WILDLAND FIRE STRUCTURE PROTECTION FOR ENGINE COMPANIES
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Due to the prolific construction of homes in the wildland areas of California, there is a growing possibility that your engine company may be involved in protecting structures during a wildland fire. Whether your involvement is as a single increment, or part of a strike team or task force, the following guidelines will help you perform your assignment in a safe and effective manner.

A. **ORIENTATION**: As quickly as possible, orient yourself to the area and to the situation.

1. Acquire a good map of the area as soon as possible.

2. Figure out the lay of the land, topography, cardinal directions and prominent landmarks.

3. Figure out the street/road system and how the address system works.

4. Find out where the main fire is, what direction it is expected to move and what fire behavior can be anticipated.

5. Find out what the weather is expected to do.

6. Locate available barriers, safety islands, and water sources.

B. **COMMUNICATIONS**: Remember that face-to-face communications is usually the most effective method.

1. Maintain a common tactical radio frequency with your immediate supervisor and other elements of your strike team/task force.

2. Know what the assigned tactical and command radio frequencies are. They should be designated both by name ("white, local, Tac. 2, etc.) and number (154.280, 151.220, etc.).

3. Keep radio volumes at appropriate levels.

4. Avoid excessive use of outside speakers; too much noise contributes to confusion.

5. Always use clear text (no codes) and proper radio procedures: minimize radio traffic.

6. Keep your crew within range of voice communications whenever possible.

C. **STRATEGY**: The situation will change rapidly, stay mobile and be prepared to hit and run.

l. Understand the objectives of the Incident Action Plan and your specific task. If you are unsure about anything, ask your supervisor.

2. Triage the structures you are assigned to protect; write off the losers, concentrate on the winners.

a. If the roof is fully involved on arrival, you are probably too late.

b. If there is not adequate clearance of wildland vegetation, the risk is probably to great.

c. If there is not a good escape route, it is probably not worth it.

3. Stay aware of what is happening around you at all times.

a. Keep in touch with your crew, supervisor, and neighbors.

b. Listen to the radio.

c. Post rooftop lookouts.

4. Don't become over committed to a single location; be prepared to leave if you have to, and know in advance where you are going to go.

5. Encourage property owners to leave before the fire arrives; controlling people detracts from controlling fire.

D. **TACTICS**: Take appropriate actions in a timely manner. Don't waste time and effort. Be prepared to change tactics if the situation changes.

1. Position your engine headed out the escape route and using the structure as a shield whenever possible.

2. Use 100-200' pre-connected 1 1/2" lines and tank water. Do not chain yourself to a hydrant; they're hard to tow.

3. Ladder the roof, using the homeowner's ladder if possible (save your ladder for when none other is available).

4. Clear a path free of obstacles (bicycles, garden rakes, etc.) all the way around the structure.

5. Close all doors, windows, and insulated drapes. Remove light curtains from windows. Cover attic openings.

6. Remove flammables near the structure. In addition to vegetation, this means lawn furniture, woodpiles, lumber, etc.

7. Pre-connect garden hoses and lay them out in a position to provide maximum range and ease of movement.

8. If hydrants are close, consider laying hand line direct from hydrants to structures. If there is a pool or pond and you have a portable pump, use it. Keep your engine full of water and mobile whenever possible.

9. Don't waste water pre-wetting the brush ahead of the fire. Save it to put directly on spot fires, flare-ups, flying embers landing on the roof, etc.

10. If conditions are such that there are a lot of embers traveling horizontally, consider tearing down porches, awnings, lean-to roofs, etc., that will trap embers in wind eddies.

11. Position personnel within sight and voice range whenever possible. Talk to each other and stay aware of what is happening.

12. Consider backfiring around the structure from a scratch line or wet line only as a last resort and only with the permission of the appropriate supervisor. Backfiring operations at the wrong place or time may create dangerous complications at other positions on the fire.

13. Tanker and helicopter drops should be requested if your apparatus or people are in danger. Know how to request them and how to describe your location so aircraft can find you.

14. If overwhelmed by fire, retreat to a safe position. If the fire is fast-moving and fuels are light, you may be able to re-enter the area behind the flame front and still save the structure.
15. As soon as the area you are assigned to protect is safe, check with your supervisor for a new assignment.

