United States Department of Agriculture
Forest Service

Little Fire Shelter Use
San Bernardino National Forest
Facilitated Learning Analysis

Picture taken by E-1 firefighter on Little Thomas Mountain Road. Smoke column is pushing to the N/NE.

USDA Forest Service
San Bernardino National Forest
San Jacinto Ranger District
Idyllwild, California

FLA Team Members

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What is a Facilitated Learning Analysis (FLA)?

The purpose of the FLA is to facilitate the dialogue of individuals and crews who shared an experience that may have contributed to unintended outcomes. The FLA Team's role is to capture the stories and perspectives of those involved, and convey this information in a narrative document that compels the reader to think about how these experiences may provide learning lessons in his or her life. Additionally, the FLA can serve as tool (a case study, if you will, or analysis) in a crew-teaching environment. Leadership growth begins when lessons are learned from these experiences.

Executive Summary

The San Bernardino National Forest experienced a number of large fires throughout the summer of 2013. On August 24, at 1514 hours, Forest Service Engine 1 (E-1), from an area Ranger District, responds to an initial smoke check in the Little Thomas Mountain area. A number of resources mobilize to assist. Patrol Technician 1 (PT-1) is first on scene as Type 3 Incident Commander. When the Battalion Chief (BC) arrives, he assumes command and assigns Captain E-1 as Division A (Div-A).

The 2 p.m. weather forecast for the area shows partly cloudy with a slight chance of showers and thunderstorms in the evening. Minimum temperatures are predicted to be 60-67 degrees with maximum humidity of 35-45 percent. Winds on both slopes and ridge tops are predicted south at 15 mph with gusts along slopes up to 30 mph. The Lighting Activity Level is 3. With humidity and winds dropping slightly the next day, and maximum temperatures at around 85-90 degrees, initial attack operations could anticipate reasonable success.

Div-A and crew of E-1 begin prepping in staging, as the general size-up was favorable, and they are preparing for a good evening's work on the 1- to 2-acre fire. In under 2 hours, Div-A and crew will learn the value of adaptability and resilience in the face of breathtaking challenges.

The Dispatch Response

The table delineates incident events derived from the dispatch record. The chronology of events begins with the dispatch call and ends when engine E-2 arrives. The chronology continues with the story narrative where events and circumstances are further explored.

Time	Dispatch Record
1509	Tahquitz Peak Lookout reports a possible smoke near Thomas Mountain.
1514	One (1) patrol, two (2) engines and one (1) water tender respond to the smoke check.
1515	Tahquitz Peak Lookout reports a thin white smoke.
1519	BC starts to request additional resources. E-1 reports that they may have visual on fire driving up to Little Thomas Mountain Road.
1521	E-2 reports that the fire is building and requests a first alarm.
1527	PT-1 arrives on scene and reports ¼- to ½-acre with rapid rate of spread. The potential for growth to be 100 acres.
1528	PT-1 reports fire is now 2 acres making a run toward Little Thomas Mtn. Rd. The best access is Little Thomas Mtn. Rd.
1529	PT-1 assumes position of Little Fire Incident Commander (IC).
1532	Little Fire IC requests additional resources in addition to the 1st alarm assignment.
1537	IC reports to have resources hold because fire is going to bump Little Thomas Mtn. Rd.
1539	E-1 arrives on scene. Captain E-1 is assigned as Div-A.
1554	Little Fire IC reports fire is 15 acres and requests additional aircraft. Transfer of command occurs, BC assumes IC position and PT-1 is assigned to Operations.
1557	E-2 arrives on scene.

Figure 1: Little Fire FLA area overview.

The Story

At 1550 Captain E-1 (Div-A) advises his crew to stage as he goes to scout the fire. Div-A gets within 100' of the fire's edge and observes the fire backing against the wind with flame lengths up to 12 inches. The fire spread is pushing away from him to the N/NE (see cover photo) and he observes clean black to serve as a safety zone. He determines that they can engage the fire and requests the crew to "pull the lightning lay" (1000 feet of 1 ½ inch hose with no in-line tees) and advises them he will come back and guide them in. The crew responds and he starts back and ties in with them. Once they get to the fire's edge they notice that the nozzle is missing from the end of the gated wye. Div-A calls E-1 operator (E-1 Op) requesting him to bring out a nozzle and telling him he will send a firefighter back to meet him. E-1 Op requests the water tender operator to "cover" the pump panel then responds to the request. Div-A instructs the remainder of the crew to start cooling down the safety zone while they wait for the nozzle because he notices that there is a lot of residual heat in the black and is concerned about it. After a few minutes, Div-A looks back and sees the E-1 Op meet up with his firefighter and notices a spot fire uphill to the SE of their location. He then instructs E-1 Op to size up and secure the spot fire, if possible. At this time, two crewmen from E-2 are walking down along the hoselay arriving at E-1 Op's location. E-2 firefighters continue down the hoselay. E-1 crew receives the nozzle and is instructed to continue to cool down the black to improve the safety zone before continuing the hoselay. After a few minutes, the wind shifts and the main fire SE of their location has an increase of fire behavior and becomes more active. This is recognized by Div-A and E-1 Op. The main fire activity is moderate at this time. Div-A instructs his crew and E-2 FF-A to get into the black. E-1 Op instructs E-2 FF-B, who is walking down toward the E-1 firefighters, to turn around and return to him so they can escape to the staging area. They do so, comfortably, at a brisk walk.

