Crandall Ranger Station Tree Felling Accident

Sawyer Injury – September 14, 2010

Accident Prevention Analysis

"The difference between a B and a C faller is the ability to recognize and mitigate hazards."

USDA Forest Service, Rocky Mountain Region, Shoshone National Forest

CONTENTS:

EXECUTIVE SUMMARY:

On September 14, 2010, an Assistant Fire Engine Operator (AFEO) was struck and pinned to the ground by a tree he was cutting near the Crandall Ranger Station on the North Zone of the Shoshone National Forest. Two crewmembers witnessed the incident and took action to free the faller, and initiated pre-planned emergency response protocols. The AFEO was evacuated by air to West Park Medical Center, evaluated, treated for four broken spinous processes and released two days later.

A Facilitated Learning Analysis (FLA) was initiated on September 17th, including analysis of upstream decision making and risk management for current and future hazardous fuels treatment and hazard tree removal projects on the Shoshone National Forest as well as the technical and environmental aspects of the accident. There is a general feeling of concern that "normal" Forest fuels and hazard tree removal work is becoming more complex due to increased exposure to risk from tree mortality. This FLA identifies several areas of potential improvement, and highlights the operational shift while addressing the beetle kill conditions that much of the Intermountain West is experiencing.

The review team met with Shoshone National Forest Staff, North Zone Staff, the engine module and the AFEO separately and as a large group over the course of three days. It should be noted that while the in-briefing was underway, the participants began a rich discussion of risk management, High Reliability Organizations (HRO), and suggestions from the staff on how to improve operations in hazardous tree and fuels reduction activities.

"We (Forest Leadership Team) were in a meeting when the accident occurred talking about oversight and organizational change to meet the challenge. . . "

In meeting with the engine module, it is apparent that they are running a well educated, well trained, and hard working crew. The module practices internal mentorship, particularly in chainsaw operations, and has a strong sense of identity. There is a feeling of teamwork and open communication within the crew, and pride for accomplishing work quickly and efficiently. These attributes, sought after in all fire and fuels programs, may have resulted in "Compliance Drift." This means that over time, safety margins and procedures slowly, subconsciously, eroded due to the pace of work. Escape routes and stump shot in the accident cutting unit are indicators that the crew had not implemented important safety features, yet still had a feeling that they were "nailing" their cuts. In other words, they had previously missed safety features and gotten away with it, which reinforced that they could continue to skip the required steps.

"The Forest Service has created monsters with the fuels program. Our folks work hard, get rewarded with more work (and more money) and it drives them to work harder. . . they see they're a 13/13 or 18/8 and by working harder, they can work longer in the year and make mortgage payments."

The medical response to the event was rapid, professional and practiced. Zone firefighters designed and implemented a simulation exercise in July that incorporated Cody Dispatch Center (CDC), all three engine modules on the North Zone, and some members of the zone staff. The simulation focused on communication during an incident within an incident, and was generally thought of as excellent practice prior to the real accident.

"You should have heard the radio traffic, it was so smooth. Everyone said exactly the right thing at the right time."

Communication and mental models between staff members and operational resources played a small role in the event. The mental models of the work, compared to the work occurring on the ground were not aligned at several levels and may have led to different decisions about risk management and alternative solutions for removing hazard trees. For example, one program manager mentioned that he was somewhat surprised when visiting a cutting unit on the size and number of trees dropped. He felt a feller buncher may have been an effective alternative, while the fire module felt that felling these types of trees with chainsaws was a normal operation.

At the end of the initial three days spent by the review team in Cody, the participants and team agreed that many contributing factors had been discussed at length, and many potential solutions brought forward. However, there was general unease on whether or not the group had figured out a way to prevent further accidents like this one. All of the supervisors stated that they felt personally responsible for the accident, and wanted to know if there were additional tools or methods available to make their operations safer. In that light, the review team suggested a human factors approach, and moving the process to more of an Accident Prevention Analysis (APA) focused on the time just prior to, and during the cutting of the tree. This was implemented the following week and is included in a separate section titled "Human Factors Analysis Appendix."

The team suggests that readers view this report as two separate, but related documents. The first portion, excluding the Human Factors Analysis Appendix, should be read first to obtain a general understanding of events and upstream decisions that influenced the outcome of the incident.

