

# Safety Bulletin



## Topic: **Do you know the Standards... and why we have moved away from fire shelters?**

Along with the Director, the Provincial Leadership Team (PLT) has just recently approved two updated Operational Safe Work Standards (OSWS). The updated OSWS include **OSWS #2 - Staff Fatigue Management** (once titled *Fire Fighter Fatigue*), and **OSWS #4 - Fire Crew Deployment**. Some of the other OSWS are currently being updated as well, so please keep your eye out for further notices! *Crews and staff must be up-to-date with all standards!* A suggestion is to take the time and discuss these standards at your next safety meeting.

In a way, our OSWS are the backbone to how our organization approaches safety on and off the fireline. It is essential that all of our employees are completely familiar with the standards and that no questions exist to the meaning behind them. You can find all of our current OSWS through the *Safety* link found here through the *Protection Library* through the site below:

[http://wwwinternal.for.gov.bc.ca/PROTECT/Library/Menu\\_LAR\\_SafeWork.htm](http://wwwinternal.for.gov.bc.ca/PROTECT/Library/Menu_LAR_SafeWork.htm)

### **What, no Fire Shelters?**

The decision to suspend the use of fire shelters was a decision not taken lightly. Before any decision was made by the PLT, this issue had extensive analysis by numerous Protection staff and OH&S committees as lead by Judi Beck, our Manager of Fire Management (who has extensive knowledge in both fire sciences and fire shelters). Though the final report was written by Judi, she awards the majority of credit to the exceptional help, feedback, and input by those briefly mentioned above that helped her. Recognition is given to this staff regarding their obvious desire for Protection to continue to improve on its standards – helping to ensure that we all can more safely perform our jobs. You can find the report through the site below:

<http://wwwinternal.for.gov.bc.ca/PROTECT/Library/SAF/FireShelterBriefing.pdf>

Please feel free to review this document. Protection's continued commitment to safety, and to the new direction taken to move away from fire shelter use, is supported by the operational and scientific data of this report. Fire shelters are in the process to be recalled by depot staff. If there are any further questions, do not hesitate to raise them with your local manager.

### **Prevention – What does this have to do with Fire Entrapment and Fatalities?**

**Safety includes Prevention – I cannot emphasize this enough.** I cannot recall a single case where a fire entrapment fatality could not have been easily prevented. **Respecting and closely monitoring fire weather and behaviour is essential to avoid a fire entrapment by all parties.** Case study after case study highlights both the fire management team's and crews' responsibility to pull back to a Safety Zone whenever the conditions dictate. Your Protection Branch will support any decision for anyone exercising their right to pull back to safety! These safety bulletins can only show you our support – but it is YOU that needs to act upon your decision. No tree, forest, cabin, community, nothing, is worth unduly risking your life for things that can easily be rebuilt.

## 10 Questions for Everyone on the Fireline

Regarding Fire Crew Deployment, OSWS #4 addresses when crews may be faced with a potential fire entrapment. Please look over OSWS #4 in detail with your staff. Where the potential for fire entrapment conditions exist, evidence of proper instruction should result in the worker being able to satisfactorily answer the following questions:

1. **What is fire entrapment?**
  - A. A life-threatening situation where personnel are threatened by a sudden change in fire conditions and are unable to utilize escape routes to access safety zones.
2. **What is an "escape route" and how many should be available to you?**
  - A. An escape route is a pre-identified, scouted, trimmed and marked route that provides rapid access to safety zones. Two routes are identified.
3. **How do you confirm that escape routes are available to you?**
  - A. You must confirm your escape routes with your supervisor.
4. **If there are no escape routes, what must you do?**
  - A. Withdraw from the fireline to a safe location.
5. **List four areas that could be used as "safety zones"?**
  - A. Areas mentioned could include:
    - large water sources, marshes and bogs,
    - large rocky areas,
    - large clearings,
    - large areas with sparse fuel,
    - large deciduous patches,
    - a large burned over area, and/or
    - down slope from the fire.
6. **In situations of extreme, variable or unexpected fire behaviour conditions, what must your supervisor do to monitor fire behaviour and threats of potential entrapment?**
  - A. Your supervisor must: appoint a competent "Lookout" to monitor fire behaviour and threats of entrapment; monitor radio communications; confirm receipt of communications; and ensure workers are aware of the fire behaviour.
7. **At minimum, how often must a Lookout report to the supervisor/fire crew?**
  - A. The Lookout must report to the supervisor at least hourly or more frequently if fire conditions become extreme or there is a change in weather conditions.
8. **What right/responsibility does a fireline worker need to exercise if, in their opinion, the risks of fire entrapment may be an undue hazard due to fire behaviour or loss of communications?**
  - A. The worker must exercise their right/responsibility to disengage by notifying their supervisor of their reasonable belief.
9. **How would you best protect yourself in an entrapment situation?**
  - A. To best protect yourself, you would complete the following:
    - Shelter yourself in a large area that is light or free of fuels (rocky area, water/wet area, ploughed field, a 'cool' burned area, bulldozed clearing, etc.).
    - Find a fuel-free depression or trench, preferably behind a rock or dirt pile so to block radiant heat.
    - Protect yourself with clothing: sleeves down, collar up, gloves, goggles and hard hat on.
    - Lie flat, facedown, parallel to the flame front.
    - Keep face down and protect your airways by taking shallow breaths close to the ground.
    - Curl arms and hands around head and ears.
    - Cover yourself with dirt if possible.
    - Wet clothing if possible.
    - Do not wear synthetic packs or materials.
10. **Under what circumstances would a worker who does not know established safe work procedures to avoid entrapment be permitted on the fireline?**
  - A. If a person is under the direct and immediate control of a person who can lead/direct others in following the safe work procedures (i.e.: a BC crew supervisor).

