

REVIEW REPORT

Subject: Fire Shelter Deployment

Date: September 9, 1988

Location: Table Mountain, Canyon Creek Fire, Rocky Mountain Ranger District,
Lewis and Clark National Forest

TABLE OF CONTENTS

<u>Subject</u>	<u>Page No.</u>
INTRODUCTION	01
NARRATIVE	02
COMMENDATIONS	07
FINDINGS	09
CONCLUSIONS	18
RECOMMENDATIONS	18

INTRODUCTION

On September 9, 1988 at about 1630 hours the Stanislaus Interregional Hotshot Crew and two dozer operators deployed their fire shelters in a safety zone on Division G of the Canyon Creek Fire on the Lewis and Clark National Forest. A total of 22 people entered shelters as the fire blew out of Falls Creek to the NNE, northeast and east, subsequently burning over the safety zone. There were nine individuals burned substantially enough to require medical treatment at a Great Falls, Montana hospital.

Review Team:

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Incident Name - Canyon Creek, Elk Zone

Date and Time (Shelter Deployment) - September 9, 1988, at about 1640 hours

Location - Elk Zone, Division G; NW, SE, Section 2, T17N, R7W, Principal Meridian (USGS); at the base of the escarpment of Table Mountain at its northwest corner; Rocky Mountain Ranger District, Lewis and Clark National Forest

Date Incident Started - June 25, 1988

Incident Size - September 9, 1988 = 243,840 acres

Resources Involved - Stanislaus IHC (20 people), dozer operators (2), dozer (D8) belonging to Evensen Inc. of Choteau, Montana

Topography - (at shelter site) ridgetop, 15 percent slope and a northwest aspect; (in general area) moderately steep and broken with slopes of 40+ percent, numerous rock outcrops and escarpments, natural open parks and drainages with draws/creeks oriented such as to channel, re-direct and create a chimney effect for general winds.

Fuels - sparse (from drought and grazing) grasses in open parks, primarily composed of bunch grasses where fire, without strong winds (20+ mph), does not readily carry; dense, stagnated stands of timber on top of ridge running northwest from Table Mountain and characterized of heavy ladder fuels under 20 foot high canopy; live fuel moistures were at historically low levels from

several years of drought and significantly below normal snowpack and precipitation for the current year.

Weather - (shift plan taken from Missoula afternoon forecast of 9/8) RED FLAG WATCH, Discussion: Zonal flow across district with low amplitude high pressure ridge keeping strong enough winds aloft to produce windy conditions Friday because of additional heating at the surface. Very low dew point again Friday afternoon coupled with the wind justifies red flag watch. Tomorrow: Mostly sunny, high temperatures 75-85, minimum relative humidities 8 to 15%, wind 15 to 30 mph westerly; actual area and experienced, late afternoon, mid-slope, winds in the large park just east of Falls Creek (see aerial photo) were out of the southwest at 20-25 with gusts to 40 mph; winds at the shelter deployment site at 1630 hours were much the same except for being from the west. Note: the wind conditions cited above are based on photos taken by crew members of the Stanislaus IHC just prior to the burn over. They are also based on observations of the investigators of winds occurring on the site on 9/24. These winds, from the bottom of Falls Creek to the top of the ridge at the shelter deployment site, conformed exceptionally well to burn patterns throughout the area and are projected to be much the same as experienced there on 9/9.

NARRATIVE

Events Prior To 9/9

On September 6, 1988 the Canyon Creek Fire, under the influence of a frontal passage, blew out on a front from Welcome Pass in the north to Caribou Peak in the south. By the time this run had slowed significantly it had moved some 15 miles to the northeast and expanded from about 60,000 to 240,000 acres. During the course of the blow out numerous ranches and private lands were threatened and the incident base for the Elk Zone was burned over. All but the minimally needed structural and incident base protection resources were evacuated to Augusta for the night of 9/6. About 100 people lost their personal gear as the fire burned over the incident base. However, most of the camp's supplies and equipment were successfully protected, providing the foundation for the renewed suppression efforts to follow. Meanwhile, further west on the north flank of the fire 172 people working Division A were cut off or overrun as the blowout began by spotting across Welcome Pass and into Moudess Creek just northwest of their position. About 65 individuals were working close enough to well burned out zones to walk into the black and avoid being burned over. Another 107 people were forced to move into a park of about five acres in size, burn out the grass and then deploy shelters as an added safety margin against ember burns.

For about three days following the 9/6 runs the Elk Zone of the Canyon Creek Fire remained fairly static. On September 7 the incident command team concentrated on reorganizing its resources, reestablishing the incident base,

protecting structures and obtaining intelligence regarding the fires perimeter. Line construction was scheduled to get underway again on the morning of 9/8 with emphasis remaining on structure protection. New assignments were made for 9/8 with Division Supervisor [REDACTED] moving from A to G. Structure protection on Division G included the C Bar N Camp on the Dearborn River, the Diamond Bar X Ranch on Falls Creek and a number of private residences and cabins in Joslin Basin. Sometime later that day [REDACTED] and [REDACTED], Operations Section Chief (OSC), were able to look at the division from the air to make specific plans for location of line construction. It was agreed that direct line would be constructed from the bottom of Falls Creek to the west over Twin Buttes and down into the Dearborn River at the division break between G and F. Indirect dozer and hand line was decided on from Falls Creek to the east and the break between divisions G and H at Table Mountain. This last section of line east of Falls Creek was to be constructed during the night of 9/8-9/9 with a burnout scheduled for day shift of 9/9.

