Canyon Fire Shelter Deployment and Entrapment Incident Review

Day turns to night in Division Zulu on the Canyon Fire on the afternoon of Sept. 19.

CA-AFV-003151
Vandenberg Air Force Base, California
September 19, 2016

From the first time the Division Supervisor directed resources to head to the safety zone until the sky turned black and the main fire whirl overtook resources was approximately 4-8 minutes.

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When asked "How scared were you on a scale of 1 to 10?" multiple crew members replied "9" and "10." Their escape was approximately 600 to 700 yards.

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Does it take more "guts" to stop the action, or to continue what you're doing even though you have concerns? How much weight do you give "the worst case scenario" in your risk assessment?

Excerpts from Section 4 "Considerations, Questions, and Discussion Topics"

NWCG Definition of "Entrapment":
A situation where personnel are unexpectedly caught in a fire behavior-related, life-threatening position where planned escape routes or safety zones are absent, inadequate, or compromised. An entrapment may or may not include deployment of a fire shelter for its intended purpose. These situations may or may not result in injury.
They include "near misses."

Contents

1. Executive Summary

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The people involved in this incident were eager to share their video, photos, and their stories so that the rest of the wildland fire community could learn from what occurred.

At approximately 1730 hours on September 17, 2016, the Canyon Fire erupted on Vandenberg Air Force Base in southern California. With live fuel moisture levels at their lowest of the year, coupled with drought-stressed vegetation, the fire quickly grew and threatened many rocket launch sites, nearby homes, and other critical infrastructure.

By September 18, the fire had grown to 4,528 acres with zero percent containment, prompting the request for a Type 2 Incident Management Team (IMT). The Central Sierra IMT officially took over management of the Canyon Fire on Monday, September 19 at 0600.

By 1600 on September 19, the fire had blown up in several areas. This prompted several crews to retreat to their safety zone. Two firefighters were sent to the hospital with smoke inhalation. It was later learned that these two firefighters had both dropped their packs and removed their fire shelters, with one of the firefighters actually deploying.

Goal: Make this a Lessons Learned Opportunity

As fire managers were informed of this incident's severity, notifications were made. After it was learned that one of the injured firefighters was a Bureau of Land Management (BLM) employee, the request was made by the BLM to conduct a Shelter Deployment and Entrapment Incident Review.

Although led by BLM with this agency's subject matter expert (SME) support, the U.S. Forest Service was requested to provide additional support to this follow-up effort. Because it took time for the details of this event to come to the surface, the team did not officially meet until the evening of September 22—three days after the event occurred.

Members of the team met with the South Central Sierra IMT and cooperators on Friday morning, September 23, to discuss process and what the team hoped to accomplish. There was a great deal of concern involving the use of the word "Investigation." However, after meeting with IMT and local cooperator personnel, the BLM was able to explain that the goal was to treat this as a "lessons learned" opportunity and less like a strict and formal investigation.

The team's goal was to meet with the modules and individuals assigned that day and hear their stories. It became very clear that had this been a formal and "traditional" accident investigation—coupled with the time that had passed—it would have been almost impossible to get anyone involved to want to talk about what had happened.

Fortunately, and thanks to the explanation of mere semantics, the people involved in this incident were eager to share their video, photos, and their stories so that the rest of the wildland fire community could learn from what occurred.

2. Background

Area History

The history of the surrounding area is provided here to help paint this incident's overall picture.

The Canyon Fire's location has had some level of occupation dating back 7,000 years. During a majority of this time, the Chumash Indians lived here. Today, there are four known sites that would have had annual occupation. The Chumash regularly burned these sites, possibly on an annual basis.

There are no historical accounts of a devastating event for this area. The hypothesis is that during the past three millennia, there have been multiple interruptions in the area's fuels management.

In the late 1700s, the area was settled by the Spanish missionaries, who remained until 1850 when California became a part of the United States. Ranching would then become a mainstay in this area until 1941 when Camp Cooke was established as a training camp for the U.S. Army. In 1958, Camp Cooke became Vandenberg Air Force Base, which currently serves as this country's primary launch site for orbiting satellites.

Topography

The Canyon Fire footprint is located within the Santa Ynez Mountain Range, which runs east to west. The Tranquillon Ridge, located within this range, is considered the backbone of South Vandenberg.

The southern slopes of the Tranquillon Ridge are deep and narrow. This vertical, steep terrain is covered in grass from its midway elevation down to the ocean. This grass component has resulted from grazing and fire prescriptions by ranchers to encourage water shed to the creeks for livestock.

Honda Canyon, bordered by Avery Ridge to the north and Tranquillon Ridge to the south, is the centerpiece and most significant canyon of South Vandenberg. This canyon transitions from a deep "U" shape to a "V" shape as it reaches the ocean. Continuing to the north is a 1,000-foot ridge—locally known as "Target Ridge"—that Avery Road runs along that curves westward to the Lompoc Hills.

Along the six-mile Honda Canyon, these two steep ridges (Tranquillon and Target) create hundreds of radically inclined ridges and ravines that lead down to the canyon's bottom.

The area of operation where the entrapment incident occurred was an inlet from the main Honda Canyon that formed a narrow box canyon. This box canyon is estimated to have a base elevation of 400 feet up to the ridge elevation of 1,050 feet,

sloping to the west. The box canyon's steepness ranges from 31 to 36 degrees at the inlets to 27 degrees at the drainage.

From Target Ridge to Tranquillon Ridge is approximately 2.5 miles. The slope from the Tranquillon Ridge to Honda Canyon is estimated at 50 degrees.

Maritime Chaparral. Photo courtesy California Chaparral Institute.

Fuels

The main fuel type for this area is chaparral, a fire-adapted vegetation type that is dependent on fire to stimulate germination. Most chaparral is on a 40 to 60-year regeneration cycle. Maritime chaparral (as defined from its geographical location as compared to transition or interior) is influenced by more summer cloud cover and cooler summer temperatures. Maritime chaparral has to respond to a complex set of climatic factors due to its influence from the Pacific Ocean. In coastal lowlands, the cool and moist conditions of the summer marine layer reduce evaporative demand and likely supplement moisture availability that offsets water deficits due to low annual rainfall.

The maritime influence is complex in central California, involving dimensions of mild temperatures associated with the summer marine layer, enhanced summer water availability, increased annual rainfall on coastal uplands, and reduced vulnerability to winter freeze events near the coast.

While fire regimes vary among the chaparral zones, maritime chaparral may be favored for moderately long fire return intervals that have a more intense burn. This evolution has taken place over millions of years with the natural process being interrupted with the human settlement to the area, as previously discussed.

Around the early 1900s, when the area came under military occupation, the management of the fuels would not be done on a broad landscape basis. This would set up the area's continuous vegetation cover.

Drought History

Honda Canyon contains manzanita, chamise, and scrub oak. Bear Canyon is filled with sagebrush, juniper, and light grasses. The coastal areas here contain non-native stands of Monterey cypress and chaparral.

A process known as "salt pruning" is believed to affect the vegetation along the coast. The theory is that wind and fog send salt particles inland and prune the chaparral and sage on the windward side of the vegetation, making it look dark and diseased.

Due to the December 1977 catastrophic Honda Canyon Fire—that entrapped and killed four people—and that year's subsequent drought ending winter, the fuels here had almost 40 years of uninterrupted growth.

Since 1977, there have been three recorded droughts: 1992; 2007-2009; and the current drought which started when there was a lower than average rain season during the 2012/2013 season.

The vegetation in Honda Canyon was reported as continuous extremely compact brush ranging from 3 to 10 feet in height. While the out leaf color may have suggested a very low fuel moisture during the Canyon Fire, the interior was at critical levels—if not completely dead—as growth had been choked out by other plants. The best description would be an impenetrable shrub that would have been easier to walk on than through.

Fire Behavior

Based on the predicted weather generated from a spot weather forecast on September 18, the second day of the Canyon Fire, fire spread models were developed based on the assumptions of live herbaceous moisture set at 30 percent and the live woody moisture at 80 percent, the probability of ignition (POI) was at 100 percent. The expected fire behavior when wind and topography would be in optimal alignment would have been as follows:

GS2 Fuel Model (moderate load dry climate grass-shrub)

Forward rates of spread would be 17-35 feet per minute—moderate ROS (rate of spread).
Flame lengths 5-8 feet—up to 11 feet during gusts.