Lightning Hose Lay—is a simple hose lay using 1,000 feet of 1½ inch hose. This hose line is rapidly deployed from the engine directly to the fire with no junctions in between the pump and nozzle. It is used to attack "lightning" fires, hence its name.

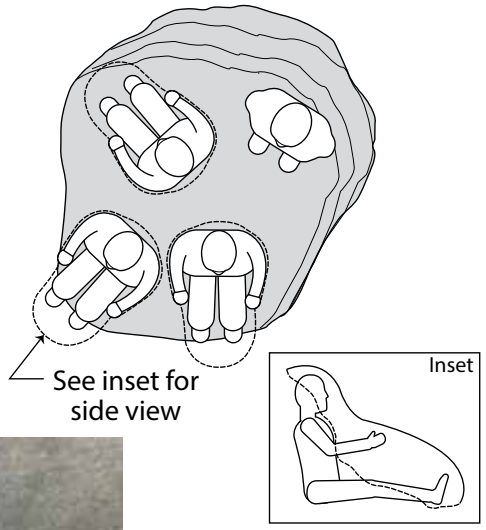
Div-A, two firefighters from E-1, and E-2 FF-A continue to work their way into the black cooling it as they go. After a couple of minutes Div-A calls E-1 Op to check his status and the status of E-2 FF-B and was told they were safely back to the engines. The fire continues to burn to the SE and also turns to the N/NE toward Div-A and the crew's general direction. Div-A and the firefighters continue to cool their way further into the black and are experiencing high temperatures from the hot ash in the black, and extreme smoke. After a few minutes the wind shifts and they reached a natural barrier from the oncoming heat and flames; in this document called Barrier Rock (figure 2).

Figure 2: Barrier rock.

At Barrier Rock they lose water pressure presumably because the hose has burned. They are still experiencing a lot of heat from the ash and are trying to stand on rocks to keep from standing in the hot ash. Div-A cannot see the main fire because both Barrier Rock and smoke impedes his vision. Visibility through the smoke is about 20 feet at best. He can hear the fire behavior but cannot see it so he reluctantly decides to have his personnel pull their fire shelters from their fire packs, as a precautionary measure. At this time, two individuals pull the red rings on the poly vinyl chloride (PVC) bags, removing the shelters. They stay at Barrier Rock for a couple of minutes. Div-A spots a large boulder (referred to in this document as Big Rock) when the wind shifts and leads his personnel there hoping to find a more comfortable location from the heat and smoke.

Figure 3: Big Rock.

When they arrive at Big Rock (figure 3) there is room for all four of them atop it. Div-A remains standing and the firefighters sit down. The fire's edge is approximately 75 feet to the east of this new location. Even though they are a good distance from any active fire, and 7 feet above the ground, they are still experiencing a lot of radiant heat from the ground. They are also still in the thick of the smoke with poor visibility. As this event unfolds they remain calm and in intermittent radio communications with the IC and Operations. While on Big Rock, Div-A tries to get some bucket drops to cool down their area but, with the thick smoke, he isn't having any success. After a couple of minutes on Big Rock, one of the firefighters asks Div-A if it would be ok to use their shelters to deflect the heat and try to create some better air to breathe. After a moment of consideration, and concern that they may get in trouble, Div-A makes the decision that his firefighters' welfare is the most important thing and gives them permission. Two more shelters are removed from the PVC bags and three of the firefighters unfold them. At the same time, the crew discovers that the water in their CamelBak and the canteen stored in the outer pouches of their packs are now extremely hot. One digs into the main compartment of his pack and finds a Gatorade that is at a drinkable temperature and another finds water, in the same condition. **The crew later reported that this simple amenity of cool water to share, along with the effectiveness of using the**



shelters as a shield from the radiant heat and smoke, greatly increased the morale of everyone. They spend about a half hour on Big Rock all the time trying to direct water drops as other crews attempt to establish a hoselay into their location. Finally, a breeze opens the smoky curtain momentarily; enough for them to see another area to their west that looks like it may provide more comfortable, cooler, and clearer conditions. Div-A scouts the area and, after finding the location more desirable, he calls the crew over to join him.