E. **SAFETY**: Always keep safety your primary concern; no structure is worth a life.

1. Always wear and use appropriate protective clothing and equipment.

2. Protect your engine as well as the structure. Keep the hose bed covered, compartments closed, and windows rolled up.

3. Park your engine in a safe area, headed out the escape route, and don't block the roadway. Back into driveways, or narrow access roads.

4. Avoid excessive idling with lights, radios, etc., on unless you can maintain adequate RPM's with a hand throttle. Excessive idling can deplete the battery, killing the engine and radio and placing you and your crew in jeopardy.

5. When moving around on the fireline in smoky conditions, keep your headlights and red lights on.

6. Keep at least one short length of 1 1/2" line charged and looped on top of the engine for protection of your engine and your crew.

7. Save the last 100 gallons of water in your tank for the protection of your engine and your crew. Never pass up an available water source when your tank is less than full.

8. Never leave your engine unattended on the fire unless it's parked in a safe area such as the burn, a cleared, or paved/graveled opening, etc.

9. If trapped by fire, retreat to the engine cab and:

   a. Keep the pump running and use the looped 1 1/2" line to deploy a fog pattern over the cab.

   b. Take SCBA into the cab and use them as necessary to protect yourself from smoke.

   c. Use fire shelters or salvage covers to help reflect radiant heat from the windows.

   d. Request air drops and declare an emergency.

e. Stay inside the cab until you are sure it is safe to go outside. If the motor has died, there is not enough oxygen outside to keep you running either. If the engine is catching on fire, so will you if you go outside. The cab will normally burn last, and buy you a lot of time for things outside to cool down.

10. Maintain control of your people. Keep calm, display a positive attitude and maintain communications. Don't make a bad situation worse by coming unglued.

11. If your engine gets hit with a retardant drop, rinse it off at the first opportunity. Dried retardant will damage paint and polished aluminum.

Remember, know what you are getting yourself into, separate the winners from the losers, stay mobile, protect your engine and your people, and don't panic. Drill on structure protection, just like any other engine company evolution, and you'll be prepared.

THIS ARTICLE CONTAINS SUGGESTIONS REGARDING THE USE OF HARDLINES DURING WILDLAND FIREFIGHTING AND STRUCTURE PROTECTION OPERATIONS ON WILDLAND FIRES. USE OF HARDLINES DURING SUCH OPERATIONS MAY BE PROHIBITED BY REGION OR RANGER UNIT POLICY. CHECK LOCAL POLICY BEFORE TEACHING OR UNDERTAKING THESE OPERATIONS.

STRUCTURE DEFENSE IN WILDLAND FIRES

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INTRODUCTION

Protecting structures and other property threatened by wildland fire is a growing problem faced by numerous fire control agencies. Thousands of structures are exposed to fires in wildland fuels; some of the most rapidly growing areas in the state are in landscapes that retain largely unaltered and highly flammable native vegetation. Literally hundreds of homes can be lost in a short time in a single fire. The public is extremely sensitive to firefighting efforts to save homes, grateful for our successes and sometimes angry about our failures.

This write-up covers material presented in a two day course directed at filling some of the acute need for training in handling the special problems of structure defense. The presentation covers two major overlapping objectives: 1) To provide a background that allows a manager to use resources effectively in directing structure defense efforts. 2) To provide the individual engine crew with guidelines on handling the detailed operations at the threatened structure and on working with nearby crews. It should be applicable whether several strike teams are staging in a neighborhood with the fire hours away, or a single engine is taking independent action at a structure just as the fire hits it. Besides the lecture presentation, the course includes group consideration of realistic fire problems and individual handling of fire situations on the simulator.

EVALUATING THE PROBLEM-SIZE-UP

One of the first things one must evaluate is the fire itself. A key piece of information is the expected time of arrival of the fire at the structures. In gauging the fire's spread rate one of the best guides available will be an estimate of the fire's recent progress, allowing for the possibility of long range spotting. Look at the fire environment adjoining the structures--what will likely be the fire's intensity as it encroaches on the structures? Obviously a fire running up through mature brush presents a different set of problems than a fire backing through ground litter or fed-off grass. Take note of sharp changes in slope or fuels at the structure. Embankments below building pads are often steeper than the natural slopes. Fuels in the cleared area around a house may be flashier (or less so) than surrounding fuels.

