

Yarnell Hill Fire Entrapment Incident Report

Incident Summary

This lightning strike fire started on Friday, June 28th, 2013 on state land to the west of Yarnell, Arizona. The fire was burning on a ridge in a sparsely populated area roughly 135 kilometres to the northwest of Phoenix. The initial Type 4 Incident Commander reported that 80 percent of the fire was out and a single rocky section was the only area producing smoke. By the 07:00 briefing on Sunday, June 30th, the fire had increased to 500 acres (205 ha) in size and a Type 2 Incident Management Team was taking command due to encroachment on the nearby town including a number of ranches.

The Granite Mountain Interagency Hotshots Crew (IHC) was the first 20 person Type 1 firefighting crew to arrive on site from Prescott, Arizona. The Granite Mountain Crew Superintendent was assigned as the Division Alpha Supervisor while the Assistant Superintendent ran crew operations. The IHC's objective was to establish an **Anchor Point** along an old 2-track (vehicle access) road and determine whether direct or indirect attack would be the best suppression method. The Division Supervisor recced ahead and decided to use a cold spot in the 'Black' on the east side of the ridge as a **Safety Zone**. The Boulder Springs Ranch, which was roughly 2.6 kilometres to the southeast, also got described as an "excellent safety zone."

At 12:00, the Division Supervisor meets with the Blue Ridge IHC Superintendent to discuss fire suppression strategies and tactics as well as the poor radio **Communications** on site. A Granite Mountain **Lookout** was established at the base of the road near an old grader 1.8 kilometres from the crew trucks to monitor the flank of the fire that the remaining crew members were working along. Trigger points for the crew and the Lookout to evacuate were established. The crew continued to directly work the fire's edge toward the north, but do not want to overextend with the control line. The crew takes lunch at 13:30 in a safe area near a rock bluff before continuing suppression activities. The line they were establishing was then then reinforced back to the original Safety Zone.

A weather forecast was received across the fire from the National Weather Service at 14:02 regarding a wind shift with speeds of up to 80 km/h due to local thunderstorms. This was updated again at 14:26 with even high wind speeds expected. The Operations Section checks that Division Alpha has copied the transmissions and he confirms the weather update. At 15:50, the Lookout was picked up by the Blue Ridge Superintendent who was in the area after a trigger point was reached and he was taken to a safe location after. Fire activity continues to escalate with the 15:30 wind shift and the fire is expected to reach Yarnell within 2 hours. The Granite Mountain IHC members moved into 'Clean Black' at this point and they monitored the fire's progression.

The Operations Section Chief believes this 20 person crew is in the black and safe from any entrapment hazards. At approximately 16:00, the Granite Mountain Superintendent has a radio conversation with the Blue Mountain Superintendent regarding a plan to use an **Escape Route** and move back to the crew's best **Safety Zone**. The Blue Ridge supervisor ensures to clarify what actions would be taken, and the Aerial Supervision Module (ASM 2) circling the fire also ensured that the Granite Mountain IHC is safe. There was little concern over the decision at this point because the Granite Mountain Hotshots were thought to be in the black and were heading to a ranch to the northeast.

The crew decided to travel southeast along the ridge they had been working on early in the day. The hotshots would have had a good view of the fire at this point, but they soon had this view obstructed after hiking down into a saddle toward the Safety Zone. The Safety Zone may have seemed quite close when observing the ranch from the ridge. However, there were boulders, brush, small trees and steep slopes hindering a rapid retreat through this box canyon.

There were no Communications with the crew between 16:04 and 16:37. This was likely due to the increase in radio transmissions throughout the incident when the fire started moving rapid toward Yarnell. At 16:37, Division Alpha explains to the Aerial Supervisor that the crew needs a retardant drop directly on their position. A Granite Mountain firefighter then exclaims that the crew is in the direct path of the approaching flame front on the Arizona 16 radio channel, which is an emergency aircraft frequency.

The Yarnell Hill Fire burnt over the Granite Mountain Escape Route roughly 2 minute after Division Alpha's final communication at 16:42. Every crew member had to work as fast as possible at this point to clear a survival zone in order to adequately deploy fire shelters. Sawyers removed the brush while other crew members started to burn out the remaining fuels in the area. The vegetation in the area had very low fuel moistures and the topography was conducive for a fast moving wildfire.

At this point, ASM 2 tries to contact Division Alpha on the radio 7 times over a 4 minute period. A medium helicopter started searching for the crew after overhearing these transmissions. No contact was made. The Blue Ridge IHC started searching from Granite Mountain shortly after.

The Granite Mountain IHC who deployed their fire shelters in the box canyon were overrun by the flame front as it progressed uphill at almost 20 km/h. These shelters effectively prevent radiant heat burns while protecting a firefighter's airway, but a fire shelter is not designed to deflect direct flame contact and this occurred during the incident. The fire reached temperatures of more than 1000° C due to the extreme fuel loads in the canyon. All 19 Granite Mountain Hotshot firefighters lost their lives.