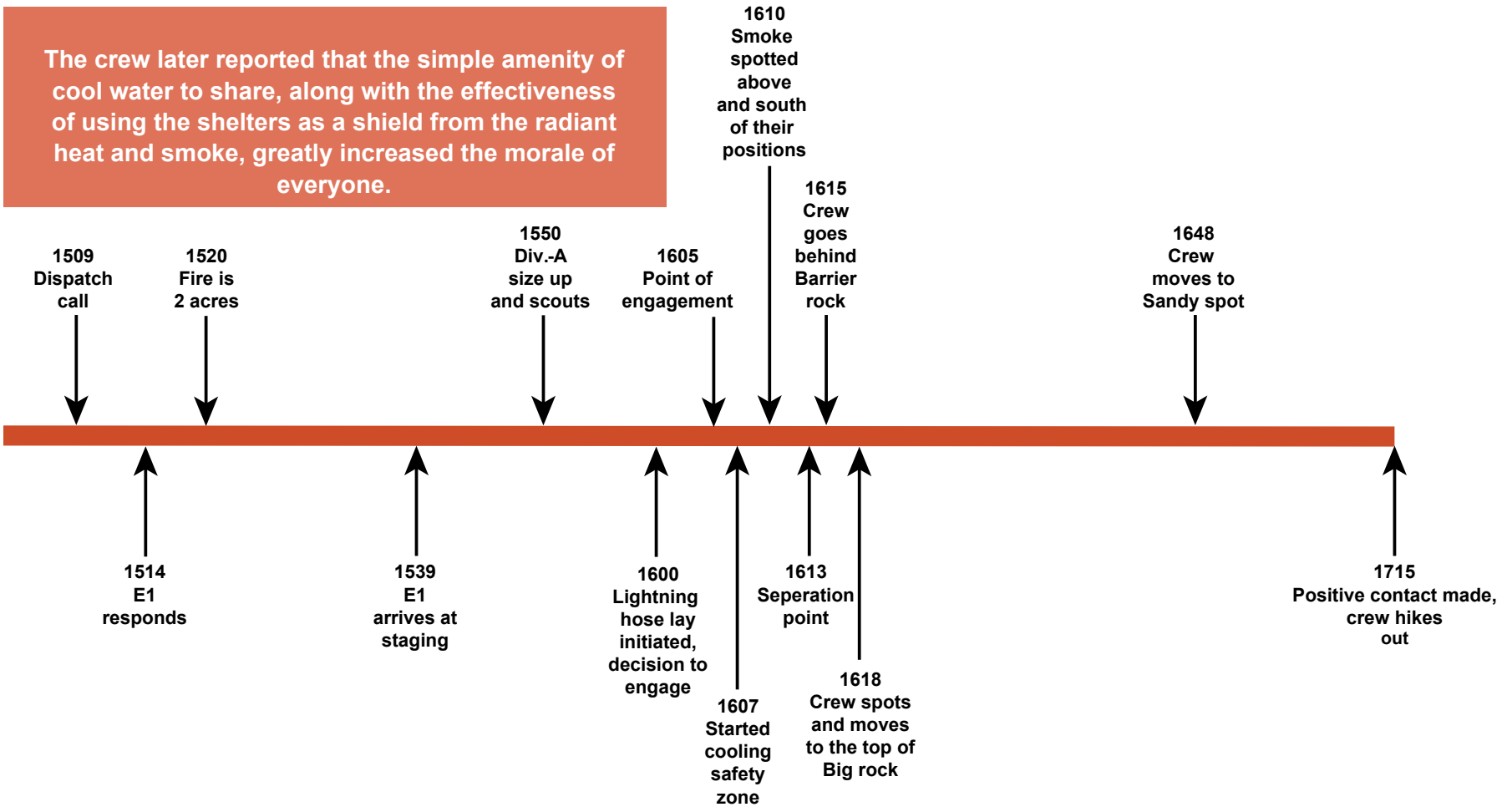
At the new location (the Sandy Spot [figure 4]), Div-A continues to try and get water drops and the hoselay to their location. Although the conditions are more desirable, there is still a lot of ground heat in the area. They make several attempts to get a latitude and longitude reading for their position sbut again have no satellite signal. They ignite some fusees in hopes that the helicopter is able to see it through the smoke but, again, haven't any luck. While at Sandy Spot, Div-A is contacted by BC-2, who arrives at the staging area to check on them. Div-A radio's in to report their current status and also advises BC-2 that they are using their shelters and, specifically, why they are using them so there isn't any confusion about the intended use of the shelters. After about another half hour they hear an engine crew bringing the hoselay through the black. When they are able to see them they walk up to them and out to the engines that remain in the staging area.

Figure 4: Sandy Spot

The crew hikes out to the engines and, although the terrain is not difficult by normal standards of their physical training, they find that their experience in the heat and smoke has drained them of all their energy. The approximately one-third of a mile hike to the engines is surprisingly hard to complete. When they reach the engines, Div-A requests that his personnel are checked out by paramedics and the crew is subsequently cleared.