Events of September 9, 1988

At the morning briefing the incident action plan for 0600-1800 hours of 9/9 was reviewed with the resources assigned for the day. Attending the briefing following their arrival from California at 0300 that day the Stanislaus IHC's Superintendent, [REDACTED], took additional time to query the Planning Section Chief, [REDACTED] regarding local fire behavior (see [REDACTED] Interview, Exhibit S) of previous days. Because division assignment control operations and special instructions were brief and incomplete (see Exhibit T), more specific information was given in on-site briefings by division supervisors.

Delivered to Drop Point 13 (Diamond Bar X Ranch) the Stanislaus IHC was lined out to improve the indirect line on Division G east of Falls Creek to Table Mountain and be prepared to burn it out from the top back down. On arrival at the anchor point in Falls Creek at approximately 1000 it was discovered that the night shift had not constructed the line as previously thought. A Field Observer, [REDACTED], was in the process of finishing line location on the upper 1/4 of this segment below Table Mtn. A D8 dozer operated by [REDACTED] and his alternate, [REDACTED] began line construction from the bottom of Falls Creek, up through the middle of a large park located on the southwest facing slope of the ridge running from Table Mtn. to the confluence of Falls and Joslin Creeks (see aerial photo, Exhibit Y and topographic map, Exhibit X). From the upper end of the park the dozer then worked east and southeast in the timber on top of the same ridge to Table Mtn. The hotshot crew followed behind the dozer and began improving the line as it entered the timber.

Meanwhile, [REDACTED] had gone to the saddle between Twin Buttes and the Diamond Bar X to check on the progress of work on the remainder of his division. The balance of Division G resources, about 140 people, were improving the line from the saddle west and northwest into Dearborn River about a 1/2 mile above the C Bar N Camp (see [REDACTED] Interview, Exhibit K).

Sometime between 0915 and 1200 the updated weather forecast (see Exhibit U) was made available to resources on the line. It called for temperatures and

relative humidity to remain about the same. Winds at the 20 foot level were forecast for 10 to 20 mph with stronger gusts in late afternoon. The 10,000 foot level winds were forecasted at 30 mph from the west and southwest. Evening red flag watch winds were forecast to be out of the southwest at 15 to 25 with gusts to 35 mph.

Proceeding east on the west side of the dozer line, [REDACTED] arrived in the bottom of Falls Creek sometime around 1200. During this time he observed some of the helicopter bucket work on spots in the lower part of Falls Creek (see photos #1 and #2) on both the east and west sides. The spots, located in the south half of sections 9 and 10, had probably originated from the major run of 9/6 but had exhibited little in the way of activity on 9/7, 9/8 and early 9/9. It was about this time that Overacker requested Dombrowske to move a crew over from the west side of the division to assist in holding the line while they burned out later in the afternoon. Agreeing with the need [REDACTED] started Blackfeet 78 in that direction. Also around noon Shulman returned from Table Mtn. to Falls Creek enroute to another assignment. Following lunch she took a relative humidity reading of 24 percent in the bottom of Falls Creek around 1230. Shortly after this she noted some torching and flaring going on up canyon to the south from where the fire line crossed Falls Creek. Sometime between 1230 and 1330 the OSC, [REDACTED], called [REDACTED] for an update on work progress and was told of the need for a revised dozer line location on the west side. He was also told that the line would be ready to burn out sometime late in the afternoon. After expressing concerns about the burnout relative to the heavy fuels next to the line in the timber [REDACTED] told [REDACTED] he would have the Fire Behavior Analyst (FBA), [REDACTED], come to provide input and make projections. At 1345 to 1400 [REDACTED] departed the area going off shift. Enroute to incident base between 1400 and 1430 he briefed [REDACTED] OSC, his replacement.

At 1345 [REDACTED] radioed Operations [REDACTED] that he was experiencing strong winds from the south and southeast in Falls Creek. About 15 minutes later as the winds continued and he could sense the humidity dropping he chose to hold the Blackfeet crew in the bottom of Falls Creek rather than send them on up to where the hotshots were working. Around 1415 [REDACTED] informed [REDACTED] he was pulling back his resources on the west side of the division to the county road in Dearborn as conditions did not feel right. Shortly afterwards the spots in the bottom of Falls Creek began to heat up showing considerable torching, flaring and short runs.

At 1430 [REDACTED] advised [REDACTED] that he thought it best for the Stanislaus IHC and the dozer operators to come off the hill. At that time the dozer was still on the ridge in the timber about 100 yards away from a small opening at the base of the scree slope below Table Mtn. [REDACTED] had been observing activity pick up in the bottom of Falls Creek not far from where they would be walking out. He then told the dozer operators to pioneer the last 100 yards into the small opening at the base of the scree slope and to construct a safety zone (see photo #3) for the crew and operators to move into. He notified [REDACTED] that he felt it wise to stay put in the dozer constructed zone that he considered a good safe area. Not able to see the immediate area the hotshots were working in [REDACTED] left the decision to remain at Table Mtn. up to

discretion. For the next 45 minutes, plus or minus 15, the dozer worked at constructing a safety zone per instructions. The zone (see photo #4) was about 180 by 120 feet in size (see Exhibit V) with its long axis oriented east to west beginning on top of the ridge and moving slightly down slope. At direction a heat shield berm about 4 or 5 feet high was constructed in the safety zone on a north-south axis some 115 feet west of the top of the ridge. A small hook to the east on the north end of the berm was added to prevent swirling and eddying of flames, heat, gases and smoke. In the center of the zone and just east of the berm the dozer constructed a shallow pit intended as a shield for itself. While the dozer was constructing the safety zone the rear guard of the crew worked its way into the area from below in the timber.