Consider the orientation and length of the fire front as it moves into the structures. A fire hitting "broadside" and threatening several structures simultaneously will require more engines than a fire that progresses along that line of structures and allows equipment to move with the fire. Try to estimate the burnout time or length of time an engine will be committed at one location. As a rough guide allow 10-15 minutes minimum commitment time, once fire control action begins, in fuels such as grass or brush where the active flame front passes fairly quickly. Shorter times are possible when firing out around a structure under favorable conditions; longer times are required in timber or where there are heavy fuels (such as logs or woodpiles). Delays while waiting for an intense fire to move clear of the engine's exit route will be additional, and can be considerable with a long, narrow driveway.

Structures can be ignited by direct flame contact, radiant heat, or airborne (and even rolling) firebrands. The vulnerability of a given structure depends on the fire intensity and on the placement and construction of the structure itself. Obviously, the closer the wildland fuels are the greater is the likelihood of ignition. There are other "intermediate" fuels that can spread fire to the structure as well. Intermediate fuels include decks, woodpiles, fences, outbuildings, and even adjacent structures. Flammable roof and/or siding material such as shakes, wood shingles, or wood siding ar much more likely to ignite than composition shingles or tile roof materials or stucco walls. In addition, materials such as shakes and wood shingles can contribute potent firebrands of their own. Count the number of structures at risk.

Openings into a building provide potential entry points for fire. Such openings include vents (roof, attic, and subfloor), windows, doorways, breezeways, and even small holes between roof tiles. A particular hazard is created by firebrands blowing through openings or under decks and porches, especially if they go unnoticed.

The distribution of the structures and the access to each one controls the movement of equipment and limits the coverage provided by each unit. If the structures are relatively close together and fronting a common street, engines can probably protect two adjacent structures from one location and can move quickly to nearby structures. If they are scattered, with long individual driveways, it is difficult for an engine to handle more than one at a time. Obstructions in the yard can interfere with the deployment of hose lines and personnel.

After assessing the fire and the number, vulnerability and distribution of structures you should have several basic plan inputs (applicable to a single unit or to a large operation):

i. The time available for preparation before the fire hits,
ii. The number of structures that will require protection and their degrees of vulnerability,
iii. The time that units will probably be committed to action at a given site and overall,
iv. Access routes and escape routes; potential problem areas,
v. Firefighting techniques likely to work.

Structure defense situations require special consideration when setting up the operation. Time constraints can be severe. It is important to work closely with the Emergency Command Center. Give the incident a name. Make clear the developing structure exposure problem with a good report on conditions, including how many there are and how soon they will be threatened. The ECC can set in motion procedures that will save time on future requests especially those involving assisting agencies. Communicate a clear and unambiguous equipment request as soon as possible. Specify not only the total units required, but indicate if you want the closest available units regardless of type. Obtain a command and tactical frequency (ideally one available to all involved agencies, such OES or Zone frequency) and get the incident off the local net.

DEVELOPING AN ACTION PLAN-THE STRATEGY

The action plan should be based on consideration of the probable and worst case scenarios and on the resources available. Be as specific as you can. Deal in measurable quantities and establish timetables of events, at least mentally.

Estimate the arrival times of the equipment you will need. Will they be there in time? Judging the number of units required is difficult; but even an approximation is better than simply guessing or sending everything available into a threatened neighborhood--you might waste equipment badly needed elsewhere (such as on the wildland fire itself). Where mobility and access are a problem at least one engine will be required for each structure that will be involved during a given interval of time. If, for example, as the fire sweeps through an area of scattered homes, and at least 6 homes will be vulnerable until the fire moves clear of any of them, then at least 6 engines would be required. On an open street the rule of thumb is that one engine can handle 2 structures. If the 6 simultaneously threatened homes mentioned above were lined up along a residential street then 3 engines would be adequate. A given residential site could easily require 2 engines if there were multiple structures present and/or fire intensity would be very high. Two engines would be necessary if the structure was to serve as an anchor point from which to extend control lines.

These are useful guidelines with a basis in experience, but they cannot cover all situations. Extremes of fuel and fire intensity and/or structure vulnerability would require adjusting such estimates of equipment required upward or downward. If you have enough equipment assign an extra engine or two to "float", remaining available to quickly handle spot fires, assist in problem areas, or replace a unit that suddenly goes out of service.

In assigning engines consider the capabilities of equipment and crews. the maneuverability, traction, and crew protection provided on a given engine will limit where it can go. The water tank capacity, actual water level, pump capacity, hose complement and setup (packs, rolls, pre-connected, etc.) and ladders will affect what the engine can do when it gets there. Don't forget to notice the condition the equipment is in, the number of crewpersons, the training of the crew and the crew leader, and their safety gear will determine what they can be expected

to do. In general, where resources are mixed, it may be best to place wildland engines in those assignments requiring the most involvement with wildland fire (such as perimeter positions, firing operations, etc.) and to place structure engines in assignments directly involving the structures themselves. Don't assign structure engines where they might get stuck.