The crew could not get a Lat/Long for their position with their GPS or smart phone throughout this event. Also, the radio batteries were not lasting very long. Div-A said he went through about 6 clam shells in the span of an hour.

The crew later reported that the simple amenity of cool water to share, along with the effectiveness of using the shelters as a shield from the radiant heat and smoke, greatly increased the morale of everyone.



Sequence of Events

Lessons Learned

Fire Shelter:

- ❏ **Decision to deploy or use a fire shelter.** This decision and the act of deployment are associated with a social stigma in the firefighting community. However, the fire shelter is provided to firefighters as personal protective equipment and should be used prudently to make difficult situations tenable. "Don't be afraid to use it as a tool."

  The Captain's and the crew's decision to use the shelter helped them adapt to a difficult situation. The fire shelters were first "pulled out" as a precautionary measure and later used to make conditions more bearable. "'Is this really happening?' was my first thought when I was told to pull my shelter. I then shook my head, listened to, and trusted my leader to keep me alive."—2nd year firefighter.

  The heavy smoke and large boulders blocked the crew's view of the fire making the assessment of fire behavior difficult. The crew was exposed to smoke and heat for approximately an hour and a half. "There is a stigma if you pull your shelter you did something wrong. In this case it was used as a tool. Don't be afraid to use it."—IC from previous FLA

- ❏ **Precautionary use.** The fire shelter was used in this situation to reduce exposure to smoke and heat. The crew climbs atop a large boulder (Big Rock) to get away from heat coming from the ground after the main fire passed through. The smoke was thick and visibility poor. The fire shelter, again, was used to get clean air. The crew moved to a second location and the shelter was used to provide relief from the smoke. The crew held the shelter in front them while sitting on Big Rock and would stick their heads in for air at different times (see figure 3) and as they moved to Sandy Spot breathing into the shelters to give them relief from the smoke and heat.

- ❏ **Fire shelter inspection.** Four fire shelters were removed from their PVC bags and three fire shelters were used. Div-A retained the shelter outside the PVC bag but it was never unfolded. Initial inspection of the used shelters revealed that two of the three fire shelters showed significant wear. One (1) to five (5) percent of the aluminum layer was missing along the fold lines. This may be indicative of wear sustained in the pack, before use. Twenty five (25) to 30 percent of the aluminum layer on the floor was missing. This is indicative of delamination of the aluminum layer when exposed to heat and abrasion during crew movement. Further inspection and testing of the fire shelters need to be complete to validate these initial indications. Inspection and rebagging procedures need to be reviewed.

- ❏ **Fire shelter deployment training.** Fire shelter training assumes that hand tools are available to prepare a deployment site by removing organic material. In some cases, engine crews on initial attack using hoselays may not carry hand tools. **"Water is our lifeline. We don't have tools on the line during IA except the captain carries a tool."**
  —Firefighter

"I'm not gonna be that guy they find with a fire shelter in his pack."

Safety Zone:

- ❏ **Importance of a good safety zone.** An area was identified as a safety zone because of the clean black not realizing how hot it was inside. It still served its purpose but was very uncomfortable. Div-A identified the safety zone prior to engagement and worked to improve the safety zone by cooling it down.
- ❏ **Natural barriers.** Natural features (Barrier, Big Rock, and Sandy Spot) proved useful in the safety zone to help protect the crew from heat and ash. "They say if the leader remains calm that the crew will. I found that it works both ways; seeing my firefighters keeping calm helped me stay calm, too."—Reflections of Div-A as he and the crew sat on top of Big Rock.

General Engine Crew Observations:

Trust your instincts. Instinct (your mental slides) is based on experience and training. When quick and difficult decisions need to be made, going with your gut and acting quickly is essential. "Don't be afraid to go with gut feeling. Don't second guess yourself."—Div-A

Keep water cooler. Keeping water canteens or hydration bladders inside the line gear reduces exposure to heat. This may provide a source for cooler drinking water especially when subjected to high temperatures. However, realize that this may hinder easy access to the water.

Lightning Hose Lay. Add inline tees to the hoselay make up to allow adding laterals without shutting water off the main hose lay line. Keep in mind that adding the inline tees will increase friction loss.

Situational awareness. "As a BC and type 3 IC, I need to continue to be aware of fire conditions; not to be afraid to not engage until we have air and adequate resources. Expect the unexpected."—BC

"It doesn't have to be hot for the fire behavior to be present."—IC

"Pay more attention to the resources we have available."—IC

"Stay calm, work as a team."—Multiple folks said this.

Training. "On the 10 and 18's, I now know more of what they mean"—Firefighter

"New way of learning, to create a safety zone."—2nd year firefighter.