Fuel Model 4 (chaparral)

Forward rates of spread 70-114 feet per minute—dangerous ROS.
Flame lengths 20-24 feet—up to 31 feet during gusts.

Fuel Model 6 (dormant brush, hardwood slash)

Forward rates of spread 35-53 feet per minute.
Flame lengths 6-8 feet—up to 10 feet during gusts.

Resources Used for This Review

While developing the inputs for this review, it became apparent that the fire behavior on the Canyon Fire was very similar to fire behavior on the December 1977 Honda Canyon Fire, that entrapped and claimed four lives. Several articles and accounts were published on the Honda Canyon Fire, including the book *Beyond Tranquillon Ridge* by Joseph N. Valencia. This publication provides a significant amount of history and descriptions of the South Vandenberg area. Valencia's observations and accounts proved to be helpful background material for the team.

In addition, the historical accounts of the Chumash Indians was provided during a phone conversation with a Chumash cultural representative from the tribe.

Much of the data about the fuels was generated from an open access article, *Ecology and Evolution,* published by John Wiley & Sons Ltd.

Why the Canyon Fire Exceeded Fire Model Analysis

The actual occurrence, based on reports from crews on the incident as well as video and photo documentation, exceeds the fire model analysis. There are a number of factors to help explain this occurrence.

First, the effects of a five-year drought have been adversely skewing fire behavior models. The current burning conditions statewide are proving to be much more volatile than what current models are predicting. This area is also much more reactive to the subtle changes in the weather, especially a moderate relative humidity level, where thresholds for a higher burning intensity is approximately 40 percent.

Second, the forecasted weather called for a slope/valley wind to be southwest to west 4-8 mph with gusts up to 13 mph, and ridgetop winds to be west at 6-10 mph with gusts up to 15 mph. The conditions at the fire site were more of a northerly influence in Honda Canyon, with the test burns being pulled south into the fire, and the active fire on the opposing north ridge backing down the canyon. Based on weather observations, the pattern would not rotate from a northerly influence to a southerly influence until 1500 on September 19, when it is believed the southern wind took hold.

Third, Honda Canyon sets up to create extreme fire behavior based on its steep canyon and numerous ravines and box coves within the ridge lines. This canyon topography encourages wind eddies, which would help developing whirl winds as the air mass moves through the fire-heated area. As this air preheats the upper-elevation fuels, the fire would be able consume receptive fuels at a higher rate of spread with high flame lengths.

At some point during this timeframe, the fire pushed back up Tranquillon Ridge, re-burning any fuels that had not previously been consumed. This event produced a convection column with enough intensity to create a black-out over the line of operation that lasted approximately one hour.

Fire Behavior in Box Canyon Where Entrapment Incident Occurred

The Canyon Fire's behavior, based on photo and video evidence, seems to be in line with the higher limits of modeled fire behavior outputs produced for this review.

Photos taken around 1025 on September 19 show that the fire on Tranquillon Ridge was about 1/3 of the way down the ridge, backing into the Honda Canyon drainage. This line of fire extended across a majority of the ridge, crawling through the live canopy component and the dead under-mix.

On the east side of the box canyon in which the entrapment incident occurred, there are two step ridges. The fire line on the farthest step (closest to the Honda Canyon drainage) looked to be at a slow to moderate rate of spread with 5 to 8-foot flame lengths, with torching heights looking to be near 15 feet. The smoke column was well pronounced and was developing a convection component.

Increased Levels of Fire Behavior

The Firing Boss reports were that the test burn had good consumption with 2 to 3-foot flame lengths and 6-foot flame lengths when heavy pockets of fuel were introduced. There is a video—time stamped at 1035—of a firing operation being introduced around the safety zone working west that was displaying increased levels of fire behavior. Flame lengths were overhead with fire whirls pulling fire 20-feet plus.

As this firing operation progressed, the head fire that was being produced was pushing the fire down canyon 30 feet with 6-foot flame lengths. At approximately 1400, the fire on the second ridge of the entrapment incident box canyon began to outpace the controlled firing moving west. At approximately 1430, the winds became calm. The column stood up and then for 10 to 15 minutes it laid over Avery Road, on which the resource personnel were operating and driving.

This fire event that was happening in the micro environment of the box canyon was most likely happening on a much grander scale within Honda Canyon. At approximately 1500, a spot was identified and picked up on the north side of Avery Road. Fire intensity at this point went to extreme levels.

Strong down-canyon winds were observed in the box canyon, followed by the fire sheeting up the box canyon's south face. It is believed that this observed canyon wind was not an isolated phenomenon but part of the totality of the weather that was affecting Honda Canyon. In fact, based on post-fire analysis of near complete consumption of fuels in both canyons during this 1430-1530 window, the entire canyon was contributing to the fire production.

Critical Rates of Spread

The fire line that was previously backing down canyon would have been pulled into the drainage with critical rates of spread with flame impingement sheeting well ahead of the main fire. During this run, spot fires would have had 100 percent probability of ignition. As such, spot fires quickly burned together, or, more likely, mass area ignition was occurring.

At some point during this timeframe, the fire pushed back up Tranquillon Ridge, re-burning any fuels that had not previously been consumed. This event produced a convection column with enough intensity to create a black-out over the line of operation that lasted approximately one hour.

Next, when this column collapsed, the fire quickly re-established a convection column until the fire progressed out of Honda Canyon, moving north into Spring and Bear canyons with slightly decreased intensity.

That night, the overnight temperatures dropped and fog rolled inland to the level where resources had to cease operations due to lack of visibility.

Triggering Factor: Significant Wind

This is the second known occurrence of a fire event in Honda Canyon that resulted in extreme fire behavior that was heavily influenced by the fuels and topography. The fuels were in their 40th year of growth in the midst of a recorded drought.

These fuels were intermixed with a heavy dead fuel component mixed into the critically dry live component. The canyon, with its steep ravines and multiple ridges that open to the Pacific Ocean, increases the opportunity for fire whirls and major convections to develop—even in the absence of a significant wind. It is possible that the regeneration cycle was being triggered.

A hypothesis for a triggering factor would be the introduction of a significant wind. The fatal 1977 Honda Canyon Fire occurred during a significant southerly wind. This 2016 event occurred during a south wind that was predicted at a much lower intensity. However, the winds that were reported on September 19 were more in line with the event that transpired in 1977.

The Canyon Fire burning behind the Atlas 5 Rocket Pad on Vandenberg Air Force Base on Monday, Sept. 18, the day before the entrapment incident. Photo courtesy Santa Barbara County Fire Department.

3. Incident Narrative

On September 19 at 0600 the Type 2 Central Sierra Incident Management Team (IMT) took over the Canyon Fire on Vandenberg Air Force Base.

That morning's Canyon Fire operational briefing had the following resources assigned to Division Zulu:

- One 20-person Hand Crew consisting of 3 Helitack Crews (who had been told during the previous operational period of their assignment);
- One local government Strike Team of Type 3 Engines (S/T 1279) with a Strike Team Leader (STLD), 3 additional County Engines (331, 321, 351), a Dozer Strike Team (9360L), 2 additional County Dozers (Dozers 1 and 2);
- One tactical Water Tender (WT 22); and
- One Division Supervisor (DIVS).

