



U.S. Forest Service Fire Shelter Project Review Communication Plan

April 15, 2015

Topic: 2014 Fire Shelter Project Review

Issue: Recent fire shelter deployments and events in 2013 prompted Washington Office Fire and Aviation Management (WO-FAM) to request acceleration of the life-cycle product review for the fire shelter and supporting components. WO-FAM requests the Technology and Development (T&D) Program to review the fire shelter system which includes the fire shelter, fireline pack, practice shelters and training. This fire shelter review had been scheduled to begin in 2015, but due to factors both internally and externally, the WO-FAM requested this review process start in 2014.

Key Messages:

- At the request of Washington Office Fire and Aviation Management, the Technology and Development Program will conduct a fire shelter project starting in 2014 with a scheduled completion in 2018.
- The purpose of the review is to identify possible improvements to the fire shelter system to maintain and ensure the safety of firefighters and fire personnel.
- Firefighters will be surveyed for their input concerning the current fire shelter, policy and development of new fire shelter goals.
- Survey results from the Fire Shelter Survey conducted in 2014 are posted on the NIFC website: http://www.nifc.gov/fireShelt/fshelt_main.html. Responses from 3,803 firefighters from all over the country were recorded.
- The goal of the fire shelter review is to explore materials and shelter designs that will maintain or improve the level of protection from radiant and convective heat exposure.
- The review will also maintain the current requirement of not exposing the occupant to dangerous levels of toxic components within the shelter.
- The review will also consider weight, bulk and cost of the fire shelter system that includes the fire shelter, fireline pack, practice shelters and training.
- We are open to all possibilities and will thoroughly explore all options during the review. Possible outcomes include transitioning to a new design; using the existing shelter with modifications; or keeping the existing shelter as is.

Questions and Answers

Fire Shelter Project Review Update – April 2015

What were the results of the 2014 firefighter survey?

Survey results from the 2014 Fire Shelter Survey are posted on the National Interagency Fire Center (NIFC) website. Responses from 3,803 firefighters from all over the country were recorded. Click the attached link for survey results: http://www.nifc.gov/fireShelt/fshelt_main.html.

What has the shelter material search yielded so far?

Twelve companies have supplied 50 material samples. Materials are still being submitted to and accepted at the Missoula Technology and Development Center (MTDC) through [FedBizOpps](#) solicitation.

What are the types of shelter materials that have been submitted?

The fire shelter material search is divided into three categories:

- Lighter weight and less bulk with similar performance to the current shelter
- Similar weight and bulk with improved performance
- Heavier weight and bulk with pronounced improved performance

How is NASA participating in the fire shelter review?

The U.S. Forest Service has entered into a collaborative agreement with the NASA Langley Research Center, located in Hampton, Virginia, to examine potential improvements to fire shelter performance. The team of engineers from NASA is developing flexible heat shields that will protect spacecraft from the high temperatures of atmospheric entry under NASA's Hypersonic Inflatable Aerodynamic Decelerator (HIAD) project. NASA and the Forest Service have found that there are common performance requirements between fire shelters and flexible heat shields that can be used to benefit both organizations.

What fire shelter material testing has occurred since project initiation?

Small scale testing on 39 material samples was conducted at MTDC since September 2014. Thirteen materials that showed no obvious shortcomings were sent to Mark Y. Ackerman Consulting in association with the University of Alberta for the first round of third party lab testing. The Fire Shelter Test Protocol is being used for this testing.

The only materials that had an improvement in the thermal protective performance tests were those that were bulkier and heavier than the current shelter material. Third party test results are being shared with those who have submitted materials for possible improvements. Another round of testing will be conducted during the summer of 2015.

Fire Shelter Design Review

What prompted the fire shelter design process?

Recent fire shelter deployments and events in 2013 prompted Washington Office Fire and Aviation Management (WO-FAM) to request acceleration of the life-cycle product review for the fire shelter and supporting components.

Why is the fire shelter design review process moved up to 2014?

This fire shelter review had been scheduled to begin in 2015, but due to factors both internally and externally, the WO-FAM requested this review process start in 2014. Conducting fire shelter reviews is standard operating procedure. The T&D Program has a life-cycle review process wherein all personal protective equipment (PPE) is reviewed periodically to determine if new materials or designs are available. In addition to the life-cycle review process, new materials are continuously being evaluated to determine if they may improve performance of the shelter or other PPE.

What does the fire shelter review process include?

