasional sprint to save your life, as Capt. Robert Stibbard relates in the video.

Your safety strategy should also recognize that you need to preserve your energy for the long haul. There may be periods of just waiting. During these down times, staying safe means knowing how to rest without losing focus. The one time that you get tired or confused could be the one time that you’ll need to react quickly and intelligently in order to save yourself.

We have already pointed out that to endure their marathon, firefighters have to stay in excellent physical shape. They also need to know how to recognize the signs of stress when they occur.

The firefighters’ equipment should also be geared for extended operations. Sometimes municipal firefighters show up in full turnout gear for an interface fire. This equipment is ideal for fighting structural fires, but it is far too cumbersome in the interface, and has caused preventable heat stress and exhaustion injuries.

Lightweight gear commonly used by wildland firefighters is better suited for interface conditions. It lets a person maneuver easily over long periods of time. It also permits the wearer to move quickly when necessary.

Think of the stories of the three incidents featured in this safety video. If the firefighters in any of these stories had been exhausted, in poor physical condition, or wearing the wrong equipment, they might not have survived those critical moments described in the video, when they really did have to rush to save their lives.

Instructors are urged to be aware of the lessons that can be learned from each story in the video.

Timber Weller can’t apply all of the lessons he learned, because he says, “I can’t be a forest ranger anymore.” Due to his burns, he says working outdoors full-time in the sun just isn’t an option. There have been changes. Florida now gives firefighters better up-to-date weather reports to help them avoid sudden downdrafts like the one that trapped Weller.

He words of advice are to do whatever you have to do to really think about safety. Says Weller: “You have to overcome that basic psychological defense of ‘Oh, it’s not going to happen to me.’ You have to recognize that firefighting is an inherently dangerous business.”

FIREFIGHTER SAFETY: FOR MORE INFORMATION

Wildland firefighter fatalities

The NWCG Safety and Health Working Team's report on historical wildland firefighter fatalities 1910-2001 is free at the address below. The data can be accessed by year, by state, and by type of activity at the time of death. It is also possible to create individual customized reports by combining the data elements of year, location, state, type of accident, organization represented, and number of fatalities in the incident: www.nifc.gov/reports/

The National Institute for Occupational Safety and Health (NIOSH) also reports on firefighter fatalities. Most relate to structural firefighting, but wildland fatalities are also included. See: www.cdc.gov/niosh/firehome.html

One example of the lessons that can be learned from even small fires is at: www.cdc.gov/niosh/face200022.html

Thirtymile Fire investigation reports
www.fs.fed.us/r6/wenatchee/fire/thirtymile-reports.html

Fire Danger Rating Pocket Card for Firefighter Safety

This 5-page document provides an overview of this safety card. Available at: www.cdc.gov/niosh/face200022.html

Fireline Handbook

This NWCG field guide (PMS 410-1) has safety information. It can be ordered through NIFC. Ordering information is available with other NIFC information at page 61 of this instructor guide.

Crew cohesion, shelters, smoke exposure

The site below contains the 15-page report on "Crew Cohesion, Wildland Fire Transition, and Fatalities."

www.fs.fed.us/fire/safety/MTDC_Lessons/documents/Crew_Cohesion/pdf02512809.pdf

At www.fs.fed.us/fire/safety/shelter/entrapments/entrap_index.html there is a downloadable report in four parts on Surviving Fire Entrapments.

At www.fs.fed.us/pnw/pubs/gtr_448.pdf there is a report titled Guide to Monitoring Smoke Exposure of Wildland Firefighters. Although this subject was not addressed in this guide, the report should be on interest to all firefighters.

LCES

This site has access to LCES workshop presentations and other materials: www.nv.blm.gov/wgbcc/lces.htm

General safety

Links to numerous other safety-related sites makes this site useful for all interface firefighters: www.for.gov.bc.ca/protect/firefighter/safety/

An extensive presentation on safety zones is at the following address: www.buttefire.com/presentations/safety.pdf

VIDEO EXCERPT:

"

From the Thirtymile Fire investigation report:

(See link at left and summary at page 61.)

