INTRODUCTION

On November 1, 1966, in a canyon near the boundary of the Angeles National Forest, a flare-up on the Loop Fire overran the Forest Service's El Cariso "Hot Shot" crew.

In presenting this training exercise we ask that each one of you carefully: (1) consider the facts as they are presented to you, (2) apply all of the knowledge of fire behavior and fire fighting principles at your command, and (3) add the benefit of hindsight of knowing what actually happened when arriving at your conclusions. In this way we will each gain the advantage of a second chance in making these vital decisions.

CHRONOLOGY OF EVENTS

11/1/66 - 0519 (PST) Fire started by a faulty electric distribution line within the Department of Army's Los Pinetos Nike Site on the Tujunga Ranger District.

0536 - Initial attack on Santa Clara Fuelbreak by one pumper and one patrol unit.

Weather History

Fire danger in the San Gabriel Mountains was above normal much of the 1966 fire season. Six Santa Ana periods occurred during later portions of September and October. The last period began on October 28 and the greatest intensity occurred on November 1, the day the fire started.

General Weather Forecast: Clear - Temp. 73° - Humid. 12% - Wind NE 10 - fire plan 8 - extreme.

Actual Weather: Temp. and Humid. as predicted. Wind 40 to 60 mph at origin, tapered off by mid-morning. E to NE 15 - 20 by mid-afternoon with some calm periods.

0600 - First reinforcements arrive. Los Angeles City and County Fire Departments were notified. District Ranger Jess Barton became Fire Boss; Hugh Masterson, Line Boss; Bill Westmoreland, Division Boss on the east line. Plans were to try and hold north and east side of fire.

0800 - William C. Beaty, Fire Staffman Angeles NF, relieved Barton as Fire Boss since Barton was not qualified as Class 1 Fire Boss. (Figure 1, P. 12). Beaty and Masterson determined that:

1. West side of fire was approaching an area burned in 1962.

2. South side of the fire would be taken care of by L.A. County and City fire Departments.
3. All Forest Service effort was to be expended on the north and east sides of fire.

4. Fire Boss Beaty cautioned Masterson to cold trail and "keep one foot' in the burn."

The north edge of the fire was to be held on the Santa Clara fuel-break pre-attack plan from point A-42 West to point A-30 (Figure 3, P. 14). A tractor line was constructed between A-30 and A-31 and held. Control on the remainder of the west perimeter was obtained through light fuels from a 1962 burned over area extending to Olive View Veterans Hospital.

0830 - The fire weather forecaster issued the following special forecast for the fire area:

"Loop Fire"
Santa Ana conditions with winds NE to E 30, gusts to 50, decreasing this afternoon and Wednesday. Maximum temperature 95, minimum relative humidity 10 percent."

Northeast winds continued throughout the day. Wind speeds were high during the early morning and the forenoon. In the nearby San Fernando Valley, winds of 24 to 28 mph were recorded at 4 AM and from 13 to 36 mph at 1 PM. One report from the fireline said the gusts were "strong enough to blow a man down if he did not brace himself."

Winds decreased during the afternoon but continued from the northeast. Fixed-wing aircraft and helicopters were able to fly. On the east side of the fire, a northeast wind of only 8 mph with gusts to 12 mph was measured at 2:30 PM. There was considerable channeling of the wind and eddies were caused by the topography.

Temperatures at lower elevations were in the 90's and at higher elevations in the 70's or low 80's. Relative humidity was 10-15%. Fuel stick moisture percents were 3.0 and 4.0 Ignition Indexes 1/ varied from 76 to 93 which meant that almost every firebrand could start a fire in light fuels. Burning Indexes were "Extreme."

TOPOGRAPHY

The lower Pacoima Canyon area consists of steep and broken topography and forms a natural chimney. The gullies have steep, almost sheer side walls. The fire started near the Los Pinosos Nike Site (point A-42) at about 4,000 feet elevation and burned downhill to about 1,500 feet behind the caretaker's residence at Pacoima Canyon Dam.

The flare-up site was about 200 feet above the canyon bottom and 1,000 feet below the main ridge.

Slopes in the chimney varied from 60 to 95 percent. Loose rock made foot travel extremely difficult and hazardous.

1/ As described in the Wildland Fire Danger Rating Handbook used by California fire agencies.
Fuels

Fuels in the lower Pacoima Canyon area were sparse and consisted chiefly of chamise, sage, and sumac. Fuel loading in the main canyon was about 149 pounds per square foot (about 11 tons per acre) which considered light to moderate. The moisture of live chamise in Pacoima Canyon on November 1 was about 60 percent which is near the minimum possible for this species.