WO-FAM requests the T&D Program to review the fire shelter system which includes the fire shelter, fireline pack, practice shelters and training. The review started in January 2014 and concludes in December 2017 and includes four parts:

- *Project Initiation (duration of 14 days) – started January 2014*
- *Planning (duration of 72 days) – started February 2014*
- *Test and Evaluation (duration of approximately 700 days) – started May 2014*
- *Implementation, if necessary, (duration of 220 days) – starts in February 2017: finish December 2017*

***NOTE: It is possible the Forest Service will retain the existing shelter if there are no significant findings during this review. Options are to keep the existing shelter as is, use the existing shelter with modifications or transition to a new design.*

What does the review process involve?

The **project initiation phase** includes determining the operational requirements documents and announcing the review process. The **planning phase** involves surveying firefighters for input, requesting possible materials from industry, identifying and developing viable materials, testing materials and shelter design(s) using fire shelter test protocols. The **test and evaluation phase** involves small and large-scale lab testing and full-scale field testing of prototype fire shelter system. Finally, the **implementation phase** provides shelter options to decision makers.

Is this review process happening earlier than expected due to the Yarnell Hill Incident?

The fire shelter design review process was scheduled for 2015, but significant events such as the Yarnell Hill Incident involving the deaths of 19 members of the Granite Mountain Hotshots prompted leadership to re-evaluate the timeframe. The report states the temperatures, heat flux, and the radiant and convective heat of the burnover appear to have been well beyond the protective capabilities of the fire shelters and protective equipment.

What is the process for finding and testing new materials?

A worldwide material solicitation is conducted through a formal Request for Information (RFI) through FedBizOpps. The Technology & Development Program will conduct a market search to identify materials, laminates or components for use in the wildland firefighter personal fire shelter. The RFI is open to all sources of material both foreign and domestic. All submitted designs and materials by interested parties are then tested and evaluated extensively. The first step during the development process is to conduct small-scale laboratory tests and evaluation to screen materials for strength, flammability, thermal performance and toxicity. Further full-scale tests measure strength, durability, flammability, thermal performance and toxicity of overall shelter design. All proposed designs include cost estimates. The NWCG Fire Shelter Subcommittee will observe the process. The final selection is based on results of extensive testing, peer review and performance.

Fire Shelter Basics

What is a fire shelter?

The fire shelter is an aluminized cloth tent that offers protection in a fire entrapment situation by reflecting radiant heat and providing a volume of breathable air. The fire shelter is shaped like a half-cylinder with rounded ends; the previous version was triangular prism-shaped, similar to a small one person tent.

When did firefighters begin using fire shelters?

Wildland firefighters have carried fire shelters since they were developed during the 1960s. Fire shelters were required as personnel protective equipment in 1977.

Are all state, local and federal agencies responding to wildfires required to carry the fire shelter?

All federal, state and local wildland firefighters carry the fire shelter (Model 2002). According to the National Fire and Aviation Executive Board (NFAEB) all agencies, cooperators and contracted resources were to transition to the new shelter by January 1, 2010.

Who makes the fire shelter?

A contractor for General Services Administration, (GSA), manufactures the shelters according to Forest Service specifications. The specifications include the exact materials to use as well as the shelter patterns and construction details. GSA administers the contracts. To ensure quality assurance and quality control, the contractor is regularly inspected by GSA, the Forest Service and Underwriter's Laboratory (UL).

When should a fire shelter be used?

Since firefighters are trained extensively in fire entrapment avoidance, fire shelters are used by firefighters in the very rare occurrence of a fire entrapment where firefighters feel the shelter is needed for protection from heat, smoke, and/or ember showers.

How does the fire shelter work?

The fire shelter provides protection primarily by reflecting radiant heat and trapping breathable air inside. The shelter is comprised of two layers. The outer layer is woven silica laminated to aluminum foil. The foil reflects radiant heat and the silica cloth slows the transfer of heat to the inside of the shelter. An inner layer is fiberglass laminated to aluminum foil. The inner layer of foil prevents heat from being reradiated inside the shelter, and it prevents gases from entering the shelter. When the two layers of materials are sewn together, the air gap between them provides additional insulation.

What are the types of heat can a fire shelter encounter?

The fire shelter works really well in radiant heat because the outside layer of aluminum foil reflects 95% of the radiant heat and temperatures inside the shelter rise slowly. Unlike radiant heat, convective heat from direct flame contact is more quickly conducted into the shelter, raising temperatures inside the shelter more quickly.

What are wildland fires temperatures?

Wildland fires are typically 1600 degrees; in some instances temperatures can reach 2000 degrees. The most extreme temperature of a wildland fire measured was 2400 degrees.