Potential fire behavior was consistently underestimated throughout the incident...All 10 Standard Fire Orders were violated or disregarded at some time during the course of the incident...Ten of the 18 Watch Out Situations were present or disregarded...

"

REFERENCE SOURCES

WILDLAND/URBAN INTERFACE AGENCY OVERVIEW

The agencies listed in this reference section are active participants in wildland/urban interface issues. Many are sponsors of the National Wildland/Urban Interface Fire Program. But the list is limited by available space in this instructor guide. The references here focus on the web sites of the listed agencies because they are easily accessible by anyone. Taken together, they have a vast selection of educational materials to supplement any instructor's experience and knowledge on interface subjects.

Only a few of the firefighter safety-related activities of each agency and web site could be described here. The agency web sites are under constant revision as more information becomes available for sharing. Be sure to bookmark the listed web addresses so you can return to the sites frequently during your use of this safety series, and for future use.

The reference materials at the Firewise web site are described on the page at right, but this organization deserves special mention here for the sheer volume of publications that are available, much more than can be described on the Firewise page.

The Firewise Communities/USA program also deserves a special mention here for the effective workshops for influential community leaders from the architect, planning, banking, emergency management, insurance, building, fire protection, developer, and land management professions. Through the workshops they will focus on the plans for a fictional community. Through simulation and discussion, they examine GIS maps, interview the residents of the community, and learn how to pool their knowledge and concerns to make specific recommendations to community managers to make sure that the development is attractive, profitable, livable, and firewise. Specifically, participants will learn how to recognize interface fire hazards, design Firewise homes and landscapes, deliver fire education, and incorporate Firewise planning into existing and developing areas of communities.

Instructors should look also for existing and successful local initiatives to address wildland/urban interface challenges. Encourage students to learn about and become involved in the programs. Many such programs are in need of additional support, and instructors can focus students on these opportunities for greater involvement.

FIREWISE COMMUNITIES

The Firewise activities are sponsored by the National Wildland/Urban Interface Fire Program. Firewise publishes numerous educational materials, shares these publications and much more on its web site, and operates the Firewise Communities effort.

Firewise Communities

Firewise Communities/USA is a unique opportunity available to America's fire-prone communities. Its goal is to encourage and acknowledge action that minimizes home loss to wildfire. It teaches you to prepare for a fire before it occurs. The program adapts especially well to small communities, developments, and residential associations of all types. Firewise Communities/USA is a simple, three-legged template that is easily adapted to different locales. It works in the following way:

Wildland fire staff from federal, state, or local agencies provide a community with information about coexisting with wildfire along with mitigation information tailored to that specific area. The community assesses its risk and creates its own network of cooperating homeowners, agencies, and organizations. The community identifies and implements local solutions.

Web site

The web site contains educational information for people who live or vacation in fire-prone areas of the United States. It was designed to acquaint anyone with the challenges of living with wildland fire. As you get familiar with various sections of the site, you will learn more about wildland fire protection, whether you are a homeowner or a firefighter. You can read Wildfire News & Notes, a publication for wildland firefighters. Or you can access one of the site's many interactive games or tutorials. If you have specific questions, ask a wildland fire expert, or use the Firewise message board. The Firewise Home Page provides learning opportunities in its Firewise Communities Workshop area and tells you how to make your own neighborhood firewise by participating in the Firewise Communities/USA recognition program.

Firewise Communities/USA is a program sponsored by the National Wildfire Coordinating Group, a consortium of wildland fire agencies that includes the USDA Forest Service, the Department of the Interior, the Federal Emergency Management Agency, the National Association of State Foresters, the U.S. Fire Administration, and the National Fire Protection Association.

Contact
Firewise
1 Batterymarch Park
Quincy, MA 02169-9101
617-984-7487

Web Site:

www.firewise.org

Web Site:

www.geomac.gov

GEOMAC: GEOSPATIAL MULTI-AGENCY COORDINATION

The Geospatial Multi-agency Coordination Group (GeoMAC) is an internet-based mapping tool originally designed for fire managers to access online maps of current fire locations and perimeters in the lower 48 states and Alaska.