Weather Conditions - at Peak Burning

Forecasted

Temperature: **38 to 40 ° C**

Relative Humidity: **12 to 15 %**

Wind Speed and Direction: **15 to 17 km/h (gust to 40 km/h) and Southwest**

Actual - Thunderstorm Activity with Minimal Precipitation

Temperature: **38 to 42 ° C** - the geographic area was in a drought.

Relative Humidity: **15 to 20 %**

Wind Speed and Direction: **25 to 35 km/h (gust to 83 km/h at deployment site) and South Southwest to West North West**

Fire Behaviour Analysis - US Equivalents

Fuel Moistures

Dead Fuels

Shaded Fuels: 6 % moisture content

Non-Shaded Fuels: 3 % moisture content

Drought Severity Index

- 4.0 - Extreme Drought
(based on water deficit)

Haines Index: **5 - Moderate** (Scale of 1 Very Low to 6 High)

This is a lower atmosphere stability index that measures air stability and dryness.

Fuel Type

The desert vegetation consisted of fine, flashy chaparral brush including scattered juniper, turbinella oak and manzinta (evergreen shrub). It was noted that wildfires in this environment need wind in order to spread rapidly, but the lack of precipitation over the past 3 months caused irregular conditions. These fuels were mature and the fuel load was heavy since there had not been a fuel reduction fire in recent years. Chaparral fuel heights ranged between 3 and 8 feet and up the 12 feet in drainages where the soils are nutrient rich.

Topography

The fire terrain consisted of flat ground, rolling hills and steep slopes. There were numerous canyons and drainages coming off the main ridge running north to south on the west side of the Yarnell Hill Fire. The entire area is very rocky.

Rate of Spread and Fire Type

The fire was wind driven, which is common in this light fuel type. The fire was spreading to the north at approximately 2 km/h until the major wind event occurred. At this point, the fire flank split into 2 southern heads reaching spread rates of 20 km/h through the heavy fuels in the bowls and canyons. The flame lengths reached 20 feet in the chaparral to the north and over 150 feet at the ridge top to the south after the wind change.

Safety Procedures in Place - US Acronym and Standards

Lookouts - in place until the fire hit this firefighter's trigger point. The crew was able to observe the fire activity while using the escape route until they reached the saddle down to the safety zone. There was not a specific aircraft assigned as a lookout for the crew.

Communications - the 2 IHC Superintendents discussed the poor radio communications early in the day. This was passed up the chain of command. The crews worked around this problem throughout the day. The lack of communication with the Operations Section Chief and the Aerial Supervisor limited the fire crew's ability to safely operate. Air tanker drops were delayed due to a lack of quality radio transmissions.

Escape Routes - there were designated escape routes along the fire perimeter for the personnel establishing a control line while the lookout was able to use an access road to reach the trucks and a safety zone. The control line had been tested and the crew could safely retreat to the cold black. The escape route to the ranch safety zone had not been recced prior to the intended retreat.

Safety Zones - there were 2 in place while completing fire suppression task. The safety zone in the 'Black' adjacent to the crew was easy to access while completing direct attack tasks. The Boulder Spring Ranch safety zone was over 2 kilometres away and difficult to reach in an emergency situation.

The US wildland firefighters do not include Anchor Points in the LCES acronym. An anchor point is synonymous with a safety zone in this safety system based on the continuous burn out practices of the IHC firefighters. They ignite unburnt fuel while constructing a control line, which secures the line while providing a safe area for the crew to retreat to as the fuels have already been removed.

10 Standard Firefighting Orders

- 1) Keep informed on fire weather conditions and forecasts.
- 2) Know what your fire is doing at all times.
- 3) Base all actions on current and expected behavior of the fire.
- 4) Identify escape routes and safety zones and make them known.
- 5) Post lookouts when there is possible danger.
- 6) **Be alert. Keep calm. Think clearly. Act decisively.**
- 7) Maintain prompt communications with your forces, your supervisor and adjoining forces.
- 8) Give clear instructions and insure they are understood.
- 9) Maintain control of your forces at all times.
- 10) Fight fire aggressively, having provided for safety first.

18 Wildfire Watch-Out Situations

- 1) Fire not scouted and sized up.
- 2) In country not seen in daylight.
- 3) Safety zones and escape routes not identified.
- 4) Unfamiliar with weather and local factors influencing fire behavior.
- 5) Uninformed on strategy, tactics and hazards.
- 6) Instructions and assignments not clear.
- 7) No communication link with crewmembers/supervisors.
- 8) Constructing line without safe anchor point.
- 9) Building fireline downhill with fire below.
- 10) Attempting frontal assault on fire.
- 11) Unburned fuel between you and the fire.
- 12) Cannot see main fire, not in contact with anyone who can.
- 13) On a hillside where rolling material can ignite fuel below.
- 14) Weather is getting hotter and drier.
- 15) Wind increases and/or changes direction.
- 16) Getting frequent spot fires across line.
- 17) Terrain and fuels make escape to safety zones difficult.
- 18) Taking a nap near the fire line.