

# Fire Environment Size-up: Human Limitations VS. Superhuman Expectations

by Jim Cook



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In August, 1994, an article appeared in The Missoulian newspaper that shook an already stunned wildland firefighting profession. In this article, Quentin Rhoades, a Forest Service smokejumper, stated that, at the highest skill levels in the wildland firefighting business (hotshots and smokejumpers), it is common practice to violate the "10 Standard Fire Orders." Reaction to this article was swift and furious, from the firefighter level to Washington offices. Many felt Rhoades' comments were just bravado from a macho fringe, while others agreed that the "10 Standard Fire Orders" did not always work in the real world.

My initial reaction was intense disagreement with Mr. Rhoades' opinion. I said that 10 years of experience, primarily initial attack on small fires, was not a valid experience base for him to make such a generalized statement. I recalled time spent more than 20 years ago memorizing the Fire Fighting Orders to recite to a Fire Control Officer during inspection time. I thought about my old yellow Fire Fighting Orders decal stuck inside my hardhat and felt it had held me in good stead during

my career. But slowly the thought built in the back of my mind that maybe Mr. Rhoades was one of the few willing to admit that the 'Emperor has no clothes.'

I still disagree with the underlying rationale of sacrificing safety guidelines for tactics to keep every fire small. The danger a fire poses to firefighters is not a function of fire size, rather it is a function of time and location that firefighters choose to engage the fire. But I do agree with Mr. Rhoades regarding the validity of using our current *10 Standard Fire Orders* and the *18 Watch Out Situations*.

In the months after the South Canyon Fire, I began to think carefully about how I applied the Fire Safety Guidelines on fire assignments: the *10 Fire Orders*, the *18 Watch Outs*, the *4 Common Denominators*, the *Downhill/Indirect Line Construction Guidelines*, and *LCES*. Did I use them all on each and every shift? Could I recall them from my long-term memory into working memory with non-stop radio chatter and a few spot fires distracting me? Were they organized in some manner that would help me use them in a procedural way? The answer to all these questions was NO!

### **Sometimes Tradition Lets Us Down**

Questions like these encouraged me to analyze what firefighters really do to size-up an assignment when they walk onto the fireline. Examining my own size-up approach further made me realize how much of what is involved is intuitive. It took some time and thought to break down the steps that I use to size-up the fire environment and decide if a given assignment is safe. From the perspective of someone who values the traditions of this business, I found the results somewhat unnerving.

At the risk of being ostracized from the fire world, I have to say that the *10 and 18* as they are presently structured were not in my size-up approach. Was it because the *10 and 18* are so well embedded in memory that I don't even know when I am thinking about them? Maybe, but I doubt it. A more plausible explanation is that the overwhelming number of guidelines learned were mentally condensed into an essential schema that enable me to perform the task of fire environment size-up.

In the mid 1980's the *Standard Fire Fighting Orders* were converted into a mnemonic device and the *13 Situations That Shout Watch out!*

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were expanded and made into a checklist in order to encourage their use as job aids (National Wildfire Coordinating Group, 1987). However, the *10 Standard Fire Orders* and the *18 Watch Out Situations* that evolved both fail as job aids because they do not provide a concise, sequential guide for sizing up a fire assignment. They also fail in another very important way. The human mind can only comprehend seven, plus or minus two, concepts or inputs when engaged in a task. This is known as Miller's Law, and was determined during research done for the U.S. Army in the early 1950's by George A. Miller (1956). The *Fire Safety Guidelines*, as they are currently structured, exceed that limitation.

A quick overview of the various *Fire Safety Guide lines* reveals a tangle of nearly 50 directives that range from critical risk mitigation procedures to vague statements concerning attitudes and leadership. Let's look at a few examples:

- The *LCES* system (Gleason, 1991) is now a stand alone item. It covers three *Fire Orders* (6, 7, & 8) and three more *Watch Outs* (3, 7, & 12). Is this duplication necessary? Ask yourself which is easier to remember and apply?

- Three more *Fire Orders* (3, 4, & 5) tell you to gather information and instructions. If those are orders, why then are three *Watch Outs* (4, 5, & 6) needed to tell you to be wary if you don't gather information and instructions?