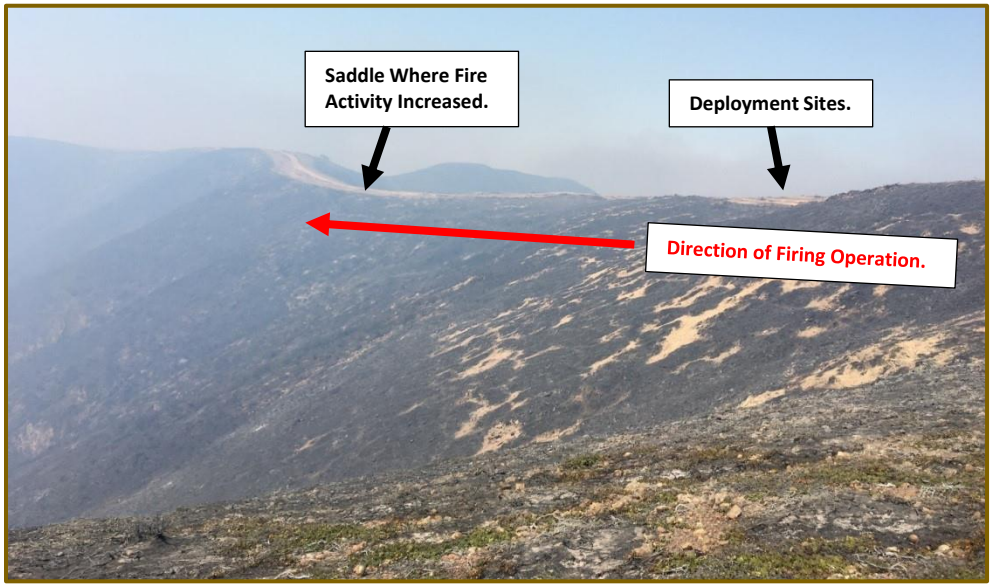
VIDEO

Using photos and videos from personnel who were working in Division Zulu, Missoula Smokejumper Mark Pieper, Visual Information SME, has developed this excellent, informative video:

https://youtu.be/4yY-cFoIYfM

The Initial Work Assignment

From the night Division Group Supervisor the objective was to try and keep the fire from getting North of Avery Road. Division directions from the Incident Action Plan (IAP) were to: "Secure the perimeter on Division Zulu; Suppress active fire within Division Zulu; Mop-up 200-feet in." In addition, special instructions were to: "Be aware of unexploded ordinances. Locate, flag area and stay out."



Looking west from the safety zone at Avery Road running along the top of the ridge.

After the Division Zulu Supervisor took some time to get oriented and discussed the viability of "going direct" it was decided that with the resources on the Division and a "long line of fire as far as the eye could see" there was too much line to be constructed to go direct.

Therefore, the decision was made for the Dozer Strike Team (9360L) to continue line construction down the ridge and that fire would be used to keep the fire "square" as the dozers progressed. The other two dozers were to stay on the ridge and assist in picking up any spot fires. Avery Road is located on a 1,250-foot ridgetop that prominently runs east-west toward the ocean (see photo above).

Change in Priorities

The Division Supervisor contacted Operations and let him know about this new plan. After contact with Operations, neighboring Divisions were notified that Division Zulu would be putting fire on the ground. After the approval from Operations, the Division Supervisor briefed Zulu resources of the plan at the safety zone.

No qualified Firing Boss (FIRB) was identified (as one was not needed because this was not a prescribed fire). However, an individual from the 20-person Helitack Crew was to run the operation and will be identified as the FIRB(t). Knowing that one of the Engine Captains from the Strike Team was a FIRB(t), the Strike Team Leader (STLD) asked that Engine Captain 253 be involved in the firing operation solely as an observer. In addition, a Holding Boss was identified from the Helitack Crew.

Weather Discussion and Briefing

The weather for September 19 in the Incident Action Plan was developed from a 1632 Sunday September 18 forecast:

> *A weak offshore influence has brought a low and strong marine inversion to the region that was currently around 500-feet deep. A very warm and dry air mass will continue above this shallow marine inversion. While there was good humidity recoveries at the lowest elevations of the fire, the forecast was for poor humidity recoveries to continue above the marine inversion.*

This September 19 weather briefing further informed:

- Onshore winds this afternoon and evening will eventually shift to south to southeast. Winds will also be associated with an influx of increasing mid-level subtropical moisture Monday afternoon into Monday night.
- Ridgetop winds will be south to southeast 5-9 mph with gusts to 12 mph, increasing to 8-14 mph with gusts to 20 mph in the afternoon. Transport winds are south to southeast 4-8 mph in the morning, becoming 10-15 mph in the afternoon.
- A very slight chance (around 10 percent probability) of thunderstorms with isolated dry lightning strikes and gusty erratic winds across the fire location late Monday afternoon into Monday night.
- The maximum temperature will be 80-85 above the marine layer. The relative humidity will be 20-30 percent.

Keep All Equipment in Safety Zone

Beyond the weather at the Division Supervisor's briefing, LCES was covered and all resources were told to have all equipment stay in the safety zone unless it was needed to help hold the road. Holders were to only progress with the firing operation: "Holders needed to be behind the burn." No questions or concerns about the operations were raised during this briefing.

Operations

Initially, the intention of the firing operation was to burn a short piece of the line from the safety zone about 1,000 feet to the west along Avery Road to improve the size of the safety zone and widen the line along the ridge and keep the fire to the south of Avery Road. While they were to keep pace with the forward progress of the fire and not let it get out in front of them and cross the primary line, the firefighting resources say "there was no real spot to hang the burn up at."

A small test burn was conducted around 0945. Once it had been determined that the test fire was successful, one lighter began "dot firing" from the safety zone and working west. Discussion with the dozers pushing down the ridge estimated that line construction would be complete in about six hours.

Initially, a FFT1(t) with a qualified FFT1 from the Helitack Crew were assigned as lookouts. They were to be positioned on top of the ridge to the east to look for spots in the green. Another Helitack Crew member was taking weather. And there was also a lookout posted at a high point on top of the ridge to the west.

Dozers 1 and 2 were to widen the ridgetop road and be available to assist picking up any spots if needed. The remaining resources were to assist with the holding operation—minus one engine off of S/T 1279 that was working its way east from the safety zone mopping-up.

As the firing operation progressed west, burning conditions were favorable with smoke staying to the south of the ridge. With these favorable conditions, the firing group wanted to increase the progress of the burn to the west. The Division Supervisor expressed his concern with this plan because the dozers were out in the green constructing line, informing: "No, we're gonna just keep it square."

Helicopter Support

Around 1400, the Division Zulu Supervisor requested helicopter support to do some bucket work to slow fire progression. Fire had begun actively backing. He wanted to prevent this backing fire from becoming established down below and running back up at resources along the ridge.

Two helicopters made multiple drops. Once the fire behavior was moderated, these helicopters left the Division. The firing operation had progressed approximately 0.25 miles with Strike Team and County Engines succeeding along with the burn facing away from the safety zone. About 30 minutes later, the Dozer Strike Team completed line construction to the west—three hours ahead of their initial estimate. In addition, the Holding Boss requested that the lookouts to the east move in front of the firing operation and find a better lookout spot.

Engine Captain 331 talked with the Division Supervisor and the Helitack Crew Boss about the 1977 Honda Canyon Fire. Captain 331 explained that the four entrapment fatalities on this fire had occurred close to where they were currently working.

The Saddle

The firing operation had advanced approximately 0.34 mile and was into the saddle on the ridge and keeping pace with the main fire's progression—adding upward of 200 feet of black below Avery Road by 1400-1415.

Very shortly after, the Engine Captain from E-331, who had gone to validate the work that the Dozer Strike Team had completed, stopped to talk to the Division Supervisor, showing him their progress on the map. At this time, the wind began to change. It was now pushing smoke to the north over the ridge at about 5 mph.

Additionally, Engine Captain 331 talked with the Division Supervisor and the Helitack Crew Boss about the 1977 Honda Canyon Fire. Captain 331 explained that the four entrapment fatalities on this fire had occurred close to where they were currently working. With the wind shift blowing embers over the line, one spot was identified and picked up easily. After about 10-15 minutes, conditions returned to being favorable.

"All Division Zulu resources pull back to the safety zone."

Division Supervisor

Dust Devils

Around 1445-1450, Helitack Crew members noticed two dust devils run across the line from south to north and relayed this to the Holding Boss. The Division Supervisor, who was out in front of the fire, walked out along a ridge that provided the best vantage point down into Honda Canyon. He sees an "orange glow" but he can't tell where it's coming from.

In case they needed to drive out, the Division Supervisor then called Operations and asked to have Avery Road shut down to restrict access coming into the area. He then called the Helitack Crew Boss over to meet him at his truck to "see what I'm seeing." The Division Supervisor then called the Dozer Strike Team to learn their location. He was informed that they were down at Surf Road and Cable Road—"in a good location."

Once the Helitack Crew Boss arrived at the Division Supervisor's truck, they walked back out to the vantage point where the fire had backed 150-200 feet in "maybe in three or four minutes." The Division Supervisor and the Helitack Crew Boss started jogging back to Division Supervisor's truck as he radioed over TAC: "All Division Zulu resources pull back to the safety zone."

The Helitack Crew Boss had the lighters fire off the remainder of the bowl.

Photo taken from the cab of an engine on Avery Road in Division Zulu.