Water supply is always a critical factor. You must evaluate both the flow available (gal/min) and the total supply available (gallons held in engines and other tanks). It is very possible that the flow will be interrupted or that heavy use will cause a serious drop in the pressure of fixed supply lines. Consider the time it will take an engine or water tender to fill and return. Do they have the fittings needed to utilize a non-standard water source? Where water tenders are the main supply, and when refill times are not extreme, it will take 2 tenders (one available while the other is refilling approximately 5000 gal/hour--enough for 1 or 2 active strike teams. Experience shows that, when carefully applied, 500 gallons of water on an engine should be adequate for successful defense of 2 or 3 average structures with decent clearance.

Fire control aircraft can be invaluable in structure defense, but they must be utilized wisely or they can be counter productive. A misplaced drop can disrupt a firing operation; wing-tip vortices or rotor blast can fan the fire or spread firebrands. Beneficial applications include knockdown of a hot spot threatening a structure and/or fire crew, pretreatment of fuels, and reconnaissance.

Close coordination of air and ground operations is important. Communicate your plans and needs to Air Attack. In some areas you may not want drops unless a problem develops; in some areas the drops may be the only suppression action available. Make sure that ground and air units understand each other when describing and referencing landmarks. It is best to use objects that are distinctive and can be seen well by both, such as roof top engine numbers, water tanks, unusual structures, etc. Numerous wires and poles exist around structures and should be pointed out to the Air Attack.

Aircraft can be diverted from your fire to a new incident unless a "no-divert" request is made by the incident commander. No-divert status is justified if there is a clear threat to life and/or structures. Make the no-divert request through the ECC before you lose the aircraft. If you have given the ECC a good indication of the threat to structures in your report on conditions they can make the request for you or at least prompt you with a question about it. To facilitate direct requests from ground personnel to Air Attack for immediate air support designate them as one or more groups (ICS), each with a Group Supervisor.

In evaluating your resources do not overlook non-fire service equipment, water, and personnel. There may be heavy equipment such as dozers or water tenders available from public road departments, mining or logging operations, or private construction companies. At least small hose lines are usually available at a residence, and there may be larger lines as part of irrigation systems, etc. Additional people, such as residents or other civilians, can be assigned tasks where they are not at undue risk. Other agencies can provide assistance with

traffic control, evacuation, first aid, or special hazards. They include police or other peace officers, medical personnel, and employees of utilities and public works departments.

"Triage" originates from a word meaning to divide into three parts. Basically, it amounts to this: 1) Eliminate the hopeless, 2) Ignore the unnecessary, 3) Deal with the rest. While we as firemen hesitate to write off any threatened structure, triage is necessary to prevent the futile waste of effort. Trying to save more than you realistically can might very well result in the loss of everything, including homes you could have saved. Forget the structures that are impossible to defend or too dangerous to try, leave those that are too well involved to save. Ignore, for now, the structure needing little or no protection. Concentrate on seriously threatened but savable structures.

What is feasible or not depends on the overall situation: what the fire does and what resources you get. For example, one unaided engine might leave a problem structure in order to provide protection to another threatened, but better situated structure. However, in the same situation if another engine is to arrive soon and can handle the second structure then the first engine might give the first house a try. You must make your triage decision based on your best guess as to how things will evolve--you cannot avoid playing the odds to a certain extent.

Evacuation may be necessary and traffic control almost surely will be. Those who are not peace officers lack the authority to order someone to evacuate, and certainly time can be better spent than arguing with someone who will not leave. We do have an obligation to inform people of the dangers and to provide them with directions on safe, helpful behavior and exit routes. Consider the magnitude of the job of evacuation and traffic control at hand. Try to use people such as police and other authorities to help you.