At about 1530 with runs in the lower part of Falls Creek building up heat (see photo #5) felt it likely that most of the drainage would be lost and headed for the Diamond Bar X to oversee structure protection efforts. Before leaving he checked with to alert him that the fire was headed his way and was in turn informed that the crew had an adequate safety zone and were fully prepared. Fire shelter were out of carrying cases but still in their plastic containers (see photo #6). Over the next hour, plus or minus 15 minutes, all personnel in the safety zone at the base of Table Mtn. were observers to high winds pushing the fire in rapid runs (see photos #7 and #8) across the drainage below them. Flame lengths in the park below them were estimated at 30 to 50 feet in height while those in the timber at the top of the ridge as the fire blew out of Falls Creek were around 200 feet. At first, the runs in the bottom of Falls Creek were from the SSW to NNE. As the runs generally paralleled each other working their way up the slope towards the safety zone the orientation changed. At mid-slope the runs were from southwest to northeast and finally at the safety zone the direction shifted to a west to east set.

At about 1630 told his crew to get down behind the berm. He had previously instructed the dozer operators to stay in their cab as they were about to take some heat. At this time the fire made its last run in the remaining timber below the safety zone (see photos #9 and #10). As it came over the zone unburned gases ignited and burned. This combined with approximately 200 foot flame lengths in the timber adjacent to the north end of the berm created a brief period of radiant heat at a high angle and directly overhead of the crew behind the berm. The most damaging intense heat (see photo #11) lasted probably less than a minute. As the fire began to go over the berm the crew attempted to deploy their shelters to avoid the heat. Some were fully successful and avoided any injury. Several individuals were able to deploy completely but not before receiving some first and second degree burns from radiant heat. A few people, due to wind, heat and malfunctioning seal openers of the plastic inner cases were unable to successfully deploy their shelters and had to double up with others to obtain the needed heat shield protection. Several of those doubling up with others also received some first and second degree burns prior to getting into someone else's shelter. The dozer operators deployed their shelters inside the cab of the tractor while watching the crew deploy theirs and were able to avoid any injury. Damage to the dozer was limited to cab windows broken by the heat.

The total length of time in the shelters ranged from 10 to 15 minutes. While in the shelters radio and verbal conversation aided in maintaining confidence and a sense of order and control. On emerging from the shelters it was learned that there were 8 or 9 individuals with varying degrees of burns needing medical treatment.

At 1645 [REDACTED] notified [REDACTED] that his crew had deployed fire shelters, were then coming out of them and that a few had minor burns. Immediate evacuation of the crew was offered by [REDACTED], however, [REDACTED] declined saying that they would walk out. He stated that they would wait until the fire had cleared the ridge area below the deployment site. Shortly after 1700 the Elk Zone Medical Unit was notified by the Safety Officer, [REDACTED], to be prepared to treat burns and administer oxygen, if needed, at Drop Point 13. By 1745 the crew had reached the lower end of their line in the bottom of Falls Creek where [REDACTED] requested a bus for eventual transportation of the crew from Drop Point 13. Because of active burning in the bottom of Falls Creek the crew was forced to wait for more than an hour for fire runs to subside and the heat to dissipate. Around 1800 an ambulance was dispatched from incident base with 2 Emergency Medical Technicians (EMT) from its crew plus 3 additional EMT's and superintendent from the Laguna IHC. A bus was also dispatched about the same time.

Shortly before 1900 [REDACTED] notified the Safety Officer [REDACTED] assigned to Division G that he would attempt to walk on out alone to the drop point. At 1855 the ambulance and bus arrived at the drop point. It was shortly after 1900 that the first of the Stanislaus IHC arrived at the drop point with the balance coming in by 1930. It then became apparent that closer to half the crew had been burned and that several had serious second degree burns requiring more extensive medical treatment. By 2000 the crew had received preliminary medical treatment and were on their way back to incident base. At this point [REDACTED] and [REDACTED] recommended that the entire crew be transported to a motel in Great Falls where the trauma team that was enroute would meet with them. The crew arrived back in incident base about 2100 where they collected their gear and left about 2130 for Great Falls. In Great Falls three or four more seriously burned individuals were treated at Columbus Hospital the night of 9/9. The less serious burned were treated early the next morning with checkups performed on a couple of people later in the afternoon of 9/10.

Events subsequent to September 9, 1988

The crew met with the critical incident stress team for much of the day on 9/10 to debrief and discuss their experiences related to the burn over the previous day. The meetings were conducted in an informal and relaxed setting at the Great Falls Sheraton. Later that day and early the next morning a number of crew members provided information (see exhibits A through J) for the shelter deployment review team assigned. By 0800 on 9/11 the Stanislaus IHC had been released from the Canyon Creek Fire and were flying home out of Great Falls.

For the remainder of 9/11 and most of 9/12 the shelter deployment review team interviewed individuals of the Elk Zone Incident Command Team, talked with

members of the Area Command Team (see exhibits K through R) in Lincoln and gathered documentation relative to the shelter deployment incident. Because significant snow had covered the deployment site during a storm in the area on 9/10 and early 9/11 it was decided to delay attempts by the review team to visit the site until conditions improved. On 9/13 the review team briefed R1's Assistant Director for Fire Suppression, [REDACTED] and R5's Agency Representative/Coordinator, [REDACTED] on the status of the review to that time.