Day Turns to Night

Shortly after the Division Supervisor made the call for resources to head to the safety zone, the sky turned from "day to night" almost immediately.

It took a few minutes for the 20-person Helitack Crew, who had divided down into their three "normal" crews for accountability, to be gathered-up and for the engine personnel to load-up and to maneuver their engines to head toward the safety zone.

"We couldn't see five feet in front of us."

Division Zulu Firefighter

As the fire became established in the bottom of the canyon, the consumption of fuels was audible on the ridge. Once again, the Division Supervisor repeated himself twice—each time "consecutively louder with brevity"—for all resources to get to the safety zone.

Progress Moving to the Safety Zone is Slow

With the necessary moving around of vehicles, progression to the safety zone was slow. Captain 253, whose engine was the farthest engine to the west, began walking east toward the safety zone to make sure the various resources had heard the Division Supervisor's transmission to head to the safety zone.

While the remainder of the resources were already heading toward the safety zone, the following personnel in a vehicle and a dozer, located near where the dozer line turned away from Avery Road, headed down the ridge: the Division Supervisor, one County Dozer, the Helitack Crew Boss, the Firing Boss Trainee, and one other Helitack Crewmember.

The Division Supervisor then made another call for resources to hurry-up and get to the safety zone.

The smoke column began to grow and blow smoke across the ridge and through the saddle, engulfing resources to the point "that we couldn't see five feet in front of us." Firefighters explained how "large charcoal brands the size of fists were pelting the apparatus."

Due to this thick smoke and poor visibility, even after all the engines had turned around, their progress to the safety zone was still slow. They could only move forward when they could see the road through the smoke and ensure that they would not run off of the road or over any personnel on foot.

Two County Engines had made it to the safety zone when a Helitack Crewmember hit the side of the last County Engine (E-331) with his hand and asked to get inside to seek refuge from the smoke.

"Large charcoal brands the size of fists were pelting the apparatus."

Fire Whirl—Vertical Vortices

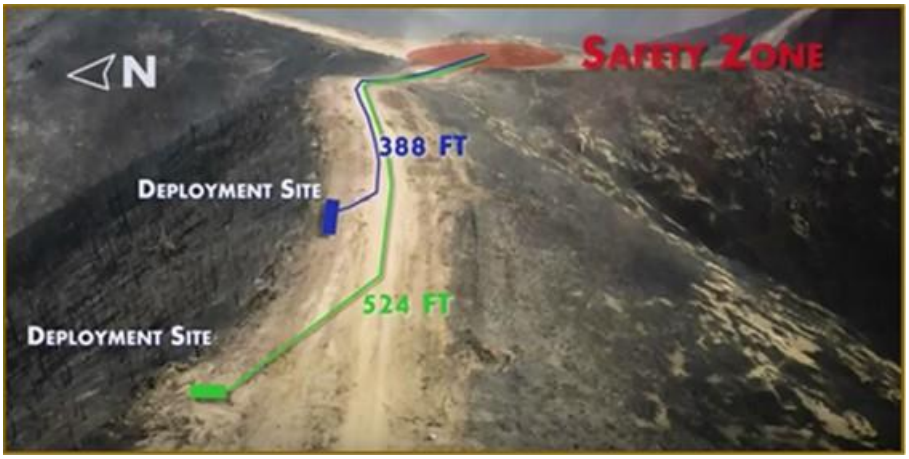
As the Division Supervisor progressed into the saddle in his vehicle he saw a fire whirl "60 to 80 feet wide" start moving. He instructed the Helitack Crew Boss and the Firing Boss Trainee to get inside his truck. As they're fumbling with their gear he tells them: "Hurry up! I don't care how you do it, just don't break the radio and don't break the window."

The Division Supervisor told the third Helitack Crewmember to get into the machine with the County Dozer operator. Next, as the Division Supervisor progressed east toward the safety zone, his truck was hit with a vertical vortices which "felt like it lifted the truck and slammed it down." Realizing that they would not be able to make it to the safety zone, he then backed up and turned around. Both the County Dozer and Division Supervisor continued to drive short distances back and forth along the ridge to avoid ember cast.

Discarded Gear

As the Helitack Crew continued their hike out, they began to hike faster, as one crewmember stated: "The whirls would blow by giving us a chance to breathe and clear our mouth and nose of smoke, dust, and ash." Another crewmember was having an exceptionally difficult time breathing in the smoke. "I felt my body shutting down. I didn't care about anything but trying to breath."

As the smoke became thicker, he could hardly see. He threw off his sunglasses and threw his tool and made the decision to pull out his fire shelter. He had difficulty getting his shelter out so he took off his



pack and knelt down and pulled out the fire shelter. As he finished pulling the plastic tab from around the shelter, another Helitack Crewmember hiking out passed by him and told him that they were close to the safety zone and they needed to go.

The Helitack crewmember left his gear—but kept the fire shelter—and followed the other Helitack Crewmember.

As E-331 progressed toward the safety zone, with the addition of the Helitack Crewmember onboard, they noticed line gear discarded on the north side of Avery Road that did not belong to this Helitack Crewmember who they had picked up.

Shelter Deployment

During Engine Captain 253's progress on foot to the safety zone he noticed that the Helitack Crew's pace picked up and he wasn't able to keep up with them. Within 15-30 seconds of following them, the plume shifted and he could barely see his feet: "I couldn't believe what was happening."

As the wind picked up, his helmet was blown off and away. As his pace increased, he began to take deeper breaths "just swallowing smoke." Every breath and every step became more difficult. Realizing that this was a bad situation and not knowing how far he had to go to the safety zone, he dropped his tool and his gear and grabbed his shelter.

"I knew it was a bad spot to deploy. There was a lot of green to the north and it was on the road," the Engine Captain recalls.

As he pulled out his shelter, he says "it felt like I'd done it a million times." He pulled the tab,

"I knew it was a bad spot to deploy. There was a lot of green to the north and it was on the road."

Engine Captain 253

grabbed the handles, shook it out, stepped inside, and got down onto his knees. While he was pulling the shelter over him, he saw people walking by and yelled for help. Two firefighters then assisted Engine Captain 253 into an engine that was still progressing toward the safety zone.

Arrival at the Safety Zone

Upon arrival at the safety zone, Engine Captain 253 began receiving treatment for smoke inhalation. Engine 253's driver had attempted numerous times to contact Captain 253 over the radio during their egress with no success.

It wasn't until Engine 253 arrived at the safety zone that contact was made with Captain 253 while he was receiving treatment in the back seat of Engine 331.

4. Considerations, Questions, and Discussion Topics – Regarding Personnel Health, Welfare, and Safety

This section provides topics and discussion points that were brought to the attention of the team that pertain to personnel health, welfare, and safety.

A. Fire Behavior, Column, and Smoke

- The fire behavior of the main fire on the opposing slope had low to moderate intensity as it backed toward the drainage with a slow rate of spread (ROS). The firing group easily kept up with it. The burnout backed downslope toward the main fire with smoke pulling toward the main fire.
- Around 1430, a column formed and stood straight up. The column then bent north over the line and started a spot. The column then returned to the south into the drainage toward the main fire. The sky above you is changing color, from grey to black. Now day has turned into night.
- The photo from helibase taken at 1536 shows plume-dominated fire behavior. Resources were entrapped around 1620. Visibility was poor on Division Zulu and resources may have been unaware of the large column near them or what it was doing.
- Just before the sky turned black there were "numerous fire whirls." Engine 331 stated that the entire saddle turned into a huge vortices with baseball sized chunks flying around in it.
- There is no safety zone in front of you. Your safety zone is back through the black sky. The width of the line is approximately six dozer blades wide. There are personnel on foot, one dozer and seven engines turning around and heading back through the black fire whirl to the safety zone.

Discussion Points

Given the benefit of hindsight, we know that the fire behavior on Division Z displayed extreme rates of spread, flame lengths, and consumption. Fire behavior training tells us that fire behavior will generally display indicators that things are changing. What indicators were present that indicated conditions were changing? How does recognition of changing conditions get relayed to resources when you notice them on a fire? How can we articulate concerns we may have when we aren't the ones in charge?