Safety is of primary importance throughout the operation and must be given consideration in formulating strategy. Make sure instructions are clear and that the situation is explained clearly to fire crews. Radiant heat is a very real threat to firefighters, especially where flames are close. Firefighters tend to place themselves at greater risk, perhaps, in a battle to save homes than in a normal wildland fire. Direct crews to use shelter where available for themselves and their equipment. Plan common escape routes, and make sure they do not become obstructed. Remind crews to also plan their individual escape routes. Point out that building interiors are usually a good safety zone if the fire overruns your position. Even if it catches fire, the building won't burn down instantly, thus providing protection while the main fire moves through. Structure defense is, overall, a wildland fire problem, so keep in mind the common wildland fire safety guidelines. Arrange a place for regrouping engines as they move out of an area. Account for all of your units, and check on the physical condition of crews (especially after exceptionally demanding firefighting).

In formulating the action plan, account for the factors described previously as realistically as you can. The plan of attack will fall into one of three broad categories:

1. Defensive Mode: Protect structures as the fire moves through, but make little direct effort to contain the fire. The defensive mode may be the only option. However there is a tendency to become psychologically stuck in a defensive posture when other options are possible. Don't forget the wildland fire.

2. Offensive Mode: Control the wildland fire before it reaches the structures. Don't overlook control possibilities in the concern over structure threats. Perhaps the accumulation of resources or a helpful turn in fire behavior will allow a successful attack on the main fire.

3. Combined Mode: Mix protection and control actions. Holding a portion of the wildland fire edge may reduce the number of structures threatened. Firing out from control lines at the structure perimeter, or holding the fire at the structure or road when it hits may actually control a significant portion of the wildland fire. Then follow up with action to control the rest of the fire.

Once the plan is made communicate it. Assemble crews and describe the situation and planned operations. One good way to allocate resources initially is to give them assignments by dividing up the workload based on your current information. Then allow them to explore, make contact at their assignment boundaries and to adjust their boundaries to better distribute the workload. Provide directions for crew actions into the future such as moving on to other areas or patrol (i.e. go without a huddle) or arrange a later meeting to do that. Point out safety considerations. Keep in mind that structure defense may be a fairly unfamiliar role to many crews and don't assume that everyone is aware of all they need to know. Request communications from individuals to keep informed on how things are progressing. Clearly define lines of communication.

TAKING ACTION--THE TACTICS

Individual crews, whether operating under a larger plan or as a single unit, will have to take the specific actions to defend a particular structure. The tactics described here are intended as guidelines for those actions; they are derived from experience gained over the years and throughout the state. Each situation is different, however, and a crew leader must call upon his or her own judgement and experience and not simply apply the guidelines blindly--as is true of any kind of firefighting.

There may be a need for an incoming engine to provide assistance with traffic control and evacuation, or to obtain reconnaissance information. Residents may ask for directions on how they can help or what they can do. A quick sketch map might be valuable to other crews or to overhead personnel. Soon, though, the crew leader must make a wise choice of the structures to defend and set up for that.

The engine should be backed in and notice taken of the route in and any guide marks along it. Going in may be fairly easy-- leaving rapidly amidst heat and confusion in zero visibility smoke may be more challenging. The engine should have the doors closed and windows rolled up and be placed considering:

1. Shielding it from the expected heat and from blowing firebrands, and not parked over flammable vegetation, (a small patch can be scraped or burned out to park on if necessary)
2. Minimizing the reach required for hose lines,
3. Overhead hazards such as power lines or flammable trees,
4. Nearness to things that might burn intensely or even explode, such as outbuildings or pressurized tanks,
5. Not blocking movement of other equipment.

Become familiar with your area. Locate escape routes and safe zones. Learn about the structure and the surrounding fuels. Where are the residents, pets, or livestock: Locate fences, water, ladder, special hazards, bad dogs, etc. Make contact with adjoining crews; know the routes for moving to assist each other.

Decide where to deploy hoselines. Commonly, two 1-1/2" lines (preferable not longer than 200 feet each) taken around opposite sides of the structure is a good choice. You'll have a back-up if one fails, and with two lines you can work the whole fire edge without dragging a long line around corners. Two streams can be directed at hot spots. (Where the anticipate fire intensity is low enough you can deploy hard lines in the same manner, and you'll have the advantage of lines that are easier to move and retrieve. Caution: Use hard lines only if you are certain the maximum fire intensity will not exceed hard line control. Also, if you have to retreat in a hurry, 1-1/2" hose can be cut loose and left with no harm done, hard lines cannot.) A separate length of 1-1/2" hose should be coiled loosely, charged, and readily available on top of the engine. All hoselines should be charged and checked. If hose lines must be laid across hot or flammable material you can wet down the ground they lay on--make sure dragging will not move them off of the wetted strip, and do not waste water! Make sure that hose lines are not laid in the exit path of the engine.