"Our training, and the training we did in the morning of the fire, helped us through this incident. It was kind of eerie that our morning scenario was about a lightning fire." —Remarks from a couple of firefighters.

"Stay calm, work as a team"

Pertinent Quotes from Similar FLA's

Bull Fire FLA

From the Bull Fire Entrapment FLA's "Recommendations" section: "The wildland fire community should take away the 'stigma' of deployment. Deploying a fire shelter is making use of a (last resort) safety tool. The trigger for a review should relate to the situation (entrapment) that required the use of the tool—rather than the use of the fire shelter tool itself." "Deployment—when necessary—should be encouraged rather than sanctioned." [For an inside perspective from one of the firefighter's entrapped on this incident, see page 8.]

<http://wildfirelessons.net/documents/BullFireEntrapmentFLAFinal.pdf>

Salt Fire FLA

Salt Fire Facilitated Learning Analysis of Entrapment, Shelter Deployment, and Equipment Loss.

From a firefighter in this August 2011 fire entrapment FLA:

"I heard: 'Now you've popped your shelter, you're going to have to answer for it'."

Another firefighter on deploying: *"I figured I might have survived without the shelter, but probably not without injuries."*

This FLA, once again, tries to address "the stigma associated with pulling a fire shelter." The FLA explains that the firefighters who deployed their shelters heard negative comments indicating "there would be trouble for all involved because a shelter was used."

In response, the Salt Fire Entrapment FLA warns: *"This cultural issue has great potential to cause people to delay using the fire shelter until it is too late."*

<http://wildfirelessons.net/documents/Salt_Fire_FLA.pdf>

Nuttall Deployment Review

"Forest officials and seasoned firefighters involved with this incident all made the point that firefighters must not be reluctant to use the fire shelter or be intimidated about using it. They all said that a stigma currently is associated with fire shelter deployment. We must work past that stigma. The decision to deploy is a positive decision."

Nuttall Complex Fire Shelter Deployment Review, December 2004

<http://www.wildfirelessons.net/documents/Nuttall_Deployment_Review_Final_2004.pdf>

I-90 Tarkio

Do We Need a Cultural Course Correction? *"The fact that when—at that critical decision point—a firefighter might be thinking more about the bureaucratic consequences of shelter deployment rather than the fire itself and his or her own personal safety, begs the question as to whether a cultural course correction is warranted."*

From the I-90 Tarkio Fire Shelter Deployment Accident Investigation Report (I-90 Tarkio FLA Team).

<http://www.wildfirelessons.net/documents/I-90_Report.pdf>

Little Fire FLA Team Feedback

Observations & Recommendations:

- ❏ The entire engine crew, as well as District and Forest leadership, should be commended for proactively managing social media. The Team's assignment, and the ability to create a safe environment for open and honest dialogue for all involved, was greatly enhanced without the distraction of undue speculation and interference created through social media and "armchair quarter-backing."

- ❏ There is a well-defined gap between what policies exist surrounding the use of fire shelters during incident response and the interpretations of these policies, in the minds and actions of firefighters, out in the field. The above FLA examples date back to 2004 and were clearly evident in statements made by those involved in the Little Fire: Shelter Use analysis. A liberal distribution of the article , "Your Fire Shelter: Would You Hestitate in Deploying It", Two More Chains Fall 2011 which clearly notes these concerns, could be a useful tool to close this gap.

- ❏ Develop a better definition of "deployment" and include other variables in Refresher Training. What is lack of full deployment…partial deployment? Or, simply, "use of a tool." Does it include a sense of urgency? As stated in the above-cited FLA, "I could have survived [without a shelter] but not without injuries."

- ❏ Gear management, including thorough fire shelter inspections, could be better reinforced with broader distribution of the "Tech Tips" write-up and flow chart that has already-established protocols for managing shelter inspections and shelf life. Using a Safety Alert or Safecom can help in getting this information out to fireline personnel this fire season.

- ❏ The Captain (Div-A) and crew discovered adverse effects; presumably from high temperatures and smoke; on their batteries, cell phones, and GPS units. Further study is needed as it appears, beyond an incidental occurrence; that six clam shell battery packs, cell phone(s), and GPS unit(s) of the other personnel; would all go similarly out of service.

- ❏ Every attempt should be made to activate an FLA Team as soon as possible following an incident. Pre-established teams may be an effective approach to managing for this need.

- ❏ Establish a feedback mechanism for participants to describe their experiences with the facilitated learning analysis and team. This would serve to help FLA teams hone their skills and help create a positive environment for addressing what worked well and what might be improved. For team members, a protocol for documenting experiences and continuous learning would be useful.