B. LCES (Lookouts, Communication, Escape route[s], and Safety zones)

Lookouts

- There was a lookout taking weather observations from a high spot in the safety zone/staging area. The Holding Boss was in constant communication with the Division Supervisor, holding forces, and the firing group. He was essentially a lookout in the middle of the operation. The firing group had a trainee managing the firing operation. The Division Supervisor was on the west end of the operation in a lookout position looking toward the firing group's progression in front of holding resources. He had communication with holding and firing personnel. There was another lookout there who was assigned to the Dozer Strike Team constructing line from Avery Road down the ridge toward the northwest to Surf Road. (See Appendix B for 9/19 planning map.)

Discussion Points

What challenges exist when lookouts cannot see the objective hazards and the crews doing work? Are there potential communication break downs when utilizing multiple short range lookouts and if so what can we do to minimize or eliminate them?

Communication

- Line of sight communications on the tactical frequency was adequate. There were instances in which personnel in the middle of the saddle and the personnel at the west end (0.56 miles away) could not hear each other. Texts were utilized several times during the operation. Personnel could see each other as they moved from east to west along the ridge.
- Fire personnel were still on the local frequencies. The NIFC Radio Cache of repeaters had not yet arrived.

Discussion Points

What do you do when even short-range communication via radio becomes challenging? What do you do to ensure there are no mix-ups with radio frequencies and communications when fires are transitioning to teams?

Escape Route

- The escape plan for resources on Division Z involved all resources traveling east along Avery Road to the pre-identified safety zone (also the initial briefing and staging area). There was a route down Avery road toward the west but that path took firefighters several miles into the green. Additionally, the Avery Road to the west was unimproved with several sandy areas that had the potential to get vehicles stuck.

Discussion Points

Training tells us that escape routes: should be the shortest distance to the safety zone, free from obstructions; we should avoid uphill escape routes when possible and that escape times should be timed. What other considerations should be taken when you are utilizing an escape route in a vehicle and not on foot? Is escaping in a vehicle always faster than escaping on foot? Why?

Safety Zone(s)

- The identified safety zone was approximately 1½ acres before firing operations began. There was significant black underneath the safety zone to the east, south, and ultimately to the west of the safety zone once firing operations began. The clean black on three sides of the safety zone made it much larger than the 1½ acres.
- The flat dozed-off portion of the safety zone was adequate for staging, although equipment were bunched-up as they strung out following the firing operation. It was a good place unless fire crossed the road to the north—then there would be the potential of smoke/fire all along the north side of Avery Road from the safety zone back to Anguilla Blvd.
- After the entrapment and shelter deployment, fire was established on the north side of Avery Road. The decision was made to leave—not because of the fire, but because the area was heavily impacted by smoke and was miserable.

Discussion Points

We are taught to estimate safety zone size for what we predict to be the worst case scenario. In the case of the Canyon Fire entrapment, worst case involved significant impact of smoke and embers from and wind-driven fire run. How do we train firefighters to take into account the effects of smoke, wind, and embers when determining if a safety zone size will be adequate?

Further Discussion

Discuss the complexities of large incidents with major fire growth during the burn period.

Consider:

Is this situation really as simple as LCES? Put yourself in the firefighters' boots on Division Zulu. There are many links in the chain between the Canyon Fire Incident Commander and you as a firefighter on the ground. One of these links, the Operations Section Chief, was likely overwhelmed by large fire growth on multiple divisions of the fire. Another link, Air Attack, may have been overwhelmed with requests. Finally, the lookout on your division was having a difficult time—due to smoke and terrain—being able to see the larger fire picture.

If you add or remove any link in the chain, the outcome on Division Z may have been different. Discuss the complexities of a large fire while it's "blowing up" (on an Air Force Base, with unexploded ordinances, rocket launch sites, and extreme terrain) at every level, from IC to FFT2. Recognize the tendency we all have to convert past situational complexity into simple, binary decisions.

Is saying LCES was inadequate, therefore they became entrapped, a factual statement? Maybe so, but delving into the nuances of the situation as a whole leads to many alternative considerations. What are some of them?

C. Weather and Incident Meteorologist (IMET)

- The weather for September 19 in the Incident Action Plan (IAP) was developed from a 1632 Sunday September 18 forecast. The weather discussion was: *"A weak offshore influence has brought a low and strong marine inversion to the region (500-feet deep). A very warm and dry air mass will continue above this shallow marine layer. Onshore winds will occur this afternoon and evening, will eventually shift to south/southeast. The maximum temperature will be 80-85 above the marine layer. The Rh will be 20-30%. Ridgetop winds will be south to southeast 5-9 mph with gusts to 12 mph, increasing to 8-14 mph with gusts to 20 mph in the afternoon. Transport winds are south to southeast 4-8 mph in the morning, becoming 10-15 mph in the afternoon."*
- The fire was on the south side of Avery Road. The wind was south 2-4 mph and downslope. There was a lookout taking weather observations each hour. The assignment was to square-up the fire, firing east to west.
- An Incident Meteorologist (IMET) arrived at the Incident Command Post the morning of September 19 and was directed to prepare weather information for the night operational period. The IMT took command of the fire that morning.

Discussion Points

There were several firefighters on the Canyon Fire who had "local knowledge" of the shifty and unpredictable winds in the area. What ideas do you have for making sure that local knowledge gets passed on to firefighters on the ground making decisions?

D. Trainees

- Resources on Division Zulu assigned a Firing Boss Trainee [FIRB(t)] to the firing operation. They also had an Engine Captain (Captain 253) assigned to watch and learn from the firing operation. There was a Helitack Crewmember who had a FFT1(t) task book assigned as a weather observer, and a lookout stationed on the hill above the safety zone.

Experience vs. Qualified VERSUS Skills vs. Ability

Just because you can, doesn't always mean you should

We are firefighters. We are doers. We make things happen. It's why we became firefighters. We are a "Can Do" group of people.

So when someone asks us to do something, our first reaction is: *"When? Where? How far? Let's go!"* Are we qualified? Do we have that on our Red Card? Am I a trainee? These are all common questions that run through our minds.

But what happens when we are "qualified" to do a particular task—but, perhaps, haven't performed that task very many times? Or, maybe you have, but it's been a long time or in a different fuel type?

Self-Reflection and Honesty

Fire people don't like to turn down assignments they are otherwise qualified to take. It takes some serious self-reflection and honesty to let that Division Supervisor know that maybe the assignment isn't the best fit for you and your crew.

It sometimes takes checking your ego to admit that maybe you might be biting-off more than you can chew. But the good news is there are ways to mitigate and really make it a win-win situation.

For instance, maybe you can shadow for a couple of shifts before taking over the Division? How about watching that "C" Faller take out that monster snag? Or maybe ask if a couple of your folks can work with the firing crew to get an idea of how the fuels are burning?

Just because you can, doesn't always mean you should. Really being honest about the skills you and your crew bring to the fire takes confidence and professionalism.

E. Medical Response and Extraction

- Engine 331 picked up a firefighter when he used his hand to smack the side window behind the driver. A few minutes later, a second firefighter was seen standing up with a fire shelter on his back. "If he hadn't been standing up, we would have driven right past him," said Engine 331 personnel.
- Both of these firefighters were driven out to the safety zone. Engine personnel called and requested an ambulance for smoke inhalation to transport personnel to the hospital. But due to the fire behavior, the ambulance could not get to the rendezvous point. Instead, personnel were

transported in an engine to the Vandenberg Training Center where they were transferred to an ambulance. An EMT-P rode in the ambulance with the affected personnel to the hospital.

F. Personnel Accountability

- From the first time the Division Supervisor directed resources to head to the safety zone until the sky turned black and the main fire whirl overtook resources was approximately 4-8 minutes. He directed them two additional times within that timeframe to leave. Seven engines, one dozer, all of the ground personnel, and two pickup trucks all had to hear this order, recognize the situation, and travel back to the safety zone.
- The Division Supervisor plus two proceeded west in the Division Supervisor's truck, along with one firefighter who rode in the dozer. Two firefighters on foot were picked up by an engine while the rest of the ground resources hiked to the safety zone.
- Engine 253 personnel were looking for their Captain who they eventually found at the safety zone. The mix of Helitack Crews moved out individually. Everyone was accounted for when they got to the safety zone, with the exception of the three crewmembers who escaped to the west. There was no communication back to Division personnel.