Using a standard web browser, fire personnel can download this information to pinpoint the affected areas. From a specific critical concern over western wildland fires in the summer of 2000, this application also became available to the general public.

In order to give fire managers near real-time information, fire perimeter data is updated daily based on input from incident intelligence sources, geographical positioning system data, and infrared imagery from fixed wing and satellite platforms.

The GeoMAC web site allows users in remote locations to manipulate map information displays, zoom in and out to display fire information at various scales and detail, including downloading desired information and printing hard copy for use on the fireline. The fire maps also have relational databases in which the user can display information on individual fires, such as name of the fire, current acreage and other fire status information with just the click of a mouse.

However, it should be noted that it was not designed to display the level of detail needed by an incident to plan strategies and tactics. GeoMac literature advises us to think of it this way: incident mapping helps managers develop a battle plan for their particular battlefield; GeoMAC, a fire internet map server application, displays the locations of the battlefields but not the details of the battle.

GeoMAC is housed at the U.S. Geological Survey's Rocky Mountain Mapping Center in Denver, CO. The GeoMAC team is a multi-agency group with technical subject matter experts from the Department of the Interior's fire management agencies and the U.S. Forest Service of the Department of Agriculture. As the sole science agency for the Department of the Interior, the U.S. Geological Survey also plays a pivotal role. Other partners include the National Interagency Fire Center and the National Oceanic and Atmospheric Administration.

Contact
GeoMAC
Building 810, Denver Federal Center
Denver, CO 80225

NATIONAL FIRE PROTECTION ASSOCIATION

NFPA was an original sponsor of the National Wildland/Urban Interface Fire Program. Activities related to the Program include a Wildland Fire Management member section, wildland fire-related safety standards, investigation reports, and other special presentations and reports.

NFPA Wildland Fire Management Section

The NFPA Wildland Fire Management Member Section was formed to bring together individuals in wildland fire management for mutual professional and technical benefit. The section promotes the exchange of information among its members; promotes cooperation between the section, wildland fire agencies of other nations, and federal, state, and local fire fighting organizations; and advances the interests of wildland fire management. The Section conducts meetings for the exchange of information and encourages participation by its members in the NFPA standards-making system.

Safety standards

Among the wildland-related safety standards are NFPA 1051, Standard of Wildland Fire Fighter Professional Qualifications; NFPA 1977, Standard on Protective Clothing and Equipment for Wildland Fire Fighting; and NFPA 1906, Standard for Wildland Fire Apparatus.

Anyone can review proposed changes to these standards during their revision periods by visiting the NFPA web site and navigating to the Codes and Standards page. From there, look for Proposals and Comments and then select one of the standard numbers referenced there.

Investigation reports

Anyone visiting the NFPA web site may download any of several free investigation reports, including those covering the South Canyon Fire, where 14 firefighters died; the Oakland Fire of 1991 in which 25 people died; the Black Tiger Fire in which numerous homes were lost; and the Stephan Bridge Road Fire, also where numerous homes were lost.

NFPA annual meetings in May and November feature presentations on wildland and wildland/urban interface subjects.

Web Site:

www.nfpa.org

Web Site:

www.nifc.gov/

NATIONAL INTERAGENCY FIRE CENTER

The National Interagency Fire Center (NIFC) in Boise, Idaho is the nation's support center for wildland firefighting. Seven federal and state agencies call NIFC home and work together to coordinate and support wildland fire and disaster operations. These agencies include the Bureau of Indian Affairs, Bureau of Land Management, USDA Forest Service, Fish and Wildlife Service, National Park Service, National Association of State Foresters, National Weather Service, and Office of Aircraft Services.

At the NIFC web site there are links to Prevention and Education, Wildland Fire Statistics, Safety, Science and Technology, and other reports and publications. From the Links to Related Sites, there is access to the Wildland Fire Lessons Learned Center, which has after-incident reports, the Scratchline Newsletter, and a growing library of lessons learned, best practices, and wildland fire curriculum source material for instructors.