23 September 2013
Little Fire—Personal Protective Equipment Procedures and Analysis Report

Scope

This report is based on site visits, interviews with the firefighters, and examination of their equipment. The objective of this report is to provide supporting technical information to be used with the Facilitated Learning Analysis report. It is written as a stand-alone document that can be used to assist in other training activities. For clarity, this report will refer to definitions from the National Wildfire Coordinating Group (NWCG) Glossary of Wildland Fire Terminology, July 2012. <http://www.nwcg.gov/pms/pubs/glossary/f.htm>

Background

The initial inspections of the personal protective equipment (PPE) were performed on site. Fire shelters were collected and a detailed inspection of the fire shelters was conducted at the Technology and Development Center, Missoula, MT. The condition of fire shelter materials are expressed in percentage of the item affected. The condition of flame resistant (FR) clothing is expressed in the area of the item affected. The values are visual estimates.

The table below shows minimum threshold temperature to give the reader an indication of the exposure to heat.

Table 1: Threshold temperature indicators

Breathing becomes uncomfortable/difficult	250-300 °F
Fire shelter polyvinyl bags-melt	280 °F
Aramid cloth- dye sublimation (discolored)	400 °F
Foil/Shelter cloth bond–delamination	500 °F
Fire shelter polyvinyl bags–auto-ignite	945 °F

Figure 1: Little Fire area overview

Discussion

Four firefighters were performing initial attack on the Little Fire. Fire activity increased, preventing egress back to their engines. The firefighters went into their predetermined safety zone. The safety zone was the "black". The brush and small trees in the area were already consumed. Areas of duff were still smoldering and had residual heat, figure 1.

After the four firefighters were separated and committed to the safety zone, they took refuge behind Barrier Rock (figure 1). This barrier provided some relief by partially shielding them from the heat but also obstructed their view of the main fire. The increase in the fire behavior prompted the firefighters to begin a shelter deployment sequence.

The four firefighters removed fire shelters from their fire line packs and opened the poly vinyl chloride (PVC) bags. Three firefighters deployed fire shelters; one did not. All four firefighters remained as a group throughout the incident. There were no injuries.

Fire shelter access and deployment sequence.

1. **Removal of fire shelters from fireline packs at Barrier Rock**–Four firefighters removed shelters from their fire line packs to be ready if conditions worsened. Three firefighters reported no issues with removing the shelters from packs. However, one firefighter had difficulty removing the shelter from the pack's shelter compartment. This firefighter had to sling the pack to one shoulder to facilitate removal. All four firefighters were using a commercially purchased fireline pack.

2. **Opening the PVC bag**–Two firefighters reported no issues with opening the PVC bags. However, two firefighters had trouble with the red PVC pull rings. They were able to achieve partial bag opening. One pull ring was pulled off of the bag. They used gloved fingers to enlarge the hole initiated by the pull rings.

Two firefighters observed grey powder and aluminum flakes drop out of the PVC bags upon opening.

The firefighters held the shelters in their hands while assessing the situation at Barrier Rock. They relocated to a large rock (Big Rock) which provided some relief from the heat produced by the smoldering duff, smoke, and blowing ash, figure 1. This positioned them about 7 feet above the ground surface. They raised their FR shirt collars for added protection. Persistent smoke and heat prompted three of the firefighters to continue with the deployment of their shelters.

3. **Fire shelter deployment**–Three used the shake handles to fully open the shelters. Shelters were used from a seated position on top of Big Rock. The firefighters used the shelters intermittently; sticking their heads inside for relief. One firefighter did not deploy the shelter and remained standing on Big Rock, figures 2 and 3.