What is considered a survivable temperature for humans?

A tenable condition for an extended period for humans is about 250 degrees. Humans can survive up to 300 degrees Fahrenheit for a short period of time.

Have the fire shelter been field tested?

The fire shelter has been tested and shown survivable temperatures in typical exposures of 1700 degrees with some flame contact.

Fire Shelter deployment statistics.

Shelter	Total Deployed	Precautionary	Burn Injury Prevented	Life Saved	Fatality
Old-Style	1100	500	300	300	20
M-2002	154	7	90	25	21

What kind of training do firefighters need to use the fire shelter?

Wildland firefighters must be properly trained in the use of fire shelters. Required annual training includes, at a minimum, reviewing the training pamphlet, viewing the fire shelter training video, and practicing deployments using a practice fire shelter. Firefighters are trained that fire shelters are not fail-safe and to not take additional risks because they are carrying a fire shelter.

How is the fire shelter carried, how big is it and how much does it weigh?

Fire shelters are enclosed in a carrying case, worn on a belt, chest harness or as a component of the firefighter’s fire-line pack. A regular-sized fire shelter weighs 4.3 lbs. and the carrying case is approximately 9 x 5¾ x 4½ inches.

How is a fire shelter deployed?

Firefighters remove the shelter from its protective container, unfold and “shake out” the shelter, and get inside. Firefighters lay stomach-down on the shelter floor and slip their arms through the hand-hold straps, with their feet toward the advancing fire.

Describe a shelter deployment scenario:

Fire shelters are deployed in entrapment situations where firefighters feel they need to use it to prevent possible burn injury or death. Shelter deployment training stresses that firefighters deploy shelters in the largest possible area that is free of fuels. Optimal deployment sites include natural fuel breaks like wide stream beds and rockslides, gravel or paved roads (maintaining awareness of vehicles); areas cleared to bare mineral soil by mechanical equipment such as dozers, previously burned or “black” areas, or firefighter-cleared areas. Places to avoid for deployment include areas where shelters can be exposed to direct flame contact or convective heat such as narrow ravines (“chimneys”), steep slopes, draws and saddles. Sites where rocks, logs, or standing dead trees (snags) can roll or fall onto shelters should be avoided if possible. Flammable equipment (such as fusees and chainsaw fuel) should be left outside and away from the shelter.

Fire Shelters – 2002 to Present

How was the current fire shelter developed?

The original shelter was designed to reflect radiant heat, however direct flame contact could cause damage. Fatalities occurred when flame contact was severe.

Development of the current fire shelter began in 2000. A worldwide material search was conducted. Small and full scale tests were developed to measure the strength, durability, flammability, thermal performance, and toxicity of various shelter designs and materials. The testing took place at the Protective Clothing Equipment Research Facility at the University of Alberta in Edmonton. More than 60 materials and combinations of materials were considered and 17 full scale designs were tested. Interagency Fire and Aviation Management selected the new shelter from a final four in June 2002.

When was the current fire shelter introduced?

The final shelter design was selected in 2002. The current fire shelter was introduced in 2003 and provided improved protection from radiant and convective heat. As part of the continuous improvement process, products and materials undergo continuous review and testing. Since 2003, more than 100,000 shelters have been manufactured.

What is the difference between the old and current fire shelter?

The old shelter was fiberglass material laminated to aluminum foil; the new shelter is silica cloth laminated to aluminum foil on the outside layer. Inside layer is aluminum foil laminated to fiberglass. It has a different shape – hut shape with rounded ends that reflect radiant heat better and a lower profile and can take direct flame better than the old-style.

How has the performance improved with the current fire shelter?

The current fire shelter has significantly improved performance due to the materials, construction and design. Additional protection from radiant heat is achieved with the utilization of two layers. Improved glue performance allows the shelter to maintain its integrity under higher temperatures. The rounded design provides better radiant heat protection than the old style. The greatest threats a firefighter faces during an entrapment situation are burns to the body and inhalation of hot gases, which can cause asphyxiation. Scientific estimates of the maximum survivable air temperature vary, but dry air temperatures as high as 300°F are considered survivable for only very short periods of time.

There are physical limits to all materials. Although the current fire shelter offers significantly more protection it cannot protect firefighters in all circumstances. Chances of survival improve if the fire shelter is deployed where it is not exposed to direct flame. A firefighter's highest priority is to avoid situations that can lead to entrapment.

Need more information?

More information can be found at: http://www.nifc.gov/fireShelt/fshelt_main.html

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