Wildland fire communicators

At the Prevention and Education section there is a wildland fire communicator's guide that was a result of a study that sought to ascertain how wildland fire management organizations can better communicate wildland fire messages in such a manner as to meet societal needs, address community needs/concerns, gain public support, and comply with organizational mandates, all while utilizing the best science and technology available. Specifically, it set out to identify the knowledge, attitudes, skills, and backgrounds needed by a population of natural resource professionals with wildland fire communication responsibilities.

Six minutes for safety

Six Minutes for Safety is a daily safety lesson featured at the NIFC site. Users can also select a safety discussion by category for more information. Categories include LCES, fireline safety, weather and fire behavior, entrapment, and wildland/urban interface. This section has a discussion on liquefied propane gas (LPG) tank hazards. This hazard was a factor in one of the incidents described in the Firefighter Safety video in this educational video series.

The Federal Fire and Aviation Safety Team encourages every fire program to become involved in Six Minutes for Safety. This is the first interagency safety initiative that, on a daily basis, addresses the high risk situations that historically get our people in trouble. The fire community continuously works to find new ways to keep our people safe on the fireline, and we think this new initiative will have a tremendous positive impact.

Ordering information

NIFC, Great Basin Cache Supply Office, 3833 S. Development Ave., Boise, ID 83705. Orders may be faxed to 208-387-5573 or 208-387-5548. For questions or a catalog, 208-387-5104. The catalog may also be found at www.nwcg.gov

NATIONAL WILDFIRE COORDINATING GROUP

The mission of National Wildfire Coordinating Group (NWCG) is to provide leadership in establishing and maintaining consistent nationwide policies, standards, and procedures for wildland fire management.

The NWCG is made up of the USDA Forest Service; four Department of the Interior agencies, including the Bureau of Land Management (BLM), National Park Service (NPS), Bureau of Indian Affairs (BIA), and the Fish and Wildlife Service (FWS); United States Fire Administration, and state forestry agencies through the National Association of State Foresters.

NWCG coordinates programs of the participating wildfire management agencies so as to avoid wasteful duplication and to provide a means of constructively working together. Its goal is to provide more effective execution of each agency's fire management program. The group provides a formalized system to agree upon standards of training, equipment, qualifications, and other operational functions.

The National Wildfire Coordinating Group provides leadership for a seamless response to wildland fire across the nation. NWCG believes effective wildland fire management is achieved when:

Firefighter and public safety is the first priority in all fire management activities.

Individuals are held accountable for all their actions.

Shared leadership and mutual trust and assistance exist among all wildland fire organizations, regardless of jurisdictional boundaries.

Economy, efficiency, and quality is evident in all activities.

Public trust is maintained through quality service and the wise, efficient use of funds.

Public responsibility is realized through active partnerships.

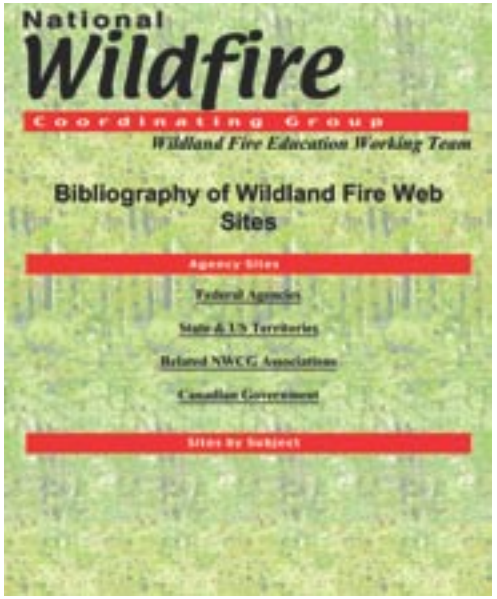
Internet information

The NWCG web site features an extensive wildland fire publications section with access to some wildland/urban interface material (such as "Establishing Fire Prevention Education Cooperative Programs and Partnerships"), and taskbooks and training material for incident command. There are extensive web links to federal, state, national, and miscellaneous information sources. Shown at right is the NWCG Electronic Bibliography, which is organized by subject. There are also documents for teachers.