- One *Fire Order* (3) tells you to recognize weather conditions but no *Fire Orders* mention fuel or terrain conditions. Do you adequately assess the rest of the fire environment when you use the *Watch Outs* (14, 15, & 16) and the *Common Denominators* (2, 3, & 4)?

- The last two *Downhill/Indirect Guidelines* (8 & 9) simply tell you to use the *Fire Orders* and *Watch Outs*. Shouldn't they have been considered prior to using the *Downhill/Indirect Guidelines*?

- Providing for safety first, maintaining control, keeping calm, and acting decisively are all desirable traits (*Orders* 1, 9, & 10). But is it reasonable to expect a few brief sentences to be an effective method for imparting those traits to an individual? Are all the current guidelines truly useful for developing a decision making process to use in field or can they be shaped into a more concise system?

## Lessons From the Dinosaurs

After reflecting on my own non-standard size-up process, a job analysis of others in the business seemed like the logical next step. A human factors technique that is often used in a job analysis is to have best performers describe or demonstrate how they perform a job. To do this type of analysis, ten hotshot crew supervisors with ten or more years experience supervising their crews were surveyed. These old hands, or "dinosaurs" as they are respectfully called by some, were asked to describe how they size-up a given fire assignment for safety. The term "size-up" in this instance was defined as the process and cues used to assess the fire environment and make the decision to commit their crew to a given assignment. Each supervisor surveyed was asked to describe their size-up process independently. This was most definitely an informal survey with a small sample size. However, the analysis does provide us a very good starting point to examine how fire size-up is accomplished by those who perform the job most often.

The most striking result of this analysis was the brevity of each supervisor's size-up process. Averaging a little over 8 steps, each was easily written out on a single piece of paper with room to spare. A second item of note was that only two of the respondents identified the use of the *10 Fire Orders* and *18 Watch Outs* in their size up process. A third respondent identified the use of Carl Wilson's *4 Common Denominators* (1974) in their size-up.

A synthesis of the survey responses revealed four common elements that were emphasized by the group. First, develop an awareness of the current fire situation through information gathering efforts. This information gathering can be referred to as situational awareness (Klein, Calderwood, and

Clinton-Cirocco, 1988). Second, assess the work assignment for hazards. The hazards considered were both environmental conditions and tactical situations. Third, establish a safe work environment. The *LCES* system was identified by nine respondents as a primary mechanism for achieving this objective. Fourth, almost every respondent described a definite conscious decision point for committing or not committing their crew to the given assignment.

There were several items not included in these four common elements that may be of interest.

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First, half of the respondents identified "time of day" as playing a role in their size-up process. Additionally, four of the respondents alluded to decisions based on experience in one way or another. One individual described it as matching the new situation to a similar one from the past as a way of recognizing known hazards and successful tactics from the past. Another described this as a mental base map image of the fire environment with overlays of various fuel types, weather conditions, and terrain built from past experiences.

Finally, the two most experienced individuals in the survey each had observations worth repeating here. One simply said "Always go into a situation think-

ing escape and safety." The other had this to say: "It is much easier now to give up on an assignment, even after putting in many hours, than it was 20 years ago."

## A Model for Discussion

Fire environment size-up is a primary job skill for the individuals surveyed, a task they may perform on a nearly daily basis during the fire season. However, for those individuals involved in fire as a collateral duty, it is a skill they utilize perhaps only a few days or weeks each year. As such, it may not be a highly developed job skill. Obviously, one cannot teach the experience that the dinosaurs have accrued over the years. But we can distill these techniques into a model which enables new or part-time firefighters to develop their situational awareness skills in order to more effectively size-up the fire environment.

The model that follows was developed from the results of the survey described previously. It is a four step process that can be used as a blueprint for a standard protocol or decision support system. The criteria used to design this model were:

1. Guide users through the correct sequence of a procedure in order to accomplish a task.
2. Reduce demand on the working memory required to accomplish a task so more attention can be devoted to perceptual needs.
3. Be generated from a job analysis.