Place a ladder, the homeowners if possible, to the roof on a side of the building away from the fire (or at least where it will not become unusable due to heat or smoke) and easily visible. Some long extension ladders can be separated to provide two ladders. Have a hose available (not necessarily stretched out) that can be quickly taken to the roof, possible a hard line. The ladder should be left where it can be quickly seen and utilized by someone who might come along and see a fire on the roof that starts after you have gone.

If time allows, much can be done to lessen the impact of the fire and the time the engine will be committed. Remove vegetation such as brush and evergreen trees (only those that will carry fire close to the structure, not isolated ornamental plants). Don't overlook hand crews and dozers in fuel reduction efforts. It may be best to build a firebreak to aid in firing out or extinguishment. Clear brush and grass around flammables that are difficult to move such as LP gas tanks, fences, or wood piles. (Firewood piles are a real headache if fire gets in them.)

Remove intermediate fuels including: yard furniture, piles, leaves, awnings--whatever might ignite and help spread fire to the structure. Clean easily ignited material like leaves and needles from roofs and rain gutters. Basically, eliminate `fuses' and `kindling'. Cover openings into which fire or embers might enter (using materials available from the residence, etc.)

If private vehicles remain at the site (and the keys are available) park them, headed out, in as protected an area as possible. Leave the keys in the ignition, the doors unlocked and the windows rolled up. The resident could take care of this.

Check the structure itself and the utilities. Gas service should be shut off. However, it may be better to leave the electricity on. Unless the interior of the structure is burning, there is little advantage in having it off. It may be important to have power to lights or to the pump for the water system. Move furniture, light curtains and other light flammables (paper, etc.) from in front of windows; close windows and doors. Heavy, non-flammable drapes or shades can be closed to block radiant heat.

How to handle the fire itself is a decision requiring careful consideration of the fire environment, the structure, and the situation of adjacent crews. There are no cut and dried answers or simple formulas. One can logically address the factors present and choose a technique based on that process--something that is done almost subconsciously by an experienced firefighter. A workable approach to deciding what to do is outlined in the following paragraphs. Here we assume the fire will not be contained before it threatens the structures. Consider, in order, the following three general situations and decide which one probably applies to you.

1. It is possible to control and stop the wildland fire short of the structure itself (the control line either surrounds the structure or joins adjacent control lines).

2. Only partial control or modification of the wildland fire as it moves past is possible.

3. The wildland fire will blow through essentially uncontrolled.

The first situation is the best--cut off the fire before it actually reaches the buildings, essentially at the outer edge of the yard. If you have time to wait for the fire and you can handle its intensity at the control perimeter you can simply put it out directly with water, a fuel

break, or hand tools. Such fires might be burning in low, light fuels and not driven too hard by wind and/or slope.

If you cannot wait for the fire or will not be able to control it directly when it arrives, you may be able to prevent it reaching the structure by firing out. The control line from which you fire can be a cleared line, a natural barrier (driveway, lawn, dirt area, etc.) or a `wet' line (in low fuels), essentially water applied as you go to control one edge of the fire you are lighting. The control line must surround the structure, join with sections that can be directly extinguished, or tie in with adjacent control lines--it must be `anchored', no gaps.

Timing a firing operation correctly is extremely important, and so is coordinating and communicating with other crews that could be affected. If you wait too long your firing operation may not be effective in stopping the main fire. If you fire too soon, your fire, which will likely be open on the ends or flanks, may become a new fire that causes problems `downstream'. Also, it is embarrassing to fire out only to have the main fire contained before it gets near the structures.

You will have to back up your firing operation until it is not itself a threat to the structure. If wind and slope are in your favor your fire will move quickly away from your control line and can probably be left right away, unless concentrations of heavy fuel continue to generate too much heat or firebrands. If your fire is moving away against the dominant wind/slope influence, firing will be slower and you will have to remain in position much longer to complete the operation.

The second situation is not ideal, and does not allow complete control of the wildland fire short of the structure. There is too much fire to put out directly, or the fuels may not carry your fire--as is often the case with fires in heavy brush lacking adequate fine surface fuels and driven at you by wind and/or slope. There may not be time, or there may be no workable control line from which to fire. You accept that the main fire will keep coming, not being stopped at the yard perimeter.