Web Site:

www.nwcg.gov

(Shown below is the NWCG WFEWT Electronic Bibliography page)



Web Site:

www.usfa.fema.gov

UNITED STATES FIRE ADMINISTRATION

The United States Fire Administration (USFA) is an original member of the National Wildland/Urban Interface Fire Program. USFA and the National Fire Academy have subsequently developed a number of courses and publications related to the wildland/urban interface. Among them are the following:

- Wildland/Urban Interface Fire Operations. This training program is a joint effort of the National Fire Academy and National Wildfire Coordinating Group to identify many of the operational activities and safety concerns when the company officer is assigned to a wildland/urban interface fire. The course goal is to provide the basic information to enable the structural firefighter to participate in safe and effective operations at a wildland/urban interface incident. This will be a self-study course of approximately 6-8 hours.
- Structure Triage During Wildland/Urban Interface/Intermix Fires. This research publication analyzed the factors that influence the survivability of structures located in wildland/urban interface and intermix zones. The purpose of the project was to produce a short, simple checklist fire officers can use to do structure triage during a wildland conflagration.
- Introduction to Wildland/Urban Interface Firefighting for the Structural Company Officer. This two-day course identifies operational activities and safety concerns for structural company officers assigned to a wildland urban interface incident. Topics covered include introduction to wildland urban interface firefighting, interface environment, wildland fire behavior, command and control issues of wildland/urban interface firefighting, and tactics.
- Command and Control of Wildland/Urban Interface Operations for the Structural Chief Officer. This two-day course is designed to provide students with the essential tools and skills to operate safely in a wildland/urban interface incident. Course content covers interface incidents, fire behavior, safety, and operational considerations.
- Cooperative Leadership Issues in Wildland/Urban Interface Fire Operations. This course is designed to provide students with the essential tools and skills to operate safely in a wildland/urban interface incident. It is designed in a modular format to be offered as a two-day course or optional modules after completing Command and Control of Wildland/Urban Interface Fire Operations for the Structural Chief Officer. Course content covers strategy development (simulation exercise), overview of the emergency management plan, new development issues, working with property owners, environmental issues, cultural issues, historic issues, news media, and cooperative leadership (simulation exercise).

USDA FOREST SERVICE

The Forest Service is an agency of the U.S. Department of Agriculture. It was established in 1905. The Forest Service manages public lands in national forests and grasslands.

The mission is to sustain the health, diversity, and productivity of the nation's forests and grasslands to meet the needs of present and future generations. Gifford Pinchot, the first Chief of the Forest Service, summed up the mission of the Forest Service this way: "to provide the greatest amount of good for the greatest amount of people in the long run."

National forests and grasslands encompass 191 million acres (77.3 million hectares) of land, which is an area equivalent to the size of Texas.

Fire and Aviation Management

The Fire and Aviation Management part of the USDA Forest Service is a diverse group of people working to advance technologies in fire management and suppression, maintain and improve the extremely efficient mobilization and tracking systems in place, and reach out in support of our federal, state, and international fire partners.

From the Fire and Aviation page there are links to current wildland fire situation morning reports during the fire season, fire weather reports, fire behavior information, fire statistics, fire photos, and other national fire news.

The Publications link has access to numerous fire-related documents. Other major links cover subjects such as Aviation Safety, Communications, Fire Management, Fire Science, Fire Use, Prevention and Education, Tools and Technology, Training, Wildland Fire Safety, and other wildland firefighting organizations.

Wildland fire safety

The wildland fire safety link has access to lessons from the Thirtymile Fire, which resulted in four firefighter fatalities. Access is also available to SAFENET, the Wildland Fire Safety and Health Reporting Network. Front line firefighters have another tool that provides a way to be heard and get unsafe situations resolved on the fireline. SAFENET is a form, and process, that has been in demand by firefighters themselves. It's a method for reporting and resolving field situations quickly and at the level closest to the fire. The information provided on the form will also help collect important, safety-related data at the National Interagency Fire Center, to determine long-term trends and problem areas. The development of SAFENET was recommended in Phase III of the Wildland Firefighter Safety Awareness Study.