The Human Factors Analysis includes a general review of the critical chronology surrounding the

accident, and can be read during a separate sitting. The Human Factors Analysis is written with a focus on the faller, his supervisor and the accident, but should not be construed as blame or failure. The Shoshone National Forest, North Zone, and review team have taken considerable steps to draw out facts *and* perceptions, recognize them for what they are, and learn from them. In doing so, this report does not hesitate to point out mistakes that occurred or accomplishments achieved, as it is necessary for continuous learning. Those who feel they could never be caught in the same situation are cautioned to re-evaluate their own processes. As the analysis points out, our minds work in a predictable way. Most readers will not have to look far to find similar scenarios happening close to home.

The review team would like to thank everyone on the North Zone, the Shoshone National Forest and the Rocky Mountain Regional Office for actively participating, learning and educating from this event. It is a great credit to all involved that they are willing to dig deeper.

Staff "We're logging out there."

Crew "That's what we've been doing for years."

CHRONOLOGY OF EVENTS:

2006

Homestead Park II Escape Prescribed Fire Review

Little Venus Entrapment and Peer Review

2008

AFEO's first attempt at chainsaw C certification

2009

October

Region 2 Hazard Tree Identification Experts come to Forest to train employees scheduled to complete hazard tree assessment and marking. Not all operational resources receive training.

November

Shoshone National Forest Hazard Tree Mitigation for Campground and Administrative Sites Strategic Action Plan FY2010

2010

April

Long Term Hazard Tree Management Safety Plan draft written

July

North Zone conducts full scale medical simulation exercise

August

13th-- Project started. Tailgate safety session subject is "site specific project safety"; potential for bad footing in creek bed is noted

20th-- Tailgate safety session subject is "Project work in high wind conditions", communication noted as being difficult for area

23rd-- Tailgate safety session subject is "Complacency", slips, trips and falls covered.

Members of Crew assigned to various fire assignments, sporadic small scale work on project through late August

September

1st-- Some trees cut by AFEO for C Certification on fire assignment.

9th-- 2-3 trees cut by AFEO for C Certification on fire assignment; recommended for C Certification

13th-- Some work done in unit, initial sizeup of tree, logs across creek and behind accident tree are cut (escape route). Tailgate safety session subject is cutting dead snags. Work is scaled back due high winds in unit. Crew returns to station early to attempt to complete administrative tasks.

14th

~1200 Work on unit begins for the day

~1415 Module Leader leaves unit to replace Bobcat part in town, leaving AFEO and 2 crewmembers on site

~1445 Decision to cut tree by AFEO

1446 First crewmember calls dispatch, ambulance and Lifeflight requested, ambulance eta=1 hour

1446 Second crewmember begins cutting log off AFEO, saw pinches

~1448 Second crewmember uses second saw to finish cutting AFEO out

~1448 AFEO walks out of trees to road under own power, initial medical assessment

1450 No Lifeflight available in Billings, flying mission

1453 Request to page out 1st Responders in cutting area (volunteers/locals) from ZFMO

1455 No Lifeflight available in Idaho Falls, flying mission--referred to Pocotello

1503 No cell coverage, vitals passed over radio

1505 Yellowstone helicopter not available

1508 ZFMO checks with dispatch on Lifeflight status

1510 Pocotello Lifeflight available, coordinates and frequencies passed, pilot checking weather

~1516 Pocotello Lifeflight lifts off

1524 ETA passed for Lifeflight=1 hour

1528 SFEO on scene, update on vitals

1529 SFEO treating patient for shock

1548 Ambulance on scene, keep Lifeflight coming

1628 Lifeflight on scene

1643 Lifeflight off ground

1652 Arrival at hospital (Cody)

15th-- Forest Safety Standdown; 24 hour report released.

16th-- AFEO released from hospital

17th-- FLA Team Ordered

20th-- 72 Hour Report released

21st-- FLA Team Inbriefing

NARRATIVE:

Preceding

The events of the Homestead Park II Escaped Prescribed Burn and Little Venus Fire and entrapment in 2006 led the Shoshone National Forest to incorporate High Reliability Organization (HRO) principles into their operations beginning in the spring of 2007. Key leadership positions were exposed to the concepts and began implementing changes to begin moving the forest back to its customary high performance. There were several avenues and approaches sought by Shoshone personnel to continue improvement in areas like HRO, and risk management. Today, there is a general feeling of attaining goals and practicing principles, but still concern over where they go from here. This perception makes what happened during the Crandall Felling Accident all the more troubling to those involved.