My goal with these bulletins is to make people think and talk about safety. **Incidents can happen to you!** Please contact me at 250 387-3726 or [Brad.Hartley@gov.bc.ca](mailto:Brad.Hartley@gov.bc.ca) should you have any safety related question.

Safety is about YOUR choices – not safety bulletins,

Brad Hartley  
Safety Officer  
HQ Victoria

**2 Escape  
Routes!**

# Personal Fire Shelters for Wildfire responders in British Columbia

Judi Beck, Ph.D., R.P.F.

April 3, 2005

## Introduction

A review of the need and use of BCFS fire line personnel to carry shelters was requested by staff following the 2003 fire season, when stocks were depleted. Fire shelter stock in British Columbia was depleted in 2003 and the shelter now used in British Columbia is no longer being manufactured. In British Columbia, fire shelters were first introduced in the mid 1980's following the Butte fire in the US. Initially fire shelters in British Columbia were issued to Rappel and Unit crews and subsequently to Initial Attack crews. Operational Safe Work Standard 4, which makes it compulsory for all regular and auxiliary staff assigned to active fire line duties to be trained in the use of and carry approved fire shelters, was introduced following the 1994 fire season. No written rationale or justification for their implementation can be found.

Fire shelters are manufactured in the United States, and a new fire shelter has been developed that is said to offer improved protection from radiant and thermal heat. Improved performance specifications have been documented by laboratory tests, and on instrumented prescribed and experimental fires (Butler and Putnam 2001; Putnam and Butler 2004). The performance of the new shelter is superior to the old one, although it is larger and weighs more (4.2 lbs vs 3.4 lbs). However, there are no CSA (Canadian Standards Association) or NIOSH (National Institute Occupational Safety and Health) standards for fire shelters. The American adoption of a new system, which includes the fire shelter, training shelter, video and booklet, began in June 2003. About 50,000 of the new shelters have already been delivered to the USA. A complete transition to the new shelter is expected to take another 2 to 4 years in the US.

	New Fire Shelter	Current Fire Shelter
Weight - w/o case	4.2 lbs	3.4 lbs
Folded size - w/o case	8.5" x 5" x 4"	8.5" x 5.5" x 3"
Folded Size - w/case	9" x 5.75" x 4.5"	9" x 5.75" x 3 1/8"
Deployed Dimensions	86" long	71" long
	15.5" high	24" high
	31" wide	48" wide
Cost	\$256 US	\$65 US (approximate)
	\$396 CND*	\$185 CND*

\*Canadian supplier costs exceed exchange rates.

A technical review of personal fire shelters was conducted in consultation with national and international technical field experts, Ministry staff and Joint Safety committees. In 2003, skidder operators, line locators, dozer operators, flatbed drivers and others working on fires for the province make decisions to remove themselves from the fire area due to the fire environment at the time. In British Columbia, constant fire assessment is a matter of routine and disengagements are a common practice.

## History of Fire Shelters and their Use

Fire shelters were developed simultaneously in Australia and the United States during the late 1950's. In Australia the protective tent was withdrawn from the market in 1967 because a manufacturing error produced a highly flammable resin and as a result of this an occupant received severe burns inside the tent during a field test.