Web Site:

www.fs.fed.us

Web Site:

www.doi.gov

UNITED STATES DEPARTMENT OF THE INTERIOR

The U.S. Department of the Interior has four agencies that are actively involved in the wildland/urban interface area, including the Bureau of Indian Affairs, Bureau of Land Management, Fish and Wildlife Service, and National Park Service.

Bureau of Land Management

The Bureau of Land Management manages 262 million acres of public land across the United States, and provides fire protection on 388 million acres of public and state land. However, no single federal or state fire organization is designed to handle its entire fire workload, and the BLM is no exception. By using common practices, operating and physical fitness standards, training, and closest forces concepts, the BLM is committed to interagency cooperation. The agency is also committed to exchanges of protection which are a necessary and integral part of wildland fire management. In the western United States alone, the BLM has agreements with at least 1,500 wildland agencies.

Fish and Wildlife Service

The Fish and Wildlife Service Fire Management Branch operates from the National Interagency Fire Center in Boise, Idaho. This Branch is responsible for overall staff direction for the Service's fire management program which includes preparedness, fire use, suppression and emergency fire rehabilitation, which functions to support the Service missions.

National Park Service

The National Park Service's Fire and Aviation Management has both wildland and structural fire protection responsibilities. National Park Service policy stresses managing fire, not simply suppressing it. This means planning for the inevitable and promoting the use of fire as a land management tool. The goal is to restore fire's role as a dynamic and necessary natural process. Structural fire protection is an important part of fulfilling the National Park Service mission. The National Park Service enabling legislation, as well as other statues, charges the service with preserving and protecting human life and the resources entrusted to its management. These resources include building and structures, irreplaceable cultural resources, valuable property, and infrastructure.

Bureau of Indian Affairs

The Fire and Aviation Management Branch of the Bureau of Indian Affairs provides for effective wildland fire protection, fire use and hazardous fuels management, and timely emergency rehabilitation on Indian forest and range lands held in trust by the United States of America, based on fire management plans approved by the Indian landowner.

THE THIRTYMILE FIRE INCIDENT OVERVIEW

The Thirtymile Fire of 2001 resulted in four firefighter deaths. It was subsequently studied in detail for the safety lessons learned. Many of the safety factors from the report are reproduced here to add to the educational opportunity to make sure this type of incident never happens again.

Executive summary

On July 10, 2001, four Forest Service fire suppression personnel were killed after they became entrapped and their fire shelter deployment site was burned over by the Thirtymile Fire, in the Chewuch River Canyon, about 30 miles north of Winthrop, Washington.

The fire, an escaped picnic cooking fire, was detected on Monday, July 9th. Initial suppression activities began that evening. In addition, the Libby South Fire was already burning about 50 miles south of this area and exceeded 1,000 acres. The Northwest Regulars #6 (NWR #6), a 21-person Type 2 crew from the Okanogan Wenatchee National Forest, was dispatched to the Thirtymile Fire in the early morning hours of July 10th. They arrived about 9:00 a.m. in relief of the Entiat IHC crew who had been working on the fire overnight.

The area was enduring a lengthy drought and the moisture levels in large fuels were very low. The Energy Release Component, a measure of potential fire intensity, was near historic high levels for this time of year. Temperatures on July 10th reached nearly 100°F, and the humidity was very low. Although there was no dramatic shift in weather that would have created high winds, such as a dry cold front, up-canyon breezes were present to aggravate burning conditions. Fire conditions were potentially extreme.