Fire crews on the Shoshone National Forest are currently, and anticipated to be heavily involved in both fuels reduction and developed site hazardous tree removal projects in environments predominately effected by tree mortality episodes such as the bark beetle. The Forest has been experiencing significant insect epidemics since 2002. Over 825,000 acres, or more than 60% of the forested landscape is dead or dying from insects. Affected areas include developed recreation and administrative sites.

The Shoshone is not presently considered part of the primary Region 2 Bark Beetle Theater and was not included in the initial distribution of extra funds to address the problem. The Shoshone National Forest Leadership Team made a decision in 2009 to remove hazard trees from campgrounds, administrative facilities, and other key infrastructure (*Shoshone NF Hazard Tree Mitigation for Campgrounds and Administrative Sites Strategic Action Plan, 11/23/09*) after several severe, high consequence near-misses of both standing dead and green trees falling in campgrounds and work sites. There were several discussions between project planners and operational resources about the project work and how to accomplish the work within expected budget. It was generally agreed that the engine modules possessed the expertise to perform hazard tree and hazard fuels removal work safely and efficiently. The Forest did eventually receive additional funding in FY10, however, decisions to commit force account resources to hazard tree and hazardous fuel removal operations in campgrounds and administrative sites were already being implemented and supplemental funds were committed to fuels reduction contract work in other wildland interface areas.

Through previous years of similar work, ground resources began evolving a system for cutting that included saw teams sizing-up hazard trees instead of only the sawyer. This concept decreases the chance that something will go wrong during the cutting process, because two people are looking at each tree before it is cut to determine hazards, lean, defects, etc., in the tree, and one can serve as a lookout, or spotter. This is not in

conflict with National, Regional, or Forest policy, as the second person leaves the cutting area before the tree is actually cut.

In accordance with the Strategic Action Plan, a *Long Term Hazard Tree Management Safety Plan* was intended to be in place by 3/1/10. Based on comments received from Forest personnel, it is generally felt that while this plan was modeled after current ground operations, and received written feedback, it was not communicated well throughout the Forest. Also, in accordance with the Strategic Action Plan, efforts to identify and mark hazard trees were increased. For the 2010 field season the North Zone hired two GS-5 seasonal employees, provided them training and tasked them with identifying and marking hazard trees in recreation areas and administrative sites. These two individuals worked independently from the crews doing the hazard tree felling/removal work.

While this does not have direct influence on the accident, it is a paralleling action by the Forest and Zone, and exemplifies a disconnection between the planning of the work and the work performed. While the objectives of the unit at the Crandall Ranger Station were to perform hazardous fuels reduction, there were many hazardous trees in the area that needed to be felled prior to working safely in the area. It is generally felt that the hazardous tree marking methods are not making sense to the personnel engaged in felling the trees. Additionally, there is frustration that not all operational resources were involved with the hazardous tree training.

"Did you even go out to the field today?"

The day before and day of the accident, questions were asked of both the Supervisory Fire Engine Operator (SFEO) and the AFEO if they thought they could finish the unit by the end of the week. Post-incident, both expressed that this line of questioning felt like pressure, even though both remember a conversation with the Zone Fire Management Officer (ZFMO) where they learned that all targets were met several weeks prior. The intent for the week following the accident was to move the crew into prescribed fire burning, and/or a more formal hazard tree removal project in one of the Forest campgrounds.

Accident

"All I can think about is the last few seconds and the butt of that tree coming at me."

Several members of a Shoshone National Forest engine module, including the AFEO, had recently returned from a Type 2 Initial Attack handcrew assignment to Idaho. During this fire assignment, the AFEO was evaluated for and received a recommendation for his chainsaw C certification. The AFEO had cut six or more trees for the certifiers, over two days, a week apart. One of the certifiers described his cutting as very good, and that on the final tree the AFEO "nailed everything." Another certifier commented that there were areas for improvement on his cutting, but his safety was solid.

"I was most impressed with the safety … even more so than the cutting."

Following R&R the reunited engine module was reassigned to a hazard fuels project at the Crandall Ranger Station administrative site. The project involved removal of dead standing spruce trees (snags) to reduce fuels and improve public safety at the site. Felled trees were then limbed, bucked to lengths that could be skidded by a Bobcat and decked for a future firewood sale. The cutting site on Tuesday 9/14 was just downstream (north) of a bridge across Lodgepole Creek on the Crandall Ranger Station entrance road.