The model's four step process incorporates several job aid checklists and provides a procedural guide for their use (see Table 1). The *Look Up, Look Down, Look Around Indicator* checklist is used in its current form. The *LCES* system

Table 1. The Fire Environment Size-up Model.

<b>STEP 1 SITUATION AWARENESS</b>	
Obtain Information	
*Tactical Instructions	*Previous Fire Behavior
*Communications	*Known Hazards
*Weather Forecast	*Local Factors
Scout the Fire	
<b>STEP 2 RISK ASSESSMENT</b>	
Estimate Expected Fire Behavior	
JOB AID: <i>Look Up/Down/Around Indicator List</i>	
Identify Watch Outs	
JOB AID: <i>Tactical Watch Outs</i> (see Table 2)	
JOB AID: <i>Urban/Wildland Watch Outs</i> (see Table 2)	
Identify Other Safety Hazards	
<b>STEP 3 RISK MANAGEMENT</b>	
Establish Anchor Point and <i>LCES</i> - MANDATORY	
Establish Other Risk Management Measures - AS NEEDED	
JOB AID: <i>Downhill Checklist</i> (see Table 2)	
Address Other Identified <i>Watch Outs</i> /Hazards	
<b>STEP 4 DECISION POINT</b>	
Has the work environment been made safe?	
YES - Next question	NO - Reassess situation
Do the strategy and tactics make sense to you?	
YES - Next question	NO - Reassess situation
Has a briefing been given with feedback opportunity?	
YES - Initiate action	NO - Reassess situation
RE-CHECK PROCESS AFTER ANY SITUATION CHANGE	

is central to how the model approaches risk management. The *18 Watch Outs*, the *Urban/Wildland Watch Outs*, and the *Downhill/Indirect Guidelines* have been redesigned to enable the user to apply them as true job aid checklists (see Table 2).

A close look at the model will show that all of the Fire Orders, Watch Outs, Downhill Guidelines, Common Denominators, and LCES are covered in the four step process or in the job aids. There are many hard won lessons learned that have been built into our current Fire Safety Guidelines. The intent here is to retain those lessons while integrating them into a system more readily applied in the field.

There is a growing recognition for the need to change the *Fire Safety Guidelines* (Braun and Latapie, 1995; Harbour, 1995; Human Factors Workshop, 1995; Putnam, 1995; and Weick, 1995). There are probably as many ideas for restructuring the *Fire Safety Guidelines* as there are Red Cards, but particular weight should be given to the methods used by our most experienced firefighters. This model is offered not as a finished product, but as a starting point for further discussion. It is a synthesis of experience from dozens of fire seasons and thousands of fires. It is about meeting superhuman expectations while living with human limitations.

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Table 2. Redesigned Fire Safety Job Aids.

#### TACTICAL WATCH OUTS

1. Building fireline downhill (see *Downhill Checklist*)
2. Building underslung fireline.
3. Building indirect fireline or unburned fuel remains between you and the fire.
4. Attempting frontal assault on the fire.
5. Terrain and/or fuels make escape to safety zones difficult.
6. Suppression resources fatigued or insufficient.
7. Night time operations.
8. Remote location operations.
9. Urban interface operations (see *Urban/Wildland Watch Outs*)

Each of these *Watch Outs* requires that you establish risk management measure(s).

#### URBAN/WILDLAND WATCH OUTS

1. Poor access and narrow one way roads.
2. Bridge load limits.
3. Inadequate water supply.
4. Wood construction and wood shake roofs.
5. Natural fuels 30 feet or closer to structures.
6. Structures located in dangerous terrain features surrounded by flashy fuels types.
7. Chaotic suppression actions or panic during public evacuation.

Each of these *Watch Outs* reduces your ability to safely defend structure(s).

#### DOWNHILL CHECKLIST

1. Assignment has been scouted.
2. Supervising overhead can see the fire or have direct contact with a lookout who can see the fire.
3. Fireline is anchored at the starting point.
4. Fire is not present directly below starting point.
5. Fireline is not in a chute or chimney.
6. Crew(s) or scout(s) are working the bottom of the fire and communication has been established with them.

Use direct attack if possible; if not, consider firing from the anchor point as line construction progresses.



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