G. Resources, Equipment, and the Assignment

- The following resources were assigned to Division Zulu at the 0600 morning operational briefing: One 20-person Hand Crew consisting of three different Helitack Modules; Strike Team 1279 (5 engines); County Engines 321, 331, 351; Dozer Strike Team 9360L; County Dozers 1 and 2; Tactical Water Tender WT-22; 1 Strike Team Leader; and the Division Supervisor.
- The work assignment was to: "Secure the perimeter on Div. Z; Suppress active fire within Div. Z; Mop-up 200 feet in." The special instructions were to: "Be aware of unexploded ordinance. Locate, flag area and stay out." There was a Helicopter Coordinator (HELCO) and two Type 2 Helicopters assigned for support. A safety/tactical briefing was conducted at the safety zone/staging area prior to the firing operation. The objective was to square-up fire going from east to west and hold the line.
- Most of the day (Sept. 19), fire behavior was characterized with a low rate of spread—until, very rapidly, the fire started to outpace the firing operation and holding.
- A decision was made to fire ahead of the fire so it would not come to the line and out-flank them.

H. Incident Management Team Notification

- This was the first operational period for the Type 2 Incident Management Team (IMT) and the incident was still on the local radio system. The IMT was notified that resources had to move back to a safety zone. They were also notified that two personnel needed an ambulance for smoke inhalation. Their Incident Within and Incident (IWI) process was initiated for this medical incident. However, it was several hours later (3+) before the Incident Commander (IC) and Deputy IC were notified that there was a shelter deployment. The IMT did start Regional notification regarding the shelter deployment.

Further Discussion

A. Escape

The escape was described by one of the Helitack crewmembers as "running on the razor's edge." When asked: *"How scared were you on a scale of 1 to 10?"* multiple crew members replied "9" and "10." Their escape was approximately 600 to 700 yards.

Screen grab from a firefighter's video of a Helitack Module Crewmember running during the Division Zulu personnel's escape to safety.

Discussion Points

- What's the difference between being scared and getting burned up? Luck. You are scared for very good reasons.
- Dropping gear and tools speed escape. Review and discuss the article on page 6 of The Wildland Firefighter Health and Safety Report: http://www.fs.fed.us/t-d/pubs/pdfpubs/pdf00512855/pdf00512855dpi72.pdf
- Dropping gear and tools is also discussed on page 4 of The New Generation Fire Shelter training booklet: http://www.nwcg.gov/sites/default/files/products/newshelt72.pdf
- Dropping a pack can be a difficult decision. Judging from not only this entrapment, but others in the past, it is rarely done.
    - If you are anywhere close to a "9" or "10" on your "scared scale," drop your pack, grab your shelter, and run. Contents of a pack are just "stuff." Everything can be replaced. Your successful escape is paramount.
- The helitack personnel ran through heavy smoke and were mostly "9's" and "10" out of "10" on the "panic meter." There were seven large engines near them that also drove through heavy smoke. Take a step back and think about running versus riding in a vehicle in a situation like this. Do vehicles give firefighters a false sense of security? Take another step back and think about what could have happened driving a huge truck on a knife ridge with almost no visibility. Add to this the people on foot—near you—who are trying to escape, and you may realize this situation could have been much worse. Discuss the moment when it seems like you have no choice but to run or drive fast. Try to feel what it's like to be in a panic and recognize how hard it is to make sound decisions. An overriding theme in shelter deployments is how fast they can happen. How can you prepare yourself for this moment?

B. Safety Zone

Before the burnout along the ridge, the area was dozed and the south and west (fire) sides of the safety zone was burned. Even though the dozed area was relatively small, including the burnout, the total size was very large—many acres.

After escaping to the designated safety zone, some firefighters discussed the possibility of needing to deploy fire shelters. Fire started coming back toward the safety zone from the north (green) side, while smoke, heat, and embers were still coming into the safety zone from the west.

Discussion Points

- Even with safety zone guidelines (old or new), the true effectiveness of a designated safety zone is not known until the fire proves it.

- If you believe fire shelters may be needed—keep your options open and be ready.

C. Trigger Points

Trigger points on Division Z were set and used. They were, however, set incorrectly. Resources on the Division were entrapped. Is this statement hindsight biased? Yes, it is. But, to expect firefighters to set trigger points perfectly every time is foolish. Just like safety zones, the true effectiveness of trigger points is unknown until the fire proves it.

Discussion Points

- Do trigger points give firefighters a false sense of security? How do you know if your trigger points are correct?
- Can we set trigger points so that disengagement happens closer to the "first hint" instead of the "last fact"?
- Does it take more "guts" to stop the action, or to continue what you're doing even though you have concerns?
- How much weight do you give "the worst case scenario" in your risk assessment?

D. "Keeping Calm" versus "Keeping It Real"

When the Division Supervisor picked up Helitack Module Crewmembers in his truck, he stated: *"If this line of engines doesn't get moving, we're going to get burned over."* Meanwhile, with hot embers blowing over one of the engines, that driver states: "We're OK."

Discussion Points

- Does trying to keep people calm give a false sense of security?
- Does trying to share reality expedite panic?

E. Smoke Column

The smoke column can tell you a lot about what your fire is doing and what it will likely do.

Discussion Points

- Are you in contact with anyone who has the "big picture" of your column?
- Can you see what your column is doing if you are under it?
    - If you are under the column, is it time to disengage?

5. Key Observations and Actions

A. Observation: Escape Routes and Escape Times for Vehicles/Engine Modules

There is an emphasis with hand crews to timing an escape route and making sure that escape times are known. If escape times become too long or the fire behavior conditions change, then: something has to be adjusted; identify new and closer safety zones; initiate a less aggressive level of engagement; or watch the fire until escape times will ensure a positive safety margin.

But, do we take the same approach when we are driving in a vehicle? Is it a common practice for an engine holding behind a firing operation to time their escape route? Is the time it takes to turn a Strike Team of engines around factored into escape time?

Know the escape time is necessary when developing valid trigger points. If your known escape time is long, then trigger points are adjusted and the decision to disengage will be made much sooner.

ACTION

Review the "Entrapment Avoidance, It's Your Call" (Wildland Fire Safety Office, U.S. Forest Service, March 2002) training package with your module. Discuss: the concepts of levels of engagement, positive safety margin, escape time, valid escape routes and valid safety zones.

How do these concepts apply to your specific piece of equipment or module? How can you incorporate them into your daily firefighting and decision making?

B. Observation: Entrapment Avoidance Concepts

By all accounts, the decision to fire the dozer line was not made hastily. Alternatives were considered, line was scouted, and a plan was developed. Adequate holding resources were available.

The firing operation was started from a safety zone, was anchored to black, and was working down the ridge (from high to low). In addition, wind conditions at the time were favorable.

The firefighters in Division Zulu were positioned on the flank of the fire. When the wind shifted, the firefighters on this day had very little time to seek refuge in a safety zone.

In the article "The Dead-Man Zone: A Neglected Area of Firefighter Safety" (by Phil Cheney, Jim Gould, and Lachie McCaw), the authors write:

"Firefighters engaged in parallel or indirect attack are working in a 'dead-man zone' if they do not appreciate the time and space required to find a safe refuge. In this zone, if the wind direction changes, the fire can advance so rapidly that the firefighters have very little time to seek refuge in the burnt area behind a suppressed portion of line, or egress elsewhere, before the fire overwhelms them."

ACTION

Read the "The Dead-Man Zone" article referenced above and watch the short video of the same name: https://www.youtube.com/watch?v=uMGuiv2SYeg. Are there similarities between the incident described in this report and the concepts described in the video? What mitigations can be made if you find yourself working in a similar situation? How will you apply the entrapment avoidance concepts in a similar situation?

6. Closing Thoughts

Never Forget – Always Remember

Whenever we have a tragic loss of life or a serious event in the fire service, we often hear “Never Forget” or “Always Remember.”

But how many times have you fought fire on a piece of dirt where something tragic happened and yet you never knew about it?

Once you have your resource order in hand, do you pull up the weather or take a look at the pocket card for where you’re going?

When you get to your assignment do you talk to the locals to get a feel for local weather factors or learn if there are any tragedy fires that have occurred in the area?

By always being a student of fire history and remaining curious, we can do our part to “never forget and always remember” and ensure that we honor those who have lost their lives.

The four men who perished on the December 1977 Honda Canyon Fire (from left): Colonel Joseph Turner, Fire Chief Billy Bell, Assistant Chief Gene Cooper, and Dozer Operator Clarence McCauley.