The crew had been to this same project site the previous day (9/13) but only cut 4 or 5 snags before high winds developed. The AFEO used the remaining time that day to survey the rest of the stand to assess the number of trees remaining to be cut and removed. He did a quick time estimate and safety review. He recognized that there were some complex trees that would take time to safely size up and cut including two snags west of the creek that he felt were C size. The snag involved in the incident was recognized as needing to be removed before the two C trees could be safely cut. The AFEO also cut a log that hung across the creek in a potential escape route, and began sizing up the accident tree mentally for the following day.

The crew left the unit early due to high winds and returned to Cody to complete some administrative tasks. Upon returning to the unit, the AFEO was asked if they had gone out to the unit that day at all. The AFEO perceived this comment as questioning whether they had done any work that day, and became frustrated.

"For us to be in the office is like a sin."

Tuesday morning (9/14) the full crew returned to the project area. Later that day the Bobcat broke down. At that point the SFEO and Lead Crewmember left the project to return to Cody to obtain the parts to repair the Bobcat. The AFEO and two crewmembers remained at the project and continued cutting.

The AFEO fell three more snags before moving to the final snag of the day. Examination of these three stumps revealed that they were cut missing safety features like good escape routes and stump shot. The final tree, a 70' tall, 24" diameter sound snag on the east bank of the creek was the one determined as needing to be felled to open up a lay for the two C trees on the west side of the creek. The snag had a significant lean to the SSW across the creek and toward another live spruce tree, 30 feet away, which leaned across the creek from west to east (see photo 1).

The AFEO proceeded to clear some of the dead and down material present in the creek bed to create an escape route downstream to the north. The AFEO recognized that the green tree in the intended lay created a potential hazard but decided not to remove it, intending to fall the snag to the west side of it. There had been previous discussions on stream bank stabilization, and the AFEO wanted to retain the tree for those purposes. He did remove another tree in the intended lay that was not directly on the

bank, thinking that it would create a potential for “pinching” the snag to be felled, and in order to avoid creating hazards for the bobcat operation.

The AFEO had removed some material from his escape route but a large downed log still remained in the creek located such that it blocked a true 45 degree escape route. The actual escape route was at approximately 70 degrees from the west side of the stump. The AFEO felt using this escape route rather than a 45 degree escape route was a “calculated risk” but would still allow him to safely move away from the snag.

“Never in a million years would I have expected the tree to swing that direction.”

The AFEO recognized that if the snag impacted the leaning green spruce tree adjacent to the intended lay there would be a reaction to the felled tree. To mitigate this potential hazard the AFEO planned to fall the tree to the west side of the base of the green spruce.

The AFEO began the face cut at head level standing in the creek bed. During the face cut the AFEO felt some pressure on the bar and cut as far as he felt comfortable (approximately ¼ diameter) to avoid pinching the bar. He indicated that the height of the cut made gunning the face difficult, but he felt he was within the “ball park” of his intended lay. The resulting face was actually gunned well to the left of the base of the leaning green spruce.

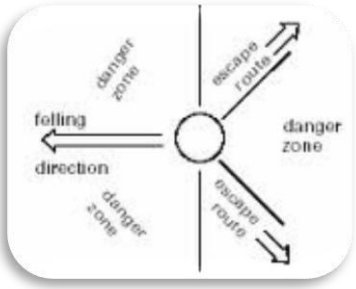
The AFEO began the backcut operation. He bored through the tree and cut up to his holding wood one inch above the horizontal face cut. During a post-accident interview, the AFEO indicated he planned to cut about 1/3 of the remaining backcut from the creek bed and to finish the backcut from the off-side, (above the creek on the east side of the tree). After initiating the backcut, he altered his plan and continued the boring backcut from the original side in the creek bed.

“There were only two ways to get to the other side, underneath the tree, or down the creek bed, and around all the logs, and there was no way I was going to walk under that leaner with a face cut in it.”

The AFEO felt that time was an issue and that the tree would “pop” off the stump early. The tree held to the stump until approx. ½” of wood remained, much longer than he anticipated. As the tree released and the AFEO escaped the stump, he stumbled and fell to his hands and knees, but pushed the saw safely away. The AFEO rolled to his back, and tried to kick himself up the west side of the creek bed to put more space between the falling tree and himself.