On 9/22 it was learned that most of the snow had gone off the site. From 9/23 through 9/25 the review team completed followup interviews, shelter deployment site visitation and research into the final fire package. On 9/24 the review team walked into the deployment site using the dozer constructed fireline as the travel route. While traveling through the large open park on the east side of Falls Creek observations were noted of burned over vegetation, unburned strips of the same, burn patterns in general and wind conditions. Throughout the day it was noted that winds matched the burn patterns from the west side of the Falls Creek drainage, across the bottom to the east side and on up to the ridge to the shelter deployment site. At the deployment site physical measurements were taken of the safety zone (see EXHIBIT V) and the dozer constructed earth berm. Observations of topography were noted. The fire shelters and plastic cases left behind on 9/9 were inspected and packaged for transportation to the Missoula Equipment Development Center (MEDC). Lastly, routes time of travel and adequacy of alternative lookout and safety zones were explored. Photographs of vegetation, burn patterns, topography, fireline, safety zones and dozer berm were taken to provide visual support for the review record. On the return trip travel times to the large open park below the shelter deployment site and to the bottom of Falls Creek were duly noted. The used fire shelters were turned over to the Lolo National Forest on 9/25 for transfer to MEDC on 9/26.

COMMENDATIONS

The majority of commendable actions and activity relative to entrapment and fire shelter deployment and treatment of the injured occurred during and after the actual burn over. Because several commendable actions did occur prior to the burn over event they are grouped accordingly.

Prior To 9/9 Fire Blowup

1. By issuing fire shelters and nomex shirts to dozer operators additional severe burn injuries were probably prevented. Many large fire efforts east of the Continental Divide obtain their dozer and engine resources from local ranches and volunteer type organizations. Most or all come with little or no personal protective equipment and, in many cases, work extended periods of time without the benefit of this safety gear. The overhead team is to be complimented for their foresight in making available and requiring the use of PPE.

2. In gathering information about previous days large fire runs from the Planning Section Chief the Superintendent of the Stanislaus IHC provided himself with important input. This input played a significant role in his eventual choice not to walk his crew back down the fireline and into a potentially more hazardous safety zone situation than that selected. The crew's superintendent is to be commended for seeking out a source of information on local fire behavior beyond what was provided in the morning briefing.
3. The timely evacuation of the majority of Division G resources just prior to the blowout may well have prevented additional injury. The Division Supervisor's recognition and reaction to a change in wind direction, increase in velocity, sensed rapid decrease in relative humidity and increasing fire activity speaks well of his alertness to ongoing weather, fire behavior and knowledge level. The actions taken on Division G occurred nearly a full hour prior to the OSC's general evacuation order.
4. The Stanislaus IHC is commended for moving all non essential flammable equipment away from the shelter deployment area and the use of nomex clothing to its maximum capability.

Shelter Deployment - 9/9

1. The more highly commendable event of the day was unquestionably the sharing of fire shelters with those who were unable to adequately deploy their own. At the risk of injury to themselves several (3-5) people willingly accommodated another person in their shelter until the burn over had subsided sufficiently to be outside safely. This unselfish act undoubtedly prevented more serious burns, at the least, and may have prevented one or more fatalities.
2. Inter-crew communications and support, both verbally and by radio, while in shelters must be noted as a positive influence in maintaining discipline and morale.

Post Shelter Deployment

1. Even though notified of only minor burns to a couple of people the offer of immediate evacuation off the safety zone was commendable on the Division Supervisor's part.
2. Given the deployment, potential smoke inhalation and burn type injuries the responsible overhead reacted quickly by arranging for ambulance (w/EMT's and oxygen) and bus transportation to be at DP 13 to provide for the crews immediate needs.
3. The highly cooperative and humanitarian attitude of the Laguna IHC EMT's and Superintendent in assisting in the treatment of the injured is nothing short of a class act.

4. The Incident Command Teams timely order of critical incident stress and shelter deployment review teams and the setting up hotel accommodations in Great Falls is also recognized as commendable.
5. Comments by the crew and the fire's assigned Civil Rights/EEO Specialist indicated that the critical incident stress teams debriefing of the crew was beneficial in maintaining or restoring confidence and morale.
6. The crew is commended for their willingness to share information on their experiences with the critical incident stress and review teams.
7. The facilitation assistance given by the Civil Rights/EEO Specialist was valuable to the crew and the incident command, critical incident stress and review teams in completing post deployment activities.
8. The narrative chronologies of the incident command team and Division G Safety Officers assisted greatly in pinning down events following actual fire shelter deployment.

FINDINGS

The findings of this report are based on the narrative of events, material contained in the appendices and information obtained by the review team during interviews and its investigative process. Findings are grouped in general categories with a brief discussion following each.

Crew And Dozer Assignment

1. The Division Assignment List, 204 ICS, of the incident action plan (IAP) for the day shift of 9/9/88 was inadequate and inaccurate in providing for needed "control operations" and "special instructions" for resources assigned to Division G.

Discussion - Control operations of the IAP (see Exhibit T) showed little or no information for Division G, nor did the "Special Instructions" provide any additional direction specific to the actual line construction efforts. No reference was given for the assignment given to the Evensen dozer and the Stanislaus IHC. The operations and instructions listed would lead one to believe that fire lines were in place and that holding and mop-up were all that were needed. One of the review team members attended the morning briefing of 9/8/88 at which time it was noted that voids and inaccuracies in instructions were not filled in. Based on interview information it appears that tactical objectives and instructions specific to Division G were formulated on the ground when resources arrived on site. This lack of information does not seem consistent with the lead time of two days since the end of the fires major run of 9/6. Intelligence should have been

sufficiently reorganized by the morning briefing of 9/9 to provide accurate, up to date information for the IAP.