In December 1977 on the Honda Canyon Fire, four people were fatality overrun by fire. This tragedy occurred on the same ridge just 1.4 miles west of the Division Zulu safety zone on the Canyon Fire. Three men perished when the Fire Commander’s vehicle was overrun by fire: Colonel Joseph Turner, Fire Chief Billy Bell, and Assistant Chief Gene Cooper. Two weeks after being burned over and hospitalized, Dozer Operator Clarence McCauley died of his burn injuries.

7. Canyon Fire Shelter Deployment and Entrapment Incident Review Team Members

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8. Appendices

Appendix A – Equipment Report

Entrapment/Shelter Deployment Site

- **Latitude x Longitude**: 34°36'42.81"N x 120°35'55.66"W
- **Elevation**: 1,025 feet.
- **Description**: The deployment sites were directly adjacent to Avery Road, 388 and 524 feet from the safety zone. The dozer widened the road to use it as control line. The majority of the south side of the road was black from the earlier burning operation. The north side of the road was considered green with 2 to 10-foot tall brush and small trees. Because the fire spread direction was to the north, the site received mostly radiant heat. Locations of all equipment was marked by flagging.

Engine Captain 253

- **Fire Shelter**: Manufacture Date – February 2014.
    - After the shelter was left at the deployment site, it was reported that the shelter was being tossed around by the wind. Dozer 2 was able to hold the shelter in place with its blade.
    - Structural Condition: A few spots of extreme heat are present. The spots were likely caused by hot embers.
- **PVC Bag**: The bag was found at the shelter deployment site, it was mostly melted.
- **Fireline Pack**: Padding cover melted.

Escape – When directed to go back to the safety zone, Captain 253 wanted to ensure that all engines got the word. He stopped at every engine he came to and told them to turn around and get back to the safety zone. Smoke and embers hit him hard. He attempted to keep pace with the Helitack Crew. It felt like the whole smoke plume came down on him. The smoke was so thick, he couldn't see his feet. The wind blew his helmet off. Keeping up with the Helitack Crew was unsuccessful.

Decision to Deploy – It was hot and very smoky. He couldn't see. He couldn't breathe. His legs quit moving. He felt he had to use his last option: His fire shelter.

Deploying Shelter – He dropped his pack and removed his fire shelter. He knew exactly what to do, he'd done it many times in training. He shook it out. It felt stiff compared to the practice shelter.

He selected the dozed area between two areas where he didn't want to be—the green and the road. He turned his back to the wind, put his feet into the shelter and began to lie down.

As he was crawling into his shelter, he saw boots and yelled for help. Two Helitack Crewmembers picked him up. As an engine drove by, they pounded on the door, opened it, and pushed him into the cab.

Helitack Crewmember

- **Fire Shelter**: The fire shelter was carried by the firefighter to the safety zone. It was mostly accordion folded.

- **PVC Bag**: The bag was found at the pack drop site, it was mostly melted.
- **Fireline Pack**: Numerous melt spots were present on the pack, most likely caused by hot ember contact during the entrapment.

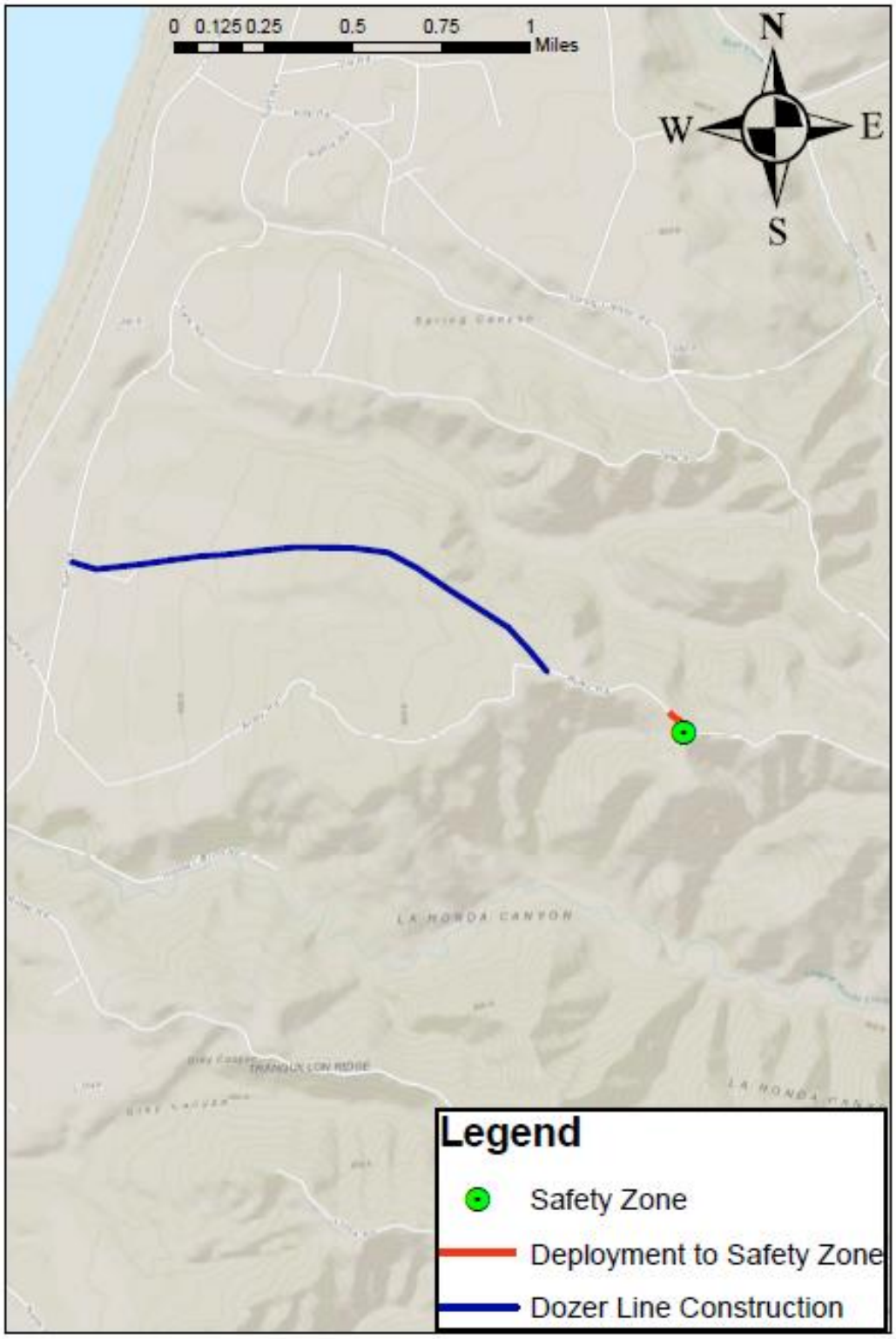
Escape – The Helitack Crewmember began to move quickly as soon as they were told to get back to the safety zone. At first, the blowing smoke and embers would come and go. It was possible to get a good solid breath of fresh air every so often. Soon the pockets of good air stopped returning. He felt he couldn't see, so he tossed his sunglasses.

Decision to Deploy – More heat, smoke and embers came. All he could see was black and orange. He felt he was suffocating and couldn't continue to the safety zone. He tossed his tool, dropped his pack and grabbed his shelter. He didn't care about his water bottles or radio.

He selected the dozed area between the green and the road to deploy his shelter. He tore open the shelter's PVC bag and grabbed the shelter, ready to deploy. Right then he saw another Helitack Crewmember hike by. With encouragement, the Helitack Crewmember once again began to run, this time with only his shelter. They then came upon Engine Captain 253 deploying his shelter and stopped to assist him with getting into an engine.