The snag fell in the direction of the face cut toward the leaning green spruce and impacted it approximately 20’ up the trunk. The reaction caused the butt end of the snag to swing upwards. The whole tree then slid backwards to the NNW, and landed on the log behind the stump. It then slid and bounced down both the leaning tree and the log into the escape route, pinning the AFEO against the rocky side of the creek bed.

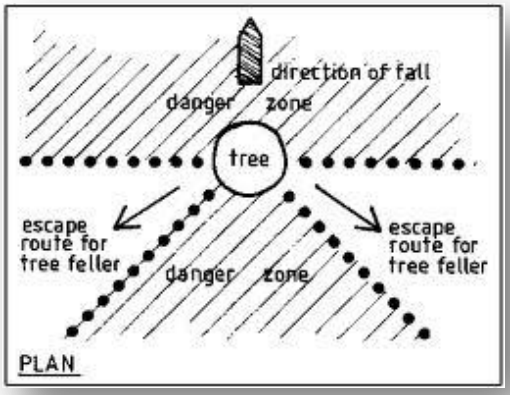
The AFEO was pinned in a sitting position, knees pushed to his chest by the log across his shins.



The two seasonal employees present when the falling accident occurred immediately realized the severity of the accident, and that medical care was required.

Crewmember 1 called CDC to notify them of the accident and initiate Emergency Medical Services at 1446 (see timeline). Crewmember 2 proceeded to collect vital information on the AFEO's condition while Crewmember 1 continued to communicate with CDC that there was a possible femur fracture.

Crewmember 2 went to check on the AFEO, who was yelling that he was ok, but to get the tree cut off him. Since the AFEO's chainsaw was still running nearby, Crewmember 2 grabbed the saw and proceeded to cut the end of the tree off the faller. The saw pinched during this cut, and he had to get another nearby saw to finish the cut.



Once the butt of the tree was off the AFEO, he stood up and began to walk away from the felling site toward the Ranger Station. He could feel the pain move in his back as the adrenaline wore off and started to feel shock setting in.

At 1503, they relayed vitals to dispatch that the injured faller was a 28 year old male, conscious, no bleeding, and pulse 100 per min. Both crewmembers were observing signs that the AFEO was going in to shock. The trauma kit that was normally carried by the crew for project work was not with them the day of the accident.

The SFEO heard the radio traffic and turned around and proceeded back to the work site.

CDC attempted to make contact with Life Flight from Billings, MT and Idaho Falls, ID, and a local agency helicopter, but none were available. They were referred to Pocatello Life Flight, which was available. They were given a ground contact name and an Air-to-Ground radio frequency, but needed to check weather conditions before launching.

At 1529, the SFEO reported that he was on scene and the AFEO had back pain and a possible broken rib, as a result of a crushing injury between a log and tree. Pupils were equal and reactive, pulse 120, respirations 28, cold and clammy, treating for shock, and a possible broken ankle. The ambulance arrived on scene at 1548. At 1558 the SFEO reported that the faller was complaining of lumbar and upper 1/3 of the back had pain with swelling, and recommended to keep Life Flight coming.

Life flight arrived on scene at 1628, and the decision was made to transport the faller to the West Park Hospital in Cody, WY. Life flight did not know the location of the hospital, and there was a brief delay while CDC found and transmitted the coordinates. Life Flight lifted from the ground at 1643, and arrived at the hospital in Cody at 1652.

Analysis of Felling Operations:

"This was all preventable."

Felling Operation Elements in Compliance with Safety Practices and Standard Operating Procedures as Detailed in National Policy and Saw Training Materials:

- Required PPE were utilized and in proper functioning order (FSH 6709.11).
- Required certifications were current (FSH 6709.11).
- Sawing operations JHA was current and reviewed by all sawyers (FSH 6709.11).
- Face cut depth for heavy leaning tree [6 inches for a 27 inch by 22 inch wide tree] (S212 - *Make horizontal cut to one third of the tree's diameter unless the tree has a heavy lean*).
- Plan was made to sequence the order of felling trees in area to remove problem trees before felling other trees (FSH 6709.11 - Fell *problem trees or snags first*).
- Angle of sloping cut to horizontal cut for the undercut [45 degrees] (S212 – *Make the sloping cut at a 45 degree angle)*.
- Tree felled in general direction of lean (S212 – *Normally fell a tree within 45 degrees of lean*).