- 2 The dozer operators and the Stanislaus IHC were placed in an unnecessary high risk situation by the control operations (tactics) assigned. The implemented control operations, in effect, violated the basic premises of the two Standard Firefighting Orders dealing with weather forecasts and fire behavior. Additionally, inadequate precautions were taken to deal with the "watch out" situation of building indirect line in heavy cover with unburned fuels between the firefighting resources and the fire.

Discussion - The actual experienced weather on 9/9/88, combined with spot fires that had been smoldering in Falls Creek for a couple of days, created what amounted to the placing of people in a heavy cover of unburned fuels directly in front of the fires main line of advance. The forecasted weather and fire behavior (see Exhibit T) of the IAP were consistent with what actually occurred on 9/9. In fact, the fire behavior forecast was prophetically accurate. Despite the above the Division Supervisor believed that he had a 24-hour delay in the forecasted winds for 9/9. This understanding apparently was based on information given in the morning forecast for 9/9 that was passed to the line sometime prior to noon and on discussions with the OSC. A check of the 9/9 morning forecast shows that the red flag watch for 9/9 was delayed until evening of that day. However, strong winds just below red flag watch levels were still forecast at the surface including 10 thousand foot winds commensurate with those in original IAP of 9/9. The strongest winds actually occurred just a couple of hours prior to the beginning of the evening red flag watch. Neither of the Operations Sections Chiefs could recall a revision in forecasted winds that would allow for a 24-hour delay. One of these individuals (see Boden Statement, Exhibit Z) did express surprise at the winds which occurred on 9/9 despite forecasts supporting such an event.

3. The probability of success for the control operations assigned the resources on the east side of Division G was low and not commensurate with the risks to personnel safety.

Discussion - Given the actual line location (see exhibits X and Y) it is difficult to project a reasonable probability of being able to construct, burnout and hold the same under the time frames allowed. The Division Supervisor stated that he and the OSC had viewed the area from the air the day before but had not visited the east side of Falls Creek on the ground. Based on the review teams on site visit and photos (see Pictures #12 and #13) taken by the crew a successful burnout of the sparse grasses in the park would have required a 20+ mph wind from the NE. Under the predicted winds and with its location down from the top of the ridge on the windward side it is probable that there would have been difficulty in holding the fire line during burnout operations. Given buildings in the NW 1/4 of the SE 1/4 of Section 34 and throughout the Joslin Basin the line location on the east side of Falls Creek was the last opportunity to control the fire short of direct structure protection. Again, the probability of success combined with the attendant risks did not warrant the tactics used.

Organization

1. The direct support overhead organization for Division G was understaffed and the resulting shortage contributed to the sequence of events leading to the shelter deployment.

Discussion - Based on a review of the Division Assignment List, ICS 204, (see Exhibit T) and interviews of participants it appears that span of control and general staffing principles under ICS were not fully followed setting up a reduced environment of safe operations. There was no Strike Team Leader for the two dozers on Division G nor a Dozer Boss assigned for the Evensen cat working the east side of Falls Creek. The Stanislaus crew provided the leadership for the dozer on their assignment. There also appears to have been a shortage of two Strike Team Leaders for crews and one or more Felling Bosses. A highly experienced lookout type, placed in a strategic viewing location in Falls Creek, seems to have been unavailable or overlooked. One Field Observer was assigned to locate the fire line on the east side of the drainage but was to work elsewhere off Division G following completion of this activity. Given some or all of the above resources the Division Supervisor (or other overhead) might have had the opportunity to make an in person, on the ground assessment of the total workload and probability of success of planned control operations on the east side of Falls Creek. With an additional or at least full shift assigned Field Observer safer escape routes and effective safety zones could have been identified in advance. Another shortage that affected the events in Falls Creek was that of aerial reconnaissance. From 1345 when the Division Supervisor reported increasing winds to the burn over at approximately 1630 there was no apparent assessment of the situation from the air.

2. General long term fatigue may have been present in some members of the Elk Zone Incident Command Team and supporting overhead. This fatigue probably contributed to the errors in judgement that affected the events leading to the shelter deployment.

Discussion - At the time of the Table Mountain shelter deployment on 9/9 the majority of the incident command teams members and supporting overhead had been on continuous fire assignment since August 9, 1988 (see Exhibit W) with only two days off in an R&R facility. By the time of their release from the Canyon Creek Fire on 9/19 most had not been home in 42 days. The core of the national incident command team had had an approximate total of six regular days off from 7/4. By 9/19 they had been away from home on fire assignment a total of 67 out of the previous 78 days. The teams previous assignment was particularly fatiguing and stressful in that considerable private property and structure loss was involved along with extensive political pressure. Following the two days of R&R after 22 days on that fire they were assigned to Canyon Creek. About three days after taking over this effort the team endures the largest single run of all fires in 1988 during which private property and structures become involved, incident base is evacuated and burned over and a shelter deployment involving 107 people occurs. The effects, particularly on the operations section, could be little less than stressful and fatiguing.