If the fire intensity and your water supply allow it, you can try to knock down that part of the fire front that is moving directly at the structure. It might work to light a backfire from a short, open segment of control line that will reduce the intensity of that section of fire front. (In this case `backfire' is used more in the actual sense: a fire drawn into the main fire by its in-draft.) In any case, split the fire and lead it around and past the structure with your hose lines. Afterwards, put out any fire on the fringes or on the structure.

The third situation is the worst. There is nothing you can do to prevent the fire from rolling over your position. That predicament is all too common in wind driven fires in California chaparral. All may not be lost. Shield yourself as the fire goes through, staying out of the heat and smoke the best you can. You might get in your engine, in the structure, or in an open area away from fuels. Consider using your breathing apparatus for clean air and your hose lines for heat protection. Make sure your engine does not burn! After the fire moves

on, the structure will probably have caught fire, but the structure fire will not, hopefully, be too extensive or deep seated yet. For all practical purposes you will have arrived at a structure fire just as it begins. Put it out. Remember the likely ignition points: the roof, the siding and under the eaves; debris blown into vents or broken windows, embers under the deck or porch; spread from intermediate fuels. Also extinguish any wildland fire still actively spreading toward you.

In any of the three above situations, you must be alert to firebrands igniting the structure before or during the time you are dealing with the wildland fire. Don't become too preoccupied and forget about the structure; check it often, especially the roof.

Wise use of water can make all the difference in whether you save a structure and in whether or not you have enough left to move on and save the next one or yourself. The order of the day is conserve. Apply water only with a purpose and when you can actually accomplish it. Generally, the supply is very limited, even where hydrants are available (since heavy use can cut the pressure way down). Know the limits of whatever your water supply is. Take advantage of chances to top off your tank, or to replace water by keeping a garden hose running in it, etc.

For moderate to high intensity fires 1-1/2" hose is required. A good combination nozzle will be very useful, though in high winds a straight tip may be necessary to keep the stream together enough to carry and penetrate. With lower intensity fires hard lines will be adequate, and will be easier to handle. Smaller lines and nozzles use less water.

When and where to apply water is critical. The heat being generated by the wildland fire can be thought of as a wave that approaches, builds up, passes by, and subsides, followed by a second wave representing combustion of the structure. Obviously, we want to prevent the second wave from ever building up. The key is to apply water only when it can stop or truly diminish the impact of the first wave, saving enough to shut off the second.

`Wetting down' is the application of water, prior to the arrival of the wildfire (the first wave), of vegetation, roofs, etc. In general, wetting down is a waste of water. (How often do we put out a wildland fire by wetting down and waiting?) Under severe fire conditions most of it will quickly evaporate--vegetation will still burn and roofs will still ignite. But you'll face those problems with less water. (There are a few exceptions, such as when you have unlimited water and the fire intensity can be significantly reduced by dampening fuels, or a roof sprinkler can be set up). Water will usually do the most good when it is applied directly to fire.

Economical water use on a fire that you cannot extinguish completely can be effective in some instances. A fire in surface fuels might be knocked down to keep it from spreading up into crown foliage (beware of fire running through the crowns from heat built up elsewhere). You might keep fire from spreading into a concentration of fuel such as a wood pile or brush patch. You will in effect be reducing the build-up of intensity of the first wave. Water applied

directly to structure surfaces heated nearly to the ignition point by radiant heat can keep them from burning. Direct application is more effective than a `water curtain'. Imminent ignition is evidenced by scorching paint and smoke production. Avoid getting water on hot window glass because the thermal shock can break it. It is more efficient to use water to keep fire intensity from building up in some fuel than it is to confront the heat when it reaches peak intensity.

As radiant heat on a firefighter becomes intense it is tempting to shoot water at the fire even if it doesn't reduce the heat much. Where you can, it is better to avoid the radiant heat by getting behind (in the `shadow') of an object. You can emerge soon enough to apply water where it will do some good, such as on the structure.

To summarize: In the case off a controllable fire, water should be applied at the beginning of the heat buildup--put the fire out and limit the buildup as much as possible. Try to work on the fire where it has moved into lighter fuels, instead of where it is burning the hottest. At the other extreme, a completely uncontrollable fire, water should be applied after the wave of heat passes, to extinguish the structure and/or yard fire. Between those extremes water application is effective only if it really reduces the intensity of heat impinging on the structure or keeps fire from coming close to it. The point to keep in mind is: do not blast away pointlessly with limited water at fire in the vain hope that it will somehow help--use water only when and where you are sure of its value.