Felling Operation Elements Not in Compliance with Safety Practices and Standard Operating Procedures as Detailed in National Policy and Saw Training Materials:

- Holding wood width [3.5 inches on-side to 4.5 inches off-side] (S212 - *Ensure the holding wood is even across the face of the tree*).
- Stump shot [1 inch] (S212 - *Height between the horizontal face cut and the backcut is the stump shot - 2 to 5 inches*).
- Primary escape route partially cleared out. (FSH 6709.11 – *Sawyers must select and prepare the work area by clearing a primary escape path and an alternative path before starting the cut*).
- Primary escape route was located at 70 degrees from behind the stump (FSH 6709.11 - *Choose an escape path that extends diagonally away (135 degrees) from the expected felling line*).
- Lay not cleared out (FSH 6709.11 – *Walk out and thoroughly check the intended lay or bed of tree. Look for… and ground debris that may cause kickbacks, rolling, or result in another tree or limb becoming a hazard*).
- Secondary escape route not cleared (FSH 6709.11 – *Sawyers must select and prepare a primary escape path and an alternative path before starting the cut*).
- No adequate safety zones established (FSH 6709.11 – *Plan the route from the stump to the safety zone, generally not less than 20 feet away; the farther the distance the better*).

- Primary escape route had poor footing [slippery rocks in stream] (FSH 6709.11 – *Escape Paths. Before felling or bucking any tree or snag, always provide for escape in emergencies. Establish firm footing*).
- Face cut not gunned or cut to intended lay (S212 – *If the tree is not aimed in the direction that you want it to fall, extend the horizontal and sloping cuts as needed, maintaining a single plane for each of the two cuts*).
- Reanalyze size up after cutting plan changed.
- Base of tree not cleared (S212 - *Swamp out the Base*)
- Back of face cut not straight across. A very subtle triangle (1/16 of an inch in width at the apex) was left in the back of the face cut (S212 – *The back of the undercut should be perpendicular to the desired felling direction*)

"I'm broke right now. . . . .I can't fathom why this happened."

PHOTOGRAPHS AT SITE:

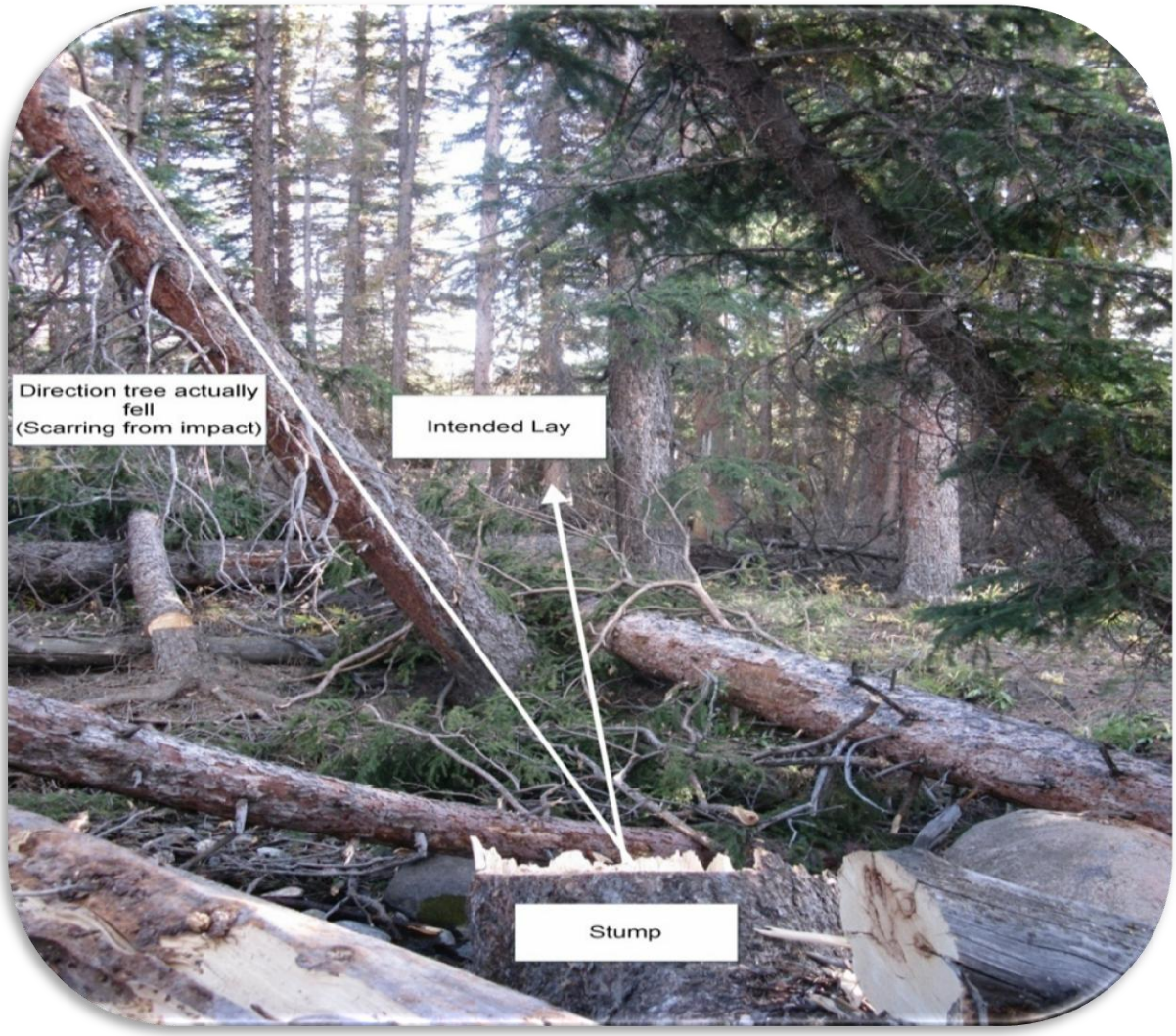


Photo 1 – View from behind stump

Photo 2 – Taken from where the AFEO was pinned.

Photo 3 – Taken from the intended lay.