3. Fatigue does not appear to be a factor in the performance of the Stanislaus IHC during the events of 9/9/88.

Discussion - According to the superintendent of the hotshot crew they had received considerable rest on their previous assignment on the Angeles NF. They had also received one or two days off at home following that assignment and prior to coming to Canyon Creek, Elk Zone. However, they only had 2 to 3 hours of sleep traveling the night prior to their assignment. The day of 9/9 was their first shift on the fire and on site evidence indicates the crew had little work to accomplish up to the time of movement into the safety zone.

4. The briefing of and a change of shift/operational work period on 9/9 for (see [REDACTED] Statement, Exhibit Z) OSC's in the early afternoon was poorly timed given transition to the critical burning period of the day.

Discussion - Fire activity was in the process of picking up and exhibiting unexpected (according to interviewed overhead) behavior when the shift change and briefing for the Operations Sections Chiefs occurred. The morning OSC was leaving the site at about the time the fire was beginning to break out while the afternoon OSC was just beginning to get reacquainted with the situation. Both actions combined to create the effect of not having top operations leadership well settled and fully knowledgeable of conditions on their assignment prior to the blowout.

Escape Routes and Safe Areas (Safety Zones)

1. There probably was insufficient time, once notified of the need, to evacuate the dozer operators and hotshot crew back down their fire line and the trail in the bottom of Falls Creek to the safe area at the Diamond Bar X Ranch.

Discussion - The time needed to walk back down the dozer line to the bottom of Falls Creek would have placed the crew at the head of the early hot fire runs in that location. Walking travel from the shelter deployment site, down the fire line, to the bottom of Falls Creek was timed at about 40 minutes. Walking the dozer out may have taken longer. Observing much of the activity (see photos #14 and #15) into which they would be walking and remembering the discussion regarding conditions of the major blowout on 9/6 the superintendent chose not to pursue an attempt to walk out ahead of the fire blowout.

2. While not as poor a safety zone alternative as the one chosen by the crew superintendent the large open park favored by the OSC's and the Division Supervisor had serious drawbacks given the actual conditions experienced.

Discussion - Operations section overhead felt that the Stanislaus IHC and the dozer operators could have pulled back down into the large open park through which their fire line had been located, burned out an area and walked into the black for a safe area. The winds during the blowout were strong enough to support a burnout of the sparse grasses and forbs

in the park and there was time to have moved the people and dozer into this area. However, in all the interviews nowhere was it stated that the crew was instructed to use this park as a safety zone. Rather, it was felt by overhead that the park was visibly available and presumed that the crew would use it. Based on interviews with the hotshot crew and observations on site of burn patterns from 9/9 and similar winds on 9/24 the open park was judged by the review team to be less than desirable. There would have been less time to prepare and set up in a safety zone in the park. Apparently, winds were gusting in excess of 40+ mph at times. In the strip fire runs across the park all vegetation below head height was burned to ash or blackened while that above 6 or 7 feet high was left green. The narrow bands of brown (scorch) between black and green were horizontal from the windward to the leeward side of the vegetation indicating extreme wind conditions. Intense concentrations of smoke and embers were held close to the ground for extended periods of time. In the hollows, eddies and around rocks along the upper end of the dozer line in the park and timber there were numerous pools of ash and ember residue. Even with a successful burnout of a safety zone in the park fire shelter deployment would have been needed to protect against smoke inhalation and ember burns. The dozer operators had not received instruction on the use of fire shelters so it is possible that they might not have been able to successfully deploy and control theirs in the winds experienced.

3. The area in which the fire shelter deployment occurred was inadequate as a safe area and did not qualify as such under the conditions of topography, fuels and weather prevailing on the site. Furthermore it was the poorest choice among two other adjacent (15 to 20 minutes travel) potential safety zones and in violation of Section 3-3, C. of the Health And Safety Code Handbook.

Discussion - The half-acre sized clearing compares unfavorably with the 5 acre safe area used in the fire shelter deployment of 9/6 that was considered marginally adequate. The site constructed by the dozer lies near the top of the ridge below the base of the escarpment on the northwest end of Table Mountain and on the edge of a saddle at the head of a draw running west from the deployment location (see Exhibit X). Winds are channeled and directed at the site and increased in velocity by the prevailing topography. Timber and vegetation was dense and too close on all but the south side of the constructed zone. There was an additional 45 to 60 minutes of time prior to the burn over that the cat was idle in which the constructed zone could have been enlarged. However, the Stanislaus IHC Superintendent felt that with the earthen berm heat shield the zone was more than adequate. This judgement is not consistent with the act of having the crew pull fire shelters out of the canvas case and place them in their laps (see photo #16) nearly a full hour prior to the burn over. Also, a dozer constructed berm of 4 to 5 feet high is an insufficient barrier to radiant heat from ignited gases overhead or 200 foot flame lengths in the adjacent timber. In other words they would be effective only against horizontally radiated heat. When asked about the adequacy of the selected site if not equipped with fire shelters the superintendent stated they would have had to move down the fire line to the large open park and burn out a safe area.

The Health And Safety Code Handbook defines a safe area as that "in which you can survive any fire condition without injury." It goes on to say "do not consider the fire shelter an alternative to a safe area or an escape route."

4. The crew and overhead failed to locate, continually inspect and utilize an effective alternative escape route and safe area.