### **United States**

On 2,992,582 wildfire incidents in the US from 1980 – 2002, there were 84 burnovers and entrapment related fatalities, and over 1100 fire shelter deployments. The USFS claims that over 300 lives have been saved as a result of fire shelters, although the number of lives lost as a direct or indirect result of implementing a mandatory fire shelter program is unknown. Recent research in the United States indicates that US firefighters indeed took additional risks because they had fire shelters (Schindler 2003; Cheney *no date*).

On the Butte fire in 1985, protective shelters were attributed by the US Forest Service to having saved the lives of at least 60 of the firefighters who were overrun by a fast moving crown fire. However, Australian fire expert Cheney noted that the incident report did not ask the question as to why the firefighters were placed in danger in the first place (Cheney *n.d.*). Cheney also suggests that the greater level of aggressive firefighting tactics that are used in the US may inevitably lead supervisors to ignore early warning signs and inadvertently placing firefighters at additional risks of entrapment. For example, although highly active fire behaviour was observed when the Butte fire was 3 km away and at least 2 hours before the fire reached the ridge line, no efforts were made to remove firefighters from the site. Cheney concluded that these firefighters were unnecessarily exposed to high-intensity fire, and these could have been avoided by sound planning and well established disengagement practices and behaviours..

Fourteen firefighters were killed in a single incident on the South Canyon fire in the US on July 6<sup>th</sup> 1994. The investigation of the fatalities found that 12 of the firefighters who perished did not have enough time to open their shelters and get under them. Two of the firefighters who perished had fully deployed their shelters but still succumbed to smoke inhalation and heat. Twenty-six firefighters survived by fleeing across the ridge-top to a lee-slope. Eight others deployed in a safety area on burnt ground, and one member of this group survived unscathed without deploying a fire shelter. Specific warnings of high winds and extreme fire behaviour although known were not conveyed to the firefighters and as a result firefighters remained on a dangerous section of the fireline until blow up conditions occurred.

Limited field results from experimental crown fires conducted on flat terrain illustrate the vulnerability of all fire shelters tested; fire shelters are not able to survive extended flame contact (Putnam and Butler 2004).

Wildland firefighters who try to use their hand-held radios inside fire shelters are unlikely able to communicate with their supervisors and may not have the ability to communicate with other firefighters inside fire shelters just 50 feet away (Etter 2003). Transmissions from the older VHF (very high frequency, 30 to 300 MHz) Bendix-King radios were not weakened as badly as those from the newer UHF (ultra high frequency, 300 to 3,000 MHz) Motorola Astro XTS 3000 radios. The standard fire shelter carried by wildland firefighters did not weaken the transmissions as much



as the new fire shelter design that is just beginning to be carried by wildland firefighters. Essentially, firefighters could shout and be heard as far as if they used their new UHF radios inside a fire shelter.

### **Australia**

The total number of wildfire incidents in Australia is not available, but there has been 23 burnover and entrapment related fatalities of firefighters in Australia from 1980 – 2002 (January 2005, personal communication with Jim Gould, Research Leader, Bushfire Behaviour and Management CSIRO Forestry and Forest Products, ACT, Australia). These fatalities have been attributed to sudden changes in fire behaviour, under-estimating existing fire behaviour and its potential, and equipment failure (response engine) due to severe burning conditions. Despite the fact that fire shelter research began in Australia, fire shelters are not used in Australia. Cheney (*n.d.*) recently conducted a review of *“the application of personal fire shelters for wildfire fighters in Victoria”* and concluded that fire shelters could not be recommended for use in the state of Victoria because

- *“The history of protective shelters shows they do not guarantee survival in all situations;*
- *Most entrapments in the US have occurred because the potential for changed fire behavior had been ignored; and*
- *There is evidence that the provision of fire shelters will encourage risk taking and this should be avoided.”*

Rather, Cheney suggests that *“fire authorities improve fire management and fire suppression training to recognize potential changes in fire behaviour and to ensure that systematic and safe working procedures are adopted at all times.”*

### **Canada**

On 194,855 wildfire incidents in Canada from 1980 – 2004, there has been a single burnover related fatality, and 3 documented shelter deployments. Fire shelters have not been responsible for saving lives in Canada.

There have been only 2 incidents in Canada where shelters were deployed, and both incidents occurred in Alberta. Only the Chisholm entrapment incident has been documented (Beck *et. al.* 2001). The Chisholm entrapment incident involved BC and Alberta crews, and the Alberta crews involved were working under BC's leadership. The environment was survivable in the absence of fire shelters, and a safe disengagement was conducted. The only other known shelter deployment in Canada was never formally reported or documented. In 1981, American crews were working on a fire in Buffalo Head Hills in northern Alberta. The crews encountered what they perceived to be extreme fire behaviour, deployed their shelters but disengaged safely with no injuries.