Sumac and very heavy litter were the most important fuel involved in the flare-up. The fuel loading was 1.60 per square foot or 35 tons per acre at the lower end of the chimney canyon. There are indications that fuel in the chute burned in about 4 minutes which means that flame temperatures, were probably 2,500°F. or higher.

Fire Behavior

Fire behavior at the Loop Fire was typical of fires starting under Santa Ana conditions. From its origin, the fire was driven by strong northeast winds downhill toward the lower front country.

By early afternoon the fire had become established near the mouth of Pacoima canyon. Under the slackening Santa Ana wind the fire backed downslope against the normal upslope wind. Burning material rolling down the steep canyons occasionally caused small "fish hook" runs. The fire was being held with little difficulty along the county bulldozer line.

Mid-morning

1. Fire Boss Beaty noticed the wind slacking off and ordered a lead plane and 5 air tankers to work on the east line and slow the spread to the east.

2. Beaty appointed Hite as Liaison Officer with Los Angeles County forces.

3. Masterson and Westmoreland, using the Chilao Hot Shot Crew and 2 County crews, began building line on the east edge of the fire, moving south from the Nike Base Site.

1200 Noon - Dalton Hot Shot Crew arrived at fire.

1300 - With the exception of a few slop-overs, the fire was holding on the east line from the Santa Clara Ridge (A-42) to a point about 40 chains below Contractors Point (A-43) or about to A-45.

1400 - Hite arrived at L.A. County command post in the SE corner of the fire in Pacoima Canyon.

County crews are approaching the SE corner with their line.

1430 - El Cariso Hot Shot Crew Forman, Gordon King, contacted Masterson at Contractors Point (A-43) for instructions. Some but not all of the instructions to King were:
1. Told to "leap-frog" Del Rosa Crew and cold trail fire edge if possible; mention was made of the steep terrain beyond point A-45 where the Del Rosa Crew was working.

2. Masterson pointed out that there would be many rocks rolling and there might be a few runs.

3. Masterson mentioned that the "main ridge" (A-45 to A-47 but not identified to King as such) could be used as an alternate if it was impossible to follow the burned edge.

Special Note: There were no more Angeles Forest radios available for King and the El Cariso Crew, as the Del Rosa Crew had taken the last radio. The crew left their fire shelters on the truck. Their fire resistant shirts had worn out and were not replaced prior to this fire call.

Loop Fire Exercise No. 1

1. Based on the information you have available:

   a. Write the briefing instructions that you would give to King for his assignment.
      
      [Text could be here, but not visible in the image.]

   b. List the factors of fire behavior that should be included in this briefing in the order of their importance.
      
      [Text could be here, but not visible in the image.]
Fire Safety
Loop Fire
Partial Organization Chart

Fire Boss
Beaty

Line Boss
Masterson

Div. Boss
Westmoreland

Div. A

Crew Boss
King

El CARISO Crew
FIGURE 2

Fire's edge at 3:30 PM
1435 - King and his assistant Burchett led their crew to point A-45 as instructed by Masterson. They held the crew at a small bench below this point until King decided that it was possible to "cold trail" the fire down into the "chimney" canyon.

King could see the county tractors and crews working the lower edge of the fire eastward toward the lower end of the deep canyon immediately west of the "chimney" canyon. He believed he could tie in with them below point A-46. He was not aware that near the base of the chimney, a 30 foot deep gully with near vertical sides would delay the forward progress of the county crew.

Loop Exercise No. 2

At point A (Figure 2, P. 13) King had to make a decision on which way to go.

a. List the items that are in favor of cold trailing down the "chimney" canyon.
   i. Gaps in the fire line to smaller size.
   ii. Sides of canyon are too steep to tie in.
   iii. Farmers would like.

b. List the items that are not in favor of cold trailing down the "chimney" canyon.
   i. Rolling material covering fire line.
   ii. Dark color of chimney.
   iii. Building line down hill with rancher help.
   iv. Hay burning.
   v. No population.
   vi. Improper equipment route (??)

   i. Based on items stated, would you continue cold trailing or go back? Explain.

   

- 8 -
1445 - Line Boss Masterson requested Division Boss Westmoreland (who was equipped with a radio) to go down the east line to make sure the crews were lined out. Westmoreland checked each crew and caught up with the tail end of the El Cariso crew on the point on the ridge (point C, Figure 2) where the fire line descended into the chimney canyon. He was unable to directly contact King because King was already well down in the canyon and did not have a radio.