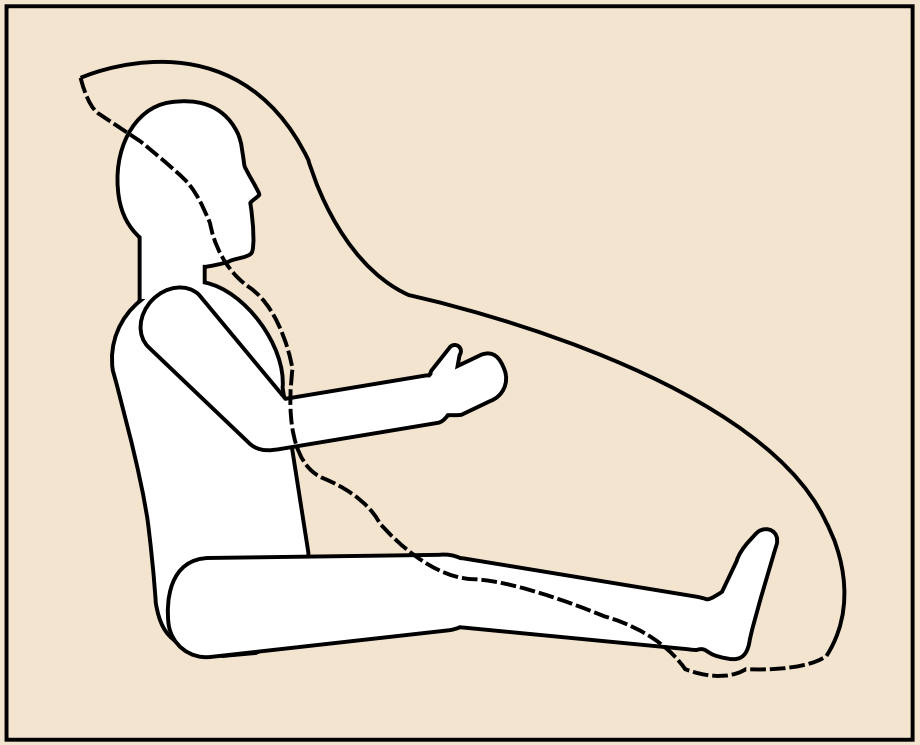


Figure 2: Seated deployment position on Big Rock.

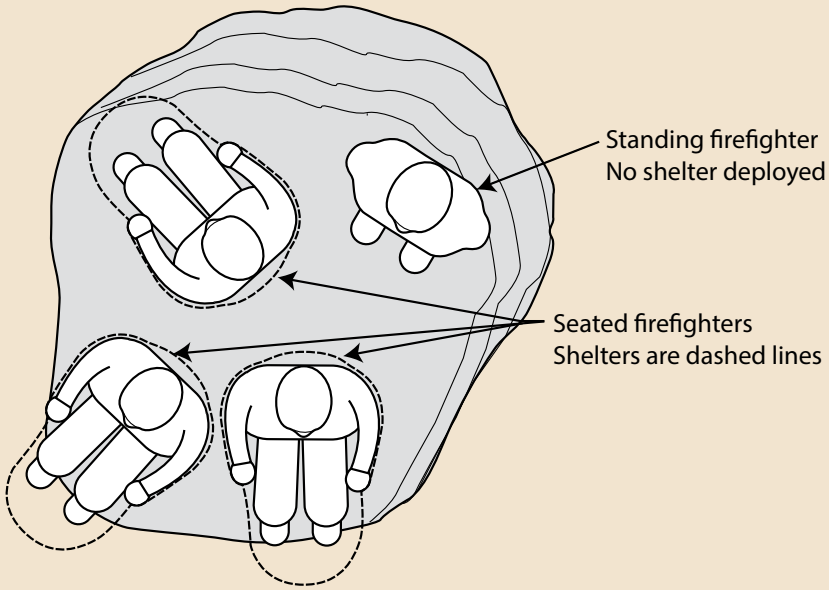


Figure 3: Firefighter and fire shelter deployment positions on Big Rock.

The firefighters spent about 30 minutes on Big Rock before moving to Sandy Spot. Shelters were held upright, as shields, while walking from Big Rock to Sandy Spot. This sandy area was free of smoldering duff and was less smoky, but the ground was still hot. One firefighter sat down on a shelter; one sat down on the hard plastic shelter liner, and one alternated between standing and sitting on the ground. One firefighter used the shelter for protection from blowing ash and smoke by intermittently lying on his side, figure 4.

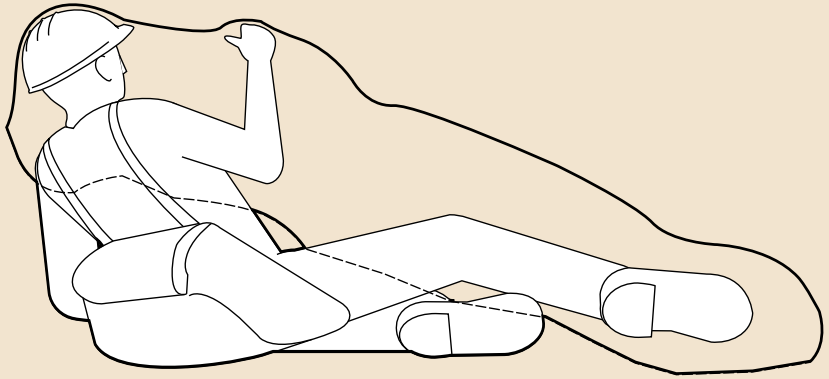


Figure 4: Firefighter lying on his side at Sandy Spot. Shelter is dashed line.

Fire Shelter Construction—The fire shelter is made of two separate layers of laminated material. The outer shell is aluminum foil laminated to a silica cloth; the inner shell is aluminum foil laminated to a fiberglass cloth. The floor of the shelter is a silica cloth laminated with aluminum foil on both sides. The shelter is sewn with both fiberglass and quartz thread.