The advice emphasized most by firefighters experienced in structure defense is to stay loose--remain mobile or at least be able to move quickly. There is sometimes a tendency to want to `dig in' and wait for the fire, with extensive supply lines and attack lines in place. But before the main fire arrives it is not unusual to be bombed with firebrands igniting numerous spot fires, often out of reach of laid lines. A structure other than yours may catch fire and require a multi-engine effort. Other crews may suddenly need assistance as the fire hits them harder. Or you may need to quickly abandon your position for your crew's safety or if your structure becomes hopelessly involved in fire. And when you've handled one structure you'll want to be able to move quickly to the next.

Try not to become too tied down. Keep supply lines and attack lines as short as possible, ideally less than 200 feet. Charged 1-1/2" line can be retrieved by throwing it on top of the engine in open folds (bleeding pressure off will make things easier), one crewman on the ground and one on the engine. If a rapid retreat is required take the brass and leave the hose. A typically equipped Type-3 engine could abandon a set of 200-foot attack lines twice and still have enough hose to deploy lines a third time. `Hit and run' tactics have proven effective in some very desperate structure defense situations.

In the case where a rapid pullout is not critical, there are important things to do before moving on. It is discouraging to leave a structure you have `saved' only to learn later that it caught fire and burned down. Check for extension of fire in the structure and for unseen ignition points such as behind vents or under porches and decks. Limit mop-up in the yard to those

hotspots that could spread fire to the structure or across control lines; save the water for more important problems elsewhere. You may be able to turn the structure over to the resident. Advise him or her on the need for continued vigilance and on key places to check for fire. Patrol the area later as time allows. Include in your checks those structures that may not have received direct protection but that could have been ignited by firebrands.

SUMMARY

Philosophical Comment:

Tactics and approaches proven successful in structure defense situations may differ from some of those that work well in conventional structure firefighting operations, as may the mental attitude of engine crews. The situation is often poorly known and changing rapidly. Wildland fire dictates the action. Additionally, units will probably not be as available as they usually are. The conventional water supply cannot be depended upon. You must be ready to take independent action, to freelance, rather than operating directly with assisting units in a clearly defined organization. You must be prepared to abandon some structures rather than counting on more resources to handle the problem. An engine crew defending structures in tough conditions will need to be mobile, resourceful, and self-reliant.

Structure defense places exceptional demands on our fire control organizations. There is an urgency to structure threat situations that can severely limit the time to plan and to assemble resources. The sheer magnitude of the problem can be overwhelming. All the fire activity a department normally handles in months can be occurring all at once. We cannot freely choose the location of control lines, we have to take the structures where they are. Often we must work with agencies we do not see routinely and work with them smoothly. Such situations place a premium on fire knowledge, coordination, and well executed action. WE'VE GOT TO BE GOOD'!

To Recap the Main Points:

Evaluation must include some projections of the wildfire's progress and estimates of the total structure threat. It includes a survey of what resources are available and estimates of the overall resource requirement. Access routes have to be determined. A realistic timetable of fire arrival, resource arrival, and resource commitment should be established. In short, you need to know what you've got to do and what you've got to do it with.

In creating the action plan you must assign resources as efficiently as possible. Take what you've got and do the most you can with it, even if you must accept some losses as inevitable. Don't assign units to tasks that are impossible to accomplish because of time limits, water limits, fire intensity, crew size, engine capability, etc., nor to tasks that are not important. Anticipate non-fire problems such as frightened residents and traffic congestion. Communicate well--let the ECC (or your supervisor) know of the problems and needs, let your crews know about the plan and safety considerations.

Taking effective action requires attention to established guidelines and the use of good judgement. The following checklist will remind you of the main steps to be taken--S T R I K E .

Set-up - place your engine and hose lines.

Take a look - familiarize yourself with the area, and locate escape routes and safety zones.

Reduce fuels & cover openings--remove flammables, clear breaks, prepare the structure.

Inform your crew--describe the plan, advise on safety, contact nearby forces.

Knock the fire down--stop it if you can, reduce its impact if feasible, save the structure in any case.

Extinguish and check--make sure no lingering hot spots cause problems.

...and through it all stay loose & conserve water.

Structure defense is not a new problem. But it is one that is certain to involve more of us more than ever as time goes on. Take advantage of the information available. Stay alert, use good judgement and your fire behavior knowledge; rely on your wildland fire control skills. Always be looking for ways to improve our ability to protect people's homes and improvements as they are threatened by wildland fire.