Discussion - Despite knowledge of the previous major fire run on 9/6, weather and fire behavior forecasts for 9/9 and numerous spot fires on both sides of Falls Creek below fire lines, all pointing to the possibility of another significant blowout, no attempt was made to locate alternative escape routes or safe areas. From 1430 when the need for evacuation was passed along to the crew and a blowout became probable, to 1630 when burned over no attempt was made by the hotshot crew to identify and use an escape route. During this time all efforts were directed at constructing a safety zone in which to ride out the fire front passage. The exposure to heat and possible burn over were anticipated in the construction of the earthen berm as a shield, the full coverage of PPE clothing and the partial (removal from canvas case) deployment of fire shelters. Followup inspections of escape routes and safe areas were not performed by operations and safety overhead as required by the H&SC handbook. Once known that some of Division G's resources would not be evacuating as originally presumed an aerial inspection of the area the crew was setting up in should have revealed the preferred escape route and rock rubble safe area immediately to the southwest.

The potential safety zone was a barren area (see photos #17 and #18) of fractured rubble rock about 40 acres in size and 250 to 300 feet higher in elevation to the southwest of the deployment site. The review team observed its possible existence throughout their foot travel along the fire line in the park, from one or two locations in the timber on top of the ridge and again from the shelter deployment site (see photos #19, #20 and #21). A member of the review team timed the travel (including traversing of recently formed snow drifts) to the center of the rock area at 15 minutes. Movement within the rock area was not difficult. A closer inspection of the barren rock area showed no traces of ash and ember particle deposits indicating a reduced or a nearly non-existent smoke exposure situation on 9/9. Winds on the site on 9/24 were much reduced (5-10 steady with 15 to 20 gusts) from those along the fire line and at the deployment site. Deployment of shelters on this site would not have been needed. In fact, the crew and dozer operators would have been treated to an unobstructed view (see photos #22, #23 and #24) of nearly all of Falls Creek and most of Joslin Basin. The judicious use of scouting by the hotshot crew should have verified accessibility and effectiveness of this potential safety zone. This zone is shown in one of the photos taken by the crew (see photo #25). Further, an experienced individual, assigned by either overhead or the crew, acting as a lookout, could have given an accurate assessment of fire activity throughout the day in Falls Creek and Joslin Basin.

Burn Over and Shelter Deployment

1. The physical action of deploying and entering fire shelters occurred too late to prevent serious radiant heat burns to a number crew members. A full deployment by all personnel in the safety zone of as little as two minutes earlier would have prevented all injuries from occurring.

Discussion - As the fire front began the run that was responsible for burning over the safety zone the hotshot superintendent directed his people to get down behind the top of the dozer berm (see photo #9). The superintendent never gave specific direction to deploy fire shelters as he felt that had been left to each individual crew members own discretion. Three of nine individuals from the crew who were interviewed indicated that the superintendent gave verbal direction to the effect "get down off the berm and I'll tell when to deploy." However, the other members interviewed and having any recollection of specific direction remember only the command to "get down off the berm." The delay in opening shelter's was observed by the dozer operators who said it was obvious from inside the dozer that the crew was waiting for someone to give the word to deploy. The wall of intense radiant heat arrived over (see photo #11) and around the earth berm much quicker than anyone expected but lasted less than 60 seconds at its greatest intensity. The response to deploy shelters was still slow as people were waiting for someone to give the word or for anyone else to deploy first. A number of crew members attribute the delay in deployment to the perceived stigma attached to undergoing such an action, particularly for IHC's. All burns were sustained while outside the shelters. The northern end of the line of deployed shelters took considerably more heat due to their proximity to heavier fuels of the timbered edge of the safety zone.

2. The direction by the Stanislaus IHC Superintendent for the dozer operators to remain in the cats cab combined with their not having had training in the deployment of fire shelters created a hazardous situation regarding their safety.

Discussion - The two dozer operators were issued fire shelters from the supply unit at incident base but were not given instructions on their deployment and use. After constructing the safety zone they were instructed to remain in the cab of the dozer and deploy their shelters if the heat became too intense. Each was wearing a nomex shirt and hard hat but at least one and perhaps both did not have nomex trousers. Neither had water with them. Fortunately they had observed the hotshot crew taking their shelters out of the canvas case. With the crew holding shelters in their laps long before the burn over the dozer operators decided it best to read the instructions in the cases of their own. As the fire front burned over the safety zone the paper identification tag on the outside of the dozer burned and the cab windows cracked. With smoke, heat and embers becoming concentrated in the cab the operators deployed their shelters on the floorboard of the dozer successfully enough to create the needed shield. Again fortunately, the duration of flame and heat was not long enough to cause the dozer to catch fire and burn leaving its operators in an entrapment of their own.

Shelter and PPE Performance

1. The fire shelter, even with two occupants, is an effective shield against the more intense types of radiant heat.

Discussion - By consensus of all interviewed crew members it was felt that no additional burns were sustained once individuals had successfully entered a deployed fire shelter. Those who were unable to deploy their own and were getting burned stated that new burns stopped once doubled up inside a shelter of another. Total time spent in the shelters ranged from 5 to 15 minutes. Once fully inside occupants were comfortable excepting for burns sustained prior to entering. Most felt that additional severe burns would have been sustained and some considered the situation to be life threatening if shelters had not been available.

2. Under a pressing need to quickly deploy a shelter the plastic case it is contained in can prove to be difficult to open.

Discussion - One or two people commented that intense radiant heat had softened the plastic cases around their shelters to a consistency making them difficult to open. Another suffered serious second degree burns to his hand immediately after taking off a glove to allow a finger to be inserted into the ring pull tab that opens the plastic case. Still others had the ring tabs break loose before the case had been opened.

3. The difficulty in deploying shelters from a sitting or prone position is considered to be a direct result of delaying the decision longer than prudent and negating the ability to deploy from a standing posture.