Canadian Interagency Forest Fire Centre (CIFFC) member agencies do not use fire shelters. CIFFC member agencies indicated that they have a low risk tolerance for entrapment, and that fire shelters are not effective for fuel types with duff or prone to crowning.

### **British Columbia**

British Columbia's practice to issue fire shelters is not consistent with those of the rest of Canada. Only British Columbia requires its wildland firefighters to carry fire shelters, although fire shelter

are not mandatory for contract crews, dozer operators, line locators, industry firefighters, or for crews imported from out-of-province.

In British Columbia there have been no injuries or burn over related fatalities since the operational introduction of fire shelters in 1994. The last known burn over fatality in BC occurred in 1991 (Ernie Kingston). Ernie Kingston was not a Ministry worker but was a forest industry worker who died of thermal burns sustained during initial response to a fire on a steep block of felled and bucked timber with heavy slash on site. Details in the coroners report, released with the permission of the Kingston Family, point to the fact that this fatality would not have been prevented by the use of either the new or old fire shelter (January 2005, personal communication with Marty Alexander, Senior Fire Behavior Research Officer, Canadian Forest Service, Northern Forestry Centre, Edmonton, Alberta). WCB now requires fire assessment and fitness standards for forest industry sector workers. Since this time any field forest industry worker who is required to respond to a fire must take the Basic Fire Suppression and Safety course (S-100) and subsequent S-10A (annual recurrency component of S-100) before they can work on a fire. The S-100 is an acceptable standard and meets the requirements of the BC Workers Compensation Board Regulations with regards to basic forest fire fighting training.

Fire shelters were first made compulsory for what was considered to be high risk responders, but history would suggest that untrained first responders are more likely to be involved in fatality incidents. The forest industry sector does not have a mandatory shelter program for industry first responders, but have implemented the S-100 as an industry training standard that include fire assessment training, but does not include avoidance training or procedures.

In the United States, training programs set training, inspection and proficiency requirements for fire shelter deployment. However, entrapment avoidance training is not required in the US. British Columbia has no established proficiency standard, published inspection standards are not followed consistently and deployment training across the province varies from 3 minutes to 1 hour. Protection's training program emphasizes entrapment avoidance and fire assessment.

British Columbia adopted "LCES" from the US, but not all supporting industry staff and agencies know what the acronym means or how to satisfy the requirements for a "Lookout, Communications, Escape Routes, and Safety Zones" and "LCES" doesn't state explicitly that the fire environment needs to be assessed. British Columbia's entrapment avoidance training material does not incorporate details on what is required of a lookout, or the latest findings of operational research on escape routes (Dakin 2002; Baxter *et al.* 2004) and safety zones (Butler and Cohen 1998a, 1998b).

It is important to note that from a human factors perspective, emergency responders would likely revert to their best-practiced behaviour when operating under undue stress (Pivetta 1998; Kiesewetter 2003). This means that fire assessment and avoidance training must be offered in the classroom but more importantly behaviours must be practiced in the field. Formal field training for fire assessment and dis/engagement has not been practiced in British Columbia. Field training must not only include "Assessing the Fire Environment: Stop, Assess (fuels, weather and topography – the fire behaviour at present and how it is likely to change in the future), Dis/engage, Report, Do-it-Again", but this behaviour must be practiced in the field and repeated in order for it

to become automatic. It is important to be very careful with what training and behaviours our program adopts, emphasizes and practices.

### Risk Assessment

It is also important to note that the government has adopted an Enterprise-wide Risk Management (ERM) as a management practice that should receive top priority, and Risk Management Branch have been consulted to support the assessment of the program's use of fire shelters. Using Tables 1A through 1D, the risk of fire fighter turnover related fatality in British Columbia is calculated to be "low". [Frequency of Exposure is "rare" (Table 1A - Rating 1). Consequence is "Single to multiple fatalities" (Table 1B - Rating 60), and the Likelihood of the consequence happening is calculated at "Extremely Remote" (Table 1C - Rating 0.5). The overall Risk Score is "low" (Table 1D -  $1 \times 60 \times 0.5 = 30$ )].