Appendix B

Map of Safety Zone, Dozer Line Construction, and Deployment Sites



Appendix C

Canyon Fire Weather Summary

Monday, September 19, 2016

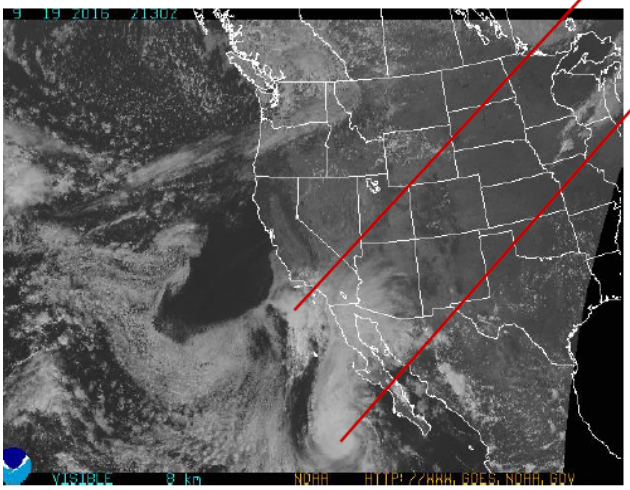
Prepared by Predictive Services, Riverside, California

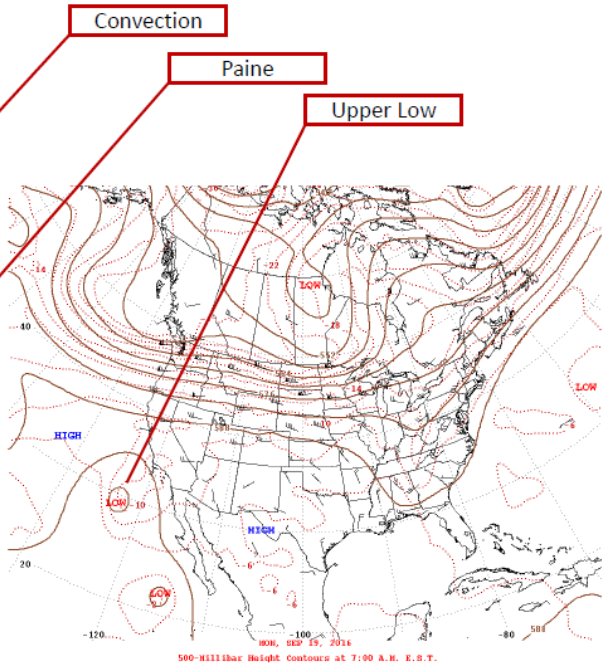
Leadership in decision
support Services

Key Features:

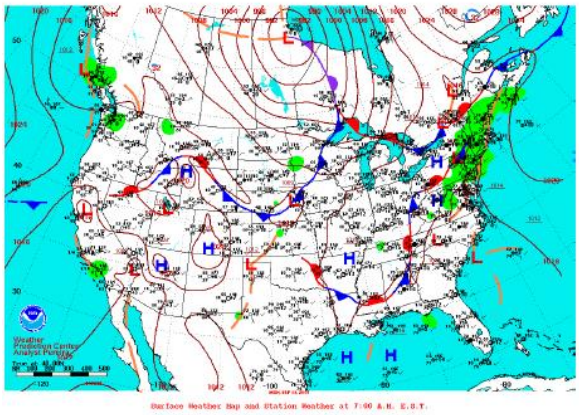
Monday, September 19, 2016

- Weak upper low to the southwest of Point Conception.
- Hurricane Paine off the southern Baja Coast.
- Convection across the Southern California coastal waters.
- Shallow marine layer along the central coast.
- Areas of mid and high level clouds.
- Atmosphere is mostly unstable.

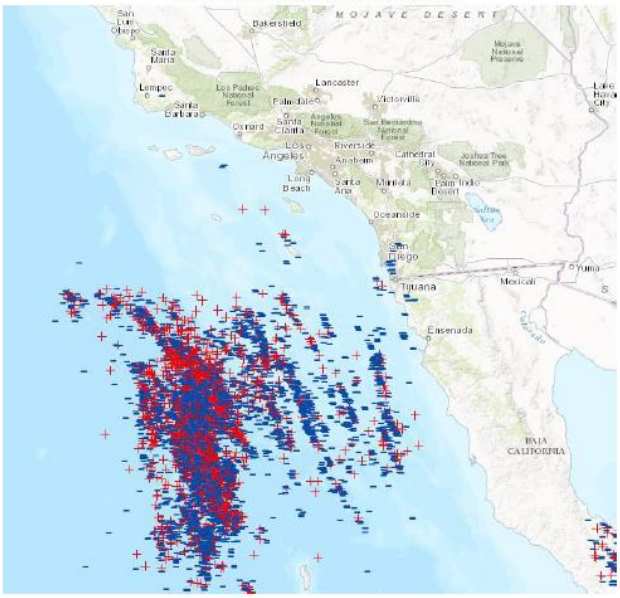




Surface map below showing weak pressure gradients in the morning indicating weak offshore or neutral flow at ground level.



Map below showing lightning strikes for Monday, September 19th. Note: there is one strike recorded east of Lompoc. Not sure what time that occurred.



Altocumulus clouds indicating elevated instability

Smoke column exhibiting plume dominated characteristics. This would support the idea of an unstable atmosphere.

Smoke near the ground appears to indicate gusty surface winds.

Observations from on and around the Canyon Fire show erratic winds beginning late morning and continuing into the afternoon.

Vandenburg Portable					
Date/Time	Temp	RH	WS	WD	WG
09/18/2016 22:34 PDT	86	16	4	SE	10
09/18/2016 23:34 PDT	86	15	6	SE	9
09/19/2016 00:34 PDT	68	52	3	S	8
09/19/2016 01:34 PDT	63	74	5	E	6
09/19/2016 02:34 PDT	68	47	2	NW	8
09/19/2016 03:34 PDT	64	65	3	E	7
09/19/2016 04:34 PDT	64	65	1	SE	4
09/19/2016 05:34 PDT	61	71	8	SW	10
09/19/2016 06:34 PDT	56	99	2	E	12
09/19/2016 07:34 PDT	56	97	3	NE	7
09/19/2016 08:34 PDT	59	95	1	W	4
09/19/2016 09:34 PDT	59	95	3	W	5
09/19/2016 10:34 PDT	64	86	2	NE	5
09/19/2016 11:34 PDT	67	74	13	SW	18
09/19/2016 12:34 PDT	70	70	9	SW	17
09/19/2016 13:34 PDT	74	51	7	W	9
09/19/2016 14:34 PDT	67	72	13	SW	19
09/19/2016 15:34 PDT	67	70	6	NE	24

Lompoc Airport				
Date/Time	Temp	RH	WS	WD
09/18/2016 22:35 PDT	61	68	3	NE
09/18/2016 23:35 PDT	61	59	6	E
09/19/2016 00:35 PDT	63	55	5	E
09/19/2016 01:35 PDT	59	72	0	Calm
09/19/2016 02:35 PDT	57	72	3	E
09/19/2016 03:40 PDT	55	72	0	Calm
09/19/2016 04:35 PDT	54	71	0	Calm
09/19/2016 05:35 PDT	52	71	3	W
09/19/2016 06:35 PDT	52	76	3	E
09/19/2016 07:35 PDT	55	72	3	E
09/19/2016 08:35 PDT	61	77	0	Calm
09/19/2016 09:35 PDT	66	64	5	W
09/19/2016 10:40 PDT	73	57	6	SW
09/19/2016 11:35 PDT	75	57	17	W
09/19/2016 12:35 PDT	73	65	9	SW
09/19/2016 13:35 PDT	79	54	9	SW
09/19/2016 14:35 PDT	72	69	14	W
09/19/2016 15:35 PDT	72	65	6	SW

On Site					
Date/Time	Temp	RH	WS	WD	WG
9/19/2016 10:00 PDT	78	35	4	N	
9/19/2016 11:00 PDT	84	35	5	SW	
9/19/2016 12:00 PDT	80	45	6	SW	
9/19/2016 13:00 PDT	80	45	8	NW	
9/19/2016 14:00 PDT	79	38	8	SW	
9/19/2016 15:00 PDT	77	34	11	N	15

Conclusion

Given all the data present, the fire is most likely being driven by the instability in the mid levels of the atmosphere (15-20K). The large area of convection off the coast most likely altered the normal wind pattern near Point Conception. It is unclear whether or not there was any convection in the vicinity of the fire, but the atmosphere appears to be mostly unstable. This instability may account for the erratic nature of the winds observed at all three sites which are either on or near the fire. The main contributors to the fire behavior would be the unstable atmosphere, gusty surface winds, and the extremely dry fuels present.

PREDICTIVE SERVICES

Satellite, upper air, and surface maps provided by NOAA – National Weather Service.
Lightning strike data provided by BLM.
Surface observations provide by MesoWest.