1500 - King led the first units of his crew carefully down and across a steep, rocky face along the edge of the fire where a "fire retardant" line had been established by air tankers. Westmoreland contacted Hite, at the County's command post on the Pacoima Road which was visible from point A. Hite told Westmoreland that King and his men were cold trailing the edge of the fire and that they would be able to construct line down the rocky chute in the chimney canyon. King was following the alternate choice in accordance with Masterson's instructions.

Westmoreland waited at point A, until the last of the El Cariso crew had cleared the rock face.

The Del Rosa Crew came down to point A. Westmoreland told them to wait there until he checked to see if this was the best way down. He would call them by radio and advise them to either come down the chute and leapfrog the El Cariso Crew or to go down ridge, A-45 to A-47, and come in from below to meet the El Cariso Crew.

Westmoreland then proceeded down the rock face. When he was about half-way down the face, he could look most of the way down the chimney canyon. Most of King's crew had crossed the rock slide at the head of the chute and had worked their way down a small bench that paralleled the chute (point C, Figure 2) in middle of bench.

The fire had backed down to the bench and gone out. It was not a clean burn.

1530 - King and some of his crew were at the "Diamond" (point B, Figure 2) with the rest of the crew strung out up the chute cold trailing on a line between C and B. Westmoreland was half-way between points A and C. A helitanker was working in the area of the gully at the time.

The fire situation at this time was as follows: From the Diamond, the burned edge dipped into the adjacent gully; thence up to the end of the cat line, and finally west to a point high on the adjoining ridge. King could see that the terrain was too steep to cold trail from the chimney canyon into the deep gully to the west and the bottom of this gully was obviously a difficult and dangerous place to hold the fire.
One of King's alternatives was to construct and hold an indirect line from the "Diamond" to the cat line across the adjacent deep gully to the west. This required building and holding line 50 to 100 feet away from the fire's edge, from the Diamond along the east edge of the deep gully to a point opposite the cat line.

The distance between the cat line, close to the edge of the fire on the opposite draw and the edge near the Diamond is approximately 500 feet. Of this 500 feet, 300 feet had natural opening from 3 feet to 10 feet wide. The remaining distance at the lower end included some 200 feet of light brush cover near the edge of the steep gully. Fireline could be constructed through it rapidly. The El Cariso Crew probably had the capacity to cut this 200 feet of line through to the gully edge in 10 to 15 minutes.

The behavior of the fire at this time (1530) was observed by King from the "Diamond", Westmoreland from the ridge above it; Los Angeles County Fire Captain Hayes from the cat line, Coordinator Hite and others from the command post in Pacoima Canyon. The fire was in a static situation with hot spots on the west side and near the bottom of the deep gully 150 feet from the cat line. The wind direction had changed and was now blowing from the Southeast favoring closing the gap between the edges of the fire.

**Loop Fire Exercise No. 3**

1. List the alternative courses of action that were available to King as he sized up the situation at the "Diamond".

   - Cut trail along both sides of line.
   - Contract line all around and burn out.
   - Blow up against fire to hold.
   - Break through and line in from county and trunk line.
   - Entire other alternatives from uphill.

2. List the fire behavior factors and any other key items for making any decision (but not necessarily actually known to King) at this point.

   - [Fire behavior factors]
   - [Key items]

   - [Tactical considerations]

   - [Resource allocation]

   - [Environmental factors]
1530 - Two critical decisions were made: one by L.A. County Captain Hayes and the other by King, Crew Boss of the El Cariso Crew. 1) Captain Hayes decided that it would be unsafe and time consuming to attempt to cross the deep gully immediately ahead of the bulldozer (point D, Figure 2). He sent the Los Angeles County Hand Crew out and around with orders to scout the opportunities of meeting King from the east side of the deep gully. 2) King decided to cut straight down (point C to point B) to meet the bulldozer firebreak. By then he was aware that the bulldozer could not cross the gully, but he was not aware that the County crew had pulled out and gone around to attempt to meet him on the east side of the deep gully.

King's decision was based on the fact that: 1) they were in light fuels, 2) had a very favorable wind, 3) no sign of fire activity on his side of the slope into the deep gully to the right, and 4) a natural break existed most of the way to the cat line which was clearly visible at the bottom of the canyon.

King's decision to go down toward the cat line with 2 men was made before it was obvious to him the fire crossed the gully (point E, Figure 2).

1535 - The fire crossed the deep gully, burned up a steep 50 foot slope on the east side and created a hot spot in the mouth of the chimney canyon.