**Table 1A – Frequency of Exposure to the hazard**

**Hazard** means a thing or condition that may expose a person to a risk of injury or occupational disease.

Frequency of Exposure		
The hazard-event occurs:	Description	Rating
Continuously	many times a day	10
Frequently	approximately once a day	6
Usually	from once per week to once per month	3
Occasionally	from once per month to once per year	2
Rarely	it has been known to occur	1
Very Rarely	not known to have occurred, but considered remotely possible	0.5

**Table 1B – Consequences - typical/most likely result of the hazardous event**

Consequences		
Degree of Severity of Consequences	Damage	Rating
Catastrophe: numerous fatalities	extensive damage [over \$1 million.]; major disruption	100
Several Fatalities	damage \$500,000 - \$999,999	75
Fatality	damage \$100,000 - \$499,999	50
Extremely serious injury or occupational disease (permanent disability)	damage \$1,000 - \$99,999	30

**Table 1C – Probability/Likelihood of consequences happening**

Likelihood or Probability		
The accident sequence, including the consequences	Description	Rating
Most likely & Expected	Is the most likely & expected result if the hazard-event takes place	10
50/50 Chance	Is quite possible; would not be unusual; has an even 50/50 chance of happening every time	6
Unusual Sequence or Coincidence	Would be unusual sequence or a coincidence	3
Remotely Possible	Would be remotely possible sequence or coincidence. It has been known to have happened.	1
Extremely Remote	Extremely remote but conceivably possible. Has never happened after many years of exposure.	0.5
Practically Impossible sequence or coincidence	A "one in a million" possibility. Has never happened in spite of exposure over many years.	0.1

**Table 1D - Risk Score**

“Risk” is the chance of injury resulting from that exposure.

Risk Score		
Hazard Classification	Description	Score
Very High	Scary – Stop the ‘activity’ and correct problem immediately	> 750
High	Correct problem immediately	250 - 750
Medium	Correct problem	90 - 250
Low	Indicator that something needs to be done. Lower degree of urgency.	20 - 90
Perhaps Risk Acceptable	Judgement call	< 20

To be successful, the fire shelter program must be based on sound, proven technology with consistent implementation standards without which there would likely be a higher risk associated with fire shelter program continuance.

### Costs Benefit Analysis

A standard risk assessment should include a costs benefit analysis of the fire shelter program. To date, the British Columbia Protection Program has spent approximately \$203,500 on fire shelters with an additional \$26,125 spent on fire shelter training per year. The new fire shelter will cost an additional \$450,000 for shelters and funding of \$25,000 would also have to be made available for new or modified fire line packs to accommodate the dimensions of the new fire shelter. The total cost of risk treatment for shelters is estimated at over \$704,625 with no apparent benefit to life safety or risk reduction in BC or Canada.

Continued risk assessment of Protection’s safety program with a review of incidents and accidents and the consequences thereof, would highlight program risks that would benefit more from program attention.

### References

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## Recommendations

### **Option 1**

- Step 1 Obtain funding and purchase new fire shelters.
- Step 2 Implement a rigorous training program for fire shelters that includes practiced deployments to a set standard, and establish a comprehensive fire shelter program that is audited.
- Step 3 Abstain from dispatching wildfire responders, industry workers, contractors, or CIFFC agency responders who do not possess a fire shelter and are not trained in its use and practiced to a standard that is audited.

### **Option 2**

- Step 1 Bring British Columbia's current practices in line with those of the rest of Canada and discontinue the requirement for fire fighters to carry fire shelters and training in fire shelter deployment. Our risk tolerance for entrapment is low; entrapment is to be avoided always by following established entrapment avoidance procedures.
- Step 2 Continue to analyze risks to wildfire responders and explore all opportunities to control these risks.
- Step 3 Continue to place training emphasis on fire assessment, entrapment avoidance and leadership. Crew leaders must continue to understand and communicate fire behaviour on a regular basis to ensure that fire behaviour conditions of the day or hour are communicated to and understood by all fire line staff. Training materials should reaffirm the requirement for wildfire responders to ensure the prevention of incidents by the on-going assessment of fire conditions. Training and workplace instruction should concentrate on requiring all wildfire responders to:  
STOP  
ASSESS the general fire environment and its potential  
DIS/ENGAGE – make a conscious decision to continue or not  
REPORT your assessment to your supervisor at designated time intervals  
DO IT AGAIN
- Step 4 Strengthen reporting to ensure that any unsafe practices or conditions are documented, discussed, and any necessary adjustments in practices are made.

### **Recommend Option 2**

**Option 2 Approved unanimously by the Protection Leadership Team**

**April 21, 2005**

**Peter Fuglem, Director Protection Program  
British Columbia Forest Service**

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