Equipment Inspection—

PPE	Condition	Remarks
FR Pants	Dye sublimation marks on three leg cuffs; approximately 3 square inches. See figure 7.	All four firefighters were wearing pants certified to NFPA-1977 Standard on Protective Clothing and Equipment for Wildland Firefighting-2011 Edition.
FR Shirts	No visual indication of exposure to high temperatures.	All four firefighters were wearing shirts certified to NFPA-1977 Standard on Protective Clothing and Equipment for Wildland Firefighting-2011 Edition.
Gloves	No visual indication of exposure to high temperatures.	All four firefighters were wearing gloves certified to NFPA-1977 Standard on Protective Clothing and Equipment for Wildland Firefighting-2011 Edition.
Helmet	No visual indication of exposure to high temperatures.	All four firefighters were wearing helmets certified to NFPA-1977 Standard on Protective Clothing and Equipment for Wildland Firefighting-2011 Edition.
Fire Shelters–All firefighters were equipped with regular sized fire shelters made to Forest Service Specification 5100-606 (M-2002).		
Fire Shelter #1	• Outside layer–Aluminum foil worn away and cracked along some fold lines. • Inside layer–Aluminum foil worn away and cracked along some fold lines. • Floor–25% aluminum foil missing from both sides of silica cloth.	Manufacture Date–January 2004
Fire Shelter #2	• Outside layer–1-inch by 1.5-inch square of aluminum foil missing. Aluminum foil worn away and cracked along some fold lines. • Inside layer–Aluminum foil worn away and cracked along some fold lines. • Floor–30% aluminum foil missing from both sides of silica cloth.	Manufacture Date–August 2003

Equipment Inspection—*continued*

Fire Shelter #3	• Outside layer–No damage • Inside–No damage • Floor–No damage	Manufacture Date–Not legible
Fire Shelter # 4	• Outside layer–Aluminum foil worn away and cracked along some fold lines. • Inside layer–No damage • Floor–No damage	Manufacture Date–January 2004. Fire shelter was not deployed.
Fire Shelter PVC Bags	• The recovered bags were partially melted and burned. Two bags were 30-40% consumed by fire; one bag was 80% consumed by fire.	Three fire shelter PVC bags were recovered from the site. One PVC bag was not recovered; it was most likely consumed by fire.

Equipment photos

Figure 5: Shelter PVC bag–280-945 °F.

Figure 6: Shelter floor delamination–500 °F.

Figure 7: Flame resistant Nomex dye sublimation (color change) 400 °F.

Analysis of Equipment

Heat and physical damage to fire shelters–The site contained areas of smoldering duff with enough heat to melt and ignite the shelter PVC bags. This surface and ground-based heat source made contact with the shelter floor material at some point. After shelters were deployed at Big Rock they were moved to Sandy Spot. Heat contact combined with physical abrasion most likely resulted in delamination of the floor material.

Summary

Three firefighters deployed the fire shelter; one firefighter chose not to. All four firefighters walked away from the Little Fire without injuries.

Fire shelter comments

"Don't be skeptical and afraid to use the shelter as a tool." –Firefighter

"I'm not gonna be that guy they find with his shelter in his pack."–Firefighter

"Don't be afraid to go with your gut [to deploy a shelter], don't second guess yourself."–Firefighter

When asked if the fire shelter helped, the firefighter replied –"Yes, [we] calmed down, [got] cleaner air, less heat, the situation calmed down, and could think better."-Firefighter

Reminders:

1. Fire shelter placement in fireline pack:

    a. Check the fire shelter compartment closure system on fireline pack.

    b. Check routing of yellow pull-strap.

    c. Check for and remove debris from hook and loop (Velcro) closures.

One firefighter had difficulty removing the shelter from the pack's shelter compartment. This firefighter had to sling the pack to one shoulder to facilitate removal.

2. Fire shelter deployment training:

    a. Practice deploying your fire shelter with your pack off your back. This is the recommended method. A pack on the back can inhibit a shelter deployment. Many firefighters carry saw gas or firing devices that need to be thrown clear of the site.

    b. Utilize the pull rings with a peeling motion, following the red strip around the bag.

    Two firefighters had difficulty getting the red PVC pull rings to peel the bag open. One pull ring was torn off, partially opening the bag. The firefighters were able to get their (gloved) fingers into the holes initiated by the pull rings to complete the bag opening.

    c. Review The New Generation Fire Shelter (March 2003): http://www.nwcg.gov/pms/pubs/newshelt72.pdf

3. Fire shelter inspection: For inspection criteria check out the Tech Tip: Fire Shelter Inspection and Rebag Direction: http://www.fs.fed.us/t-d/pubs/pdfpubs/pdf11512301/pdf11512301dpi72.pdf

Two firefighters observed dark grey powder and aluminum flakes drop out of the PVC bags upon opening. The powder can be an indicator of aluminum corrosion form water previously entering the bag.

Three shelters had cracks and peeling aluminum along the fold lines. This wear can be from abrasion inside the pack during fireline use.

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