Discussion - The opportunity to deploy earlier existed. Most interviewed crew personnel felt there was going to be a need to deploy well in advance of the burn over but there seems to have been an extreme reluctance to undergo the stigma of a fire shelter deployment. It was suggested that shelter training be modified to include deployment from sitting and prone positions. A change in the method of training people is not recommended if the needed corrective action should be to deploy in a timely manner when conditions warrant.

4. Nomex PPE clothing is not completely effective in preventing burns caused by intense radiant heat.

Discussion - The majority of the burns sustained by the Stanislaus IHC occurred with fully effective nomex clothing in place. The material was inspected by the review team and found not to be damaged, either by the radiant heat or by use previous to the burn over. Because there was no evidence of burned or scorched hair on individuals of the crew it is concluded that radiant heat was the injury causing agent present. The severity of burns was reduced wherever both cotton and nomex clothing were in place over the burn area.

5. There was clear evidence of a need to have replaced most of the fire shelters with new ones at least at the beginning of the season if not sooner.

Discussion - A careful look at the used shelters and the plastic enclosure cases showed extreme amounts of wear and were generally in very poor shape. Only 4 of 21 shelters removed from the site were in a new or nearly so condition. The balance had numerous small pin holes with a few showing large tears/rips along folds. The plastic cases were heavily or totally blackened from rubbing wear indicating that they had been carried too long. Several were so blackened from wear that they may well have been carried for two or more years. The hotshot superintendent indicated that the shelters had been inspected earlier in the season for replacement of defective Cecille Industries units. This is supported by the fact that a couple were in a new condition when later retrieved. However, the physical evidence points to a need to have also replaced many of the other shelters on the crew.

Post Burn Over Evacuation and Medical Treatment

1. The understatement to overhead of burn injuries to his crew and the decision by the Stanislaus IHC Superintendent to walk his people out from the deployment site to DP 13 resulted in 6 to 7 hours from burn over to the obtaining of agency provided medical care for the injured members of the crew.

Discussion - Immediate evacuation was offered by the Division Supervisor when notified by the hotshot superintendent of a couple of people with minor burns. The offer was declined and it took somewhere between 6 and 7 hours to move the crew to Great Falls for agency provided medical care. The crew superintendent did not indicate to either overhead or review team whether or not an aerial evacuation was possible under prevailing wind and smoke conditions. It was nearly 3 hours following the burn over before the last of the crew arrived, walking, at DP 13. The delay in walking out was unavoidable in that considerable fire activity was still going on in Falls Creek causing the crew to hold up and await a cooling off. There was no Medical Plan in the day shift IAP for 9/9. However, emergency medical treatment was waiting at the drop point when the crew arrived. By 2000 hours the crew had received emergency treatment and was enroute to incident base to pick up their gear and then on into Great Falls. The incident command team indicated concern during interviews that they had not been fully informed by the crew's superintendent of both the number of injured and the serious nature of the burns. This situation was confirmed when the review team was informed by the same superintendent over 24 hours following the entrapment that there were several burn injuries and that he considered them not very serious.

CONCLUSIONS

The tragedy of having people burned seriously at Table Mountain during an entrapment need not have happened. The injuries are primarily a result of a series of errors in judgement by both the Stanislaus IHC and operations section overhead. The crew and dozer operators were given an assignment that amounted to indirect fireline construction in front of the most probable point of a blowout. This occurred during a period in time where weather, fuels and fire behavior were exhibiting extremes not experienced in recorded history of the area. The probability of success of the assignment was low. Escape routes and safe areas were not adequately identified, followed up on and used. And finally, when entrapment was likely, the decision to deploy fire shelters was not made by the individual in charge or individually by those threatened until it was too late to avoid serious injury.

Fatigue probably played a major role in the errors in judgement made by the overhead involved. Errors in judgement committed by the hotshot crew and superintendent were likely most influenced by inexperience in the fuel types and weather of the Rocky Mountain front country. A "macho" attitude of being a Type I crew that is expected to go where the going is tough may have contributed to the taking of abnormal risks. And, there is little doubt that the perceived stigma attached to a shelter deployment influenced its timing.

Another disturbing common denominator was uncovered during the review process. There is a developing philosophy of going to and staying in places that would be unacceptable were it not for the availability of fire shelters. Several individuals felt that fire suppression efforts of the future should use the fire shelter more as a tool rather than a choice of last resort when all else has failed. This thinking is totally counter to the concept of always having an escape route and safe area available. The challenge to management is to assure no hesitation in using shelters whenever there is the slightest chance for injury yet drive home the idea that escape routes and safe areas will always be the order of the day.

RECOMMENDATIONS

1. Assure that all Crew Bosses, whether Type I or Type II, receive a copy of reviews of fire shelter deployments.
2. Utilize fire shelter deployment reviews as training tools to avoid repetitions of past errors.
3. In training for crew bosses and other overhead provide the ability for assessing levels of risk and probability of success from the "what if" perspective of not having fire shelters available.

4. Get back to the basics of scouting and lookout operations. Use these skills extensively and intensively.
5. Reaffirm and emphasize the policy stated in Chapter 3-3 of the Forest Service Health And Safety Code Handbook, FSH 6709.11. Hold overhead accountable for providing escape routes and safety areas that continually assure personnel safety regardless of availability of fire shelters.
6. Consider developing larger seal pull rings to accommodate gloved hand fire shelter deployment. Look into wire wrap seal pull for a more positive cut of the plastic wrap inner shelter container.
7. Support efforts to develop an effective hard shell protective carrying case for fire shelters.