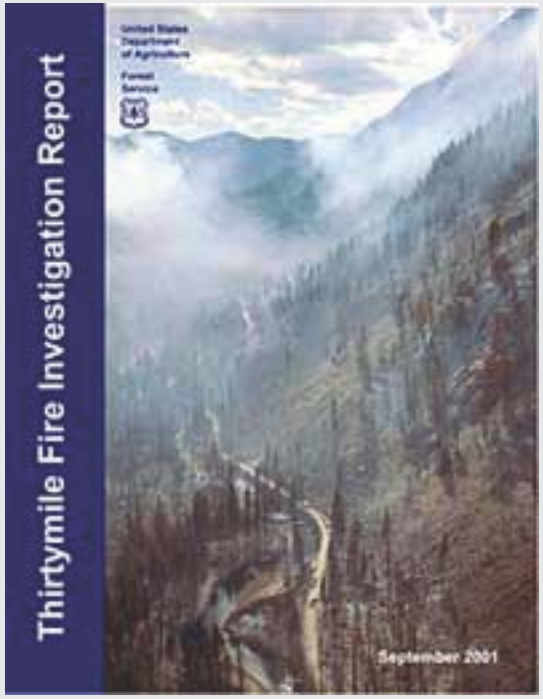
By the late afternoon the fire advanced from its perimeter east of the Chewuch River toward the top of the east ridge. At this time, the NWR #6 was suppressing fires between the road west of the Chewuch River and the river itself. They were attempting to confine the fire to the east of the road. There were no personnel east of the river at that time since it had been determined that suppression activities there were fruitless. The NWR #6 crew took a break in mid-afternoon to eat, sharpen tools, and rest. About 4:00 p.m., they responded to a request from an engine crew for help on a spot fire ¼ mile north of their position. They sent two squads to assist.

In the moments immediately prior to the entrapment, one of the squads and the crew boss trainee (a total of seven people) were working in association with a fire engine and its three person crew when a spot fire erupted right next to the road. The seven NWR #6 crewmembers and the engine crew immediately got in their vehicles and drove south past the fire along the east edge of the road to safety. While driving, they radioed the remaining 14 crewmembers who were working north, further up the river, of their dangerous situation.

The remaining 14 crewmembers (the incident commander and two NWR #6 squads) were ac-

Web Site:

www.fs.fed.us/r6/wenatchee/fire/thirtymile-reports.html



Alternate Web Site:

www.fs.fed.us/fire_new/safety/investigations/30mile/index.html

Thirtymile Fire Significant Causal Factors

A causal factor is any behavior or omission that starts or sustains an accident occurrence. Refer to the report for more details.

Inadequate safety consideration

Lack of situational awareness/ inaccurate assessment

Fatigue

Command and control

Strategy, tactics, and transition

Fire behavior

tively suppressing spot fires between the river and the road about 1/4 mile north of the first squad when they were informed of the worsening situation that threatened their escape route. Immediately, 10 of the 14 got in the crew van and began to drive south. The other four preceded the van on foot. The van was driven past these four and approached the fire that was now burning across the road. The incident commander (IC) assessed the risk as too great to proceed.

He turned the van around, picked up the four crewmembers, all of the crew gear, and drove north upriver. The IC assessed different areas as potential safety zones or shelter deployment areas. Approximately one mile north, the IC selected a site characterized by an extensive rock scree field above and west of the road. The Chewuch River and a sand bar were just east of the road. The site also had relatively sparse vegetation in the surrounding area. The NWR #6 crew unloaded and congregated on and above the road as they watched the fire. The van was turned around and parked on the side of the road next to the river.

Two civilians, a man and woman, arrived in their truck shortly after the crew. In the early afternoon they had driven to a campground near the road terminus about two miles beyond the deployment site. They had noticed the fire and suppression work while driving up the road to the trailhead. Later in the afternoon while resting they saw the smoke and decided to leave the area. No fire shelters or information about shelter deployment were made available to them when they encountered the crew.

Although observers had noted the approach of the fire, the crew was not prepared for the suddenness with which it arrived. A rain of burning embers was followed by a rolling, wave of tremendous heat, fire, smoke, and wind. Eight of the crew deployed their shelters on the road. The two civilians took shelter with one of crewmembers. One squad boss was high above the road on the rock scree observing the fire. He ran down towards the road, but could not get there before the fire arrived. He turned around and retreated back up the slope. Four crewmembers and another squad boss, who had been sitting on some large boulders above the road observing the approach of the crown fire, also retreated up-slope. These five deployed their shelters in the same vicinity as the squad boss. Four of the six people who deployed shelters in this rock scree field died.