A combination of heavier fuels, eddy currents, and thermal effects caused a run up the east side of the draw and toward the west edge of the "Diamond".

King was approximately 60 feet from the fire as it spread across the mouth of the chimney canyon.

Sumac bushes and heavy litter in this area provided additional heat, which was all directed up the natural chimney. Heat from the fire in the lower part was sufficient to ignite the sparse fuel patches in the chimney. (Spread of the fire to the top of the chimney, a distance of 2200 feet, likely occurred in less than 1 minute.

When the hot spot flared up, King, who was leading, had little or no time to do any more than yell at his followers to "move out". He made one effort to go to his left around the fire and immediately realized he should change his course.

When King shouted for the crew to "move out", the remainder of the crew was strung out up the chimney above the diamond area. It is assumed that 11 of the crew moved toward the diamond area, or an area just above it. Ten stayed in or went into the chimney, in
an area 200 feet long and 30 feet wide, and burned to death. It inflicted minor to critical injuries on 12 others, two of the critically injured died shortly thereafter. King came out below the fire, badly burned. Three crewmembers and Westmoreland survived the fire in the upper end of the chimney without injury.

Protective suits or tents would have lessened the severity of the injuries to those near the diamond but probably would not have saved the ten men in the chute.

**Lessons to be Learned**

When King started down from the point A, he had safety uppermost in his mind as he crossed the head of chimney canyon and went down the bench on the right side of the chimney.

When he started down from the diamond area, he made the choice he did, believing that it was a cinch to cut line through the unburned brush toward the cat line. It is believed that he made a decision in which he thought everything was in his favor and that it was less risky than following the edge of the fire into the head of the adjoining deep gully to his right. (This action would also have put him in a hazardous position in relation to the fire on the other side of the deep gully should a blow-up have occurred in that canyon below.)

Many of us have and will likely again face a similar decision. We might easily have made the same decision King did. But HINDSIGHT and critique are giving us a second chance. Some important lessons to be learned are:

1. **Fire behavior was the greatest safety hazard present on this segment of the Loop Fire.** The fire behavior situation under Santa Ana or other Foehn wind conditions hangs in a delicate balance. Any slackening of the wind, surge of heat, and eddy current, the fire reaching different topography, or a combination of two or more of these factors can trigger a quick and violent change in the fire behavior. Such an event appears to have been the case in the Loop Fire Accident.

2. **Recognition of topography effects on fire behavior.** The shape of the country has a definite effect on how a fire will burn. Chimneys - chutes - narrow box canyons - saddles or any similar topographic features which become a natural draft or flue must be recognized as a hazard area even if devoid of fuel.

3. **Improve intelligence** by use of helicopter, on-the-ground scouting, or both at all critical points in the fire area and particularly when two crews are working toward each other.

4. **Provide intra-division and inter-crew communications,** particularly when two crews are working toward each other.

5. **Fight fire downhill in flashy brush-type fuels only when you are positive all of these conditions are met:**

   A. After it has been evaluated by a competent scout or Line Boss.
B. You have a safe anchor point to start work.

C. The fireline is not in or adjacent to a chimney or chute. Be sure that every member of the crew recognizes the effects of topography on fire behavior and recognizes chimneys, chutes, box canyons, saddles, etc. as definite hazards. Weather may change, but topography does not.

D. Lookouts are strategically placed and have communications with the crew and are watching the weather and fire behavior.

E. Your crew can "cold trail" or build their fireline and burn out on the fire's edge so that they always have "one foot in the burn". The burn must offer an area clean enough of fuels to be safe and must never be in a chimney.

F. Be positive that a crew has started up from the bottom to meet you on the same line, that they have turned the corner and have it held to prevent outflanking.

G. That you have communications with the crew you are working towards, with your Sector Boss, and with some facet of scouting intelligence.

H. Safety zones are identified and can be reached by all personnel if the fire crosses below them. That someone is constantly assessing the safety zones to assure that they are always safe.

I. That all crew members are physically and mentally fit and have and wear protective clothing, based on Regional requirements.

J. That you keep alert and continue to evaluate all conditions constantly.

6. Build and "esprit de corps" in crews that says we are not only the best firefighters, but we are also the most knowledgeable in recognizing and taking action to meet every physical and natural challenge that a fire can present. Continue to critique each fire assignment knowing that you can learn from each experience and that you will never know what factors will influence your next assignment.

The best firefighter is one who can recognize the hazards and knows how to avoid them which accomplishing the job. He follows, and sees that others follow, the "TEN STANDARD FIREFIGHTING ORDERS".