The surviving squad boss and crewmember (who had no gloves) both left their shelters at some point when the fire abated to non-lethal levels. The squad boss fled down the rock scree field to the road and jumped in the river. The other survivor sought shelter from the radiant heat behind a large boulder for a few minutes. He then fled to the safety of the crew van. The crewmembers and the two civilians that had deployed on the road eventually relocated to the river when conditions

allowed their safe movement.

After the passage of the fire, all but four crewmembers were accounted for. The rescue party arrived approximately 35 minutes after the shelter deployment. One crewman with severely burned hands was evacuated to a hospital in Seattle while the remaining injured were treated locally and released.

All four deaths were caused by asphyxia due to inhalation of superheated products of combustion.

Newspaper editorial

This is an editorial piece written by Editorial Page Editor Tracy Warner from the September 30, 2001 issue of the Wenatchee World newspaper.

Use fire deaths to save lives: Those who were expecting some kind of whitewash by Forest Service investigators of the deaths at July's Thirtymile Fire should read their report. It is thorough and brutally honest. Four firefighters died because of a long series of misjudgments and broken safety rules. It appears the most serious errors were not made by the people who paid the ultimate price for them. "Leadership, management, and command and control were all ineffective," the report said. The report's conclusions are not unexpected. If guarding the safety of firefighters is the paramount duty of their supervisors, when firefighters are killed someone, somewhere, made a mistake.

The best course now is to gather information and learn how such tragedies might be prevented. The report issued this week is the first step in the process.

There will probably be pressure now to take some disciplinary action against people who had some connection with this sad incident, to place blame, to set examples. We see very little to be gained from this. Rolling heads and making scapegoats will do nothing to prevent deaths and injury in the future. There really is nothing in the report to indicate that the people who made these fatal mistakes are not skilled and valued public employees. It's just that the faults of their human nature, their training, and their instincts combined simultaneously with a fire of rare savagery, with fatal results.

This is among the report's recommendations for changes in Forest Service policy: "Critically review fire management leadership program on a national basis to ensure that all individuals in leadership positions, at all levels of organizations, have the skills and capabilities to unquestionably lead in a responsible way." A partial translation: Know when to fight, and know when to retreat. This may be the key point that could prevent another tragedy. Firefighters by instinct want to attack fires. Their training is mainly in how to fight fires. Perhaps they need more training in when to get out. On the Thirtymile Fire that necessary decision came a fateful few moments too late.

There are lessons here for taxpayers as well. These firefighters are in an inherently dangerous

Web Site:

www.fs.fed.us/r6/wenatchee/fire/thirtymile-reports.html

Thirtymile Fire Significant Causal Factors
(continued from page 62)

Failure in road closure and area evacuation

Management intervention

Lack of escape routes and safety zones

Failure to prepare for deployment

Deployment site selection

Personal protective equipment

Sudden up-canyon extreme fire behavior

Heat from fire

“ ”

The public, in its zeal to see the fires extinguished, should remember it is pointless to risk lives in the process.

...When the next fire comes, as it will very soon, we should think back on the events of this fatal summer and remember that when firefighters are at work, they take serious risks on the public’s behalf and for the public good. Our obligation is to see those risks are as small as prudence allows.

--from the editorial

business. The public, in its zeal to see the fires extinguished, should remember it is pointless to risk lives in the process. The government cash counters who look to firefighting budgets for cuts should think about what risks they might create. And political people who hoped to use this tragedy as leverage to attack the Endangered Species Act should read the report before they exploit death again. They are wrong.

When the next fire comes, as it will very soon, we should think back on the events of this fatal summer and remember that when firefighters are at work, they take serious risks on the public’s behalf and for the public good. Our obligation is to see those risks are as small as prudence allows.

The above is the opinion of The Wenatchee World and its Editorial Board: Editor and Publisher Rufus Woods, Managing Editor Gary Jasinek and Editorial Page Editor Tracy Warner.