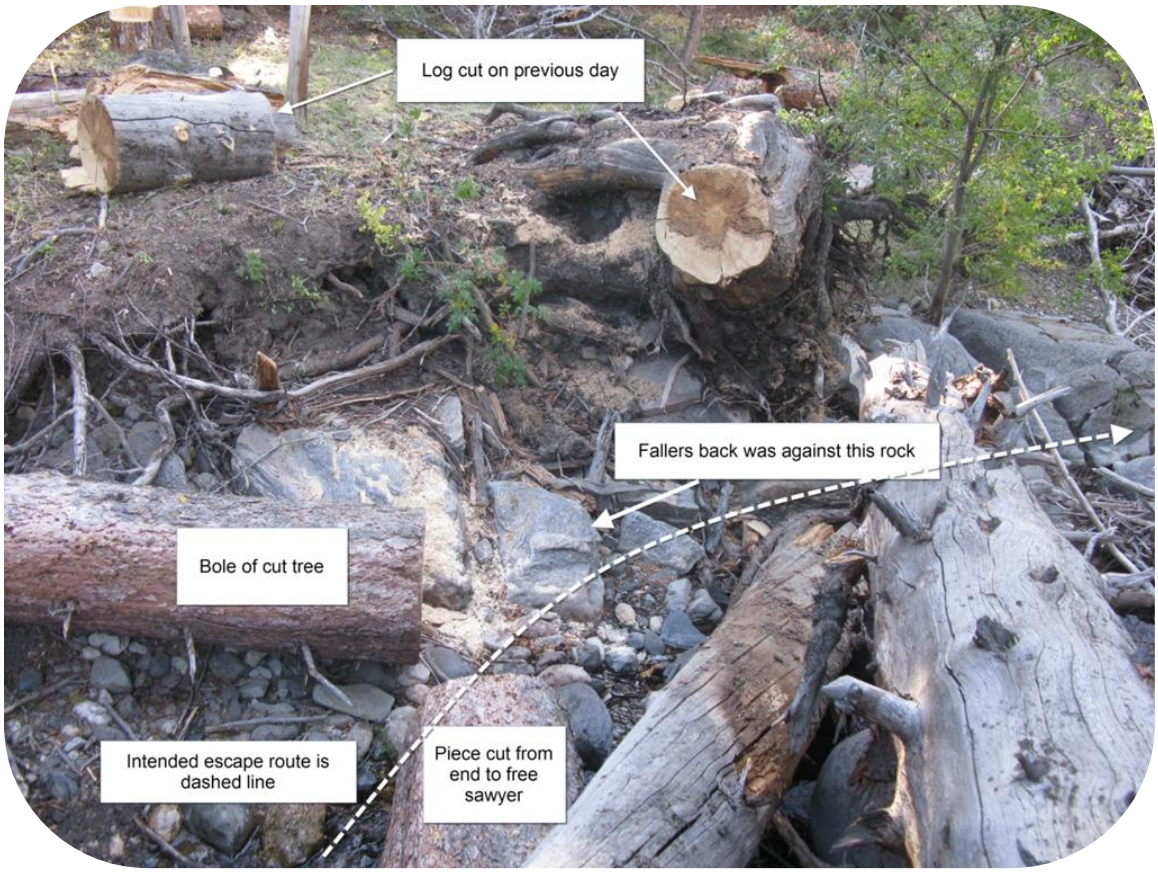


Photo 4 –Sawyer's position

Photo 5 – The stump from the uphill side

DISCOVERY POST EVENT:

Medical:

The review team was extremely impressed with the ideas put into practice for the emergency response.

The crew and CDC demonstrated that they were prepared to deal with an accident in the field, and remained calm and professional throughout the incident.

Job Hazard Analysis, Tailgate Safety briefings and documentation were up to date, and incorporated into the daily life of the crew. The tailgate safety report forms showed where they predetermined helicopter medevac sites and reported the Lat/Long to CDC for reference in daily updates.

Crewmember 1 and 2 quickly determined who was going to call CDC and who was going to assist the AFEO.

The Zone Fire program had conducted a simulation exercise earlier in the year dealing with an "incident within an incident" scenario. The exercise scenario was a search and rescue, and crewmembers and dispatch coordinated extraction of two individuals, relay of patient information and integration of medical responders. This exercise gave the CDC staff and North Zone fire crew's valuable experience on how to address emergency situations that could arise during normal daily operations.

The engine module practiced carrying a trauma kit on project work. Every day prior to the accident, the module had the trauma kit nearby at the work site. Unfortunately, the day of the accident it was left in the shop. The crew recognized how valuable the kit would have been to treat the symptoms of shock with the oxygen inside the kit.

The SFEO also dedicates time and effort to the volunteer fire department, and was able to bring a higher level of medical care to the AFEO rapidly.

There are excellent informal partnerships in the Cody area between the Forest Service, volunteer fire departments and local residents. The Zone Fire Management Officer called dispatch and requested they contact the Sherriff's office to page Crandall first responders.

Communication:

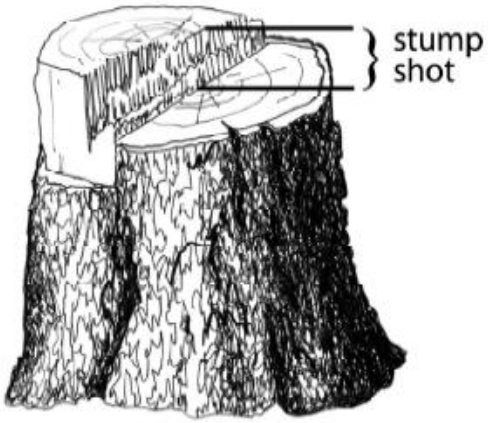
A theme throughout the interview process involved communication; both how well communication worked in some instances and how communication has been hampered or blocked in other instances. The engine module is a tight-knit, well functioning, highly educated and trained crew, with effective and free internal communications. There is frustration with regard to communication between the crew and people outside of the crew at all levels. This has led to some misunderstandings regarding many of the operations and management decisions, directions and objectives. There also has existed a communication disconnect between high level upstream decision makers and the field. This includes both policies and direction from the Forest Leadership Team, as

well as perceptions of the quality and quantity of trees being cut and moved by field crews for fuels reduction and hazard tree removal.

Field crews interviewed expressed frustration with the overall unreliability of the radio and satellite phone communication systems across the Shoshone National Forest. They felt that the frequency of these communication breakdowns is much higher on this Forest than on others within the Region.

Production Pressure:

Discussions with crewmembers, field supervisors and project managers revealed a high level of production pressure within the fire and fuels program on the North Zone of the Shoshone National Forest. Much of this derives from the self-motivation of the crew who pride themselves in their high level of work ethic. Production pressure is also generated from the feeling that by being highly productive and meeting or exceeding deadlines and targets seasonal employees - both permanent and temporary - will be rewarded with additional work. In fact, during the past ten years or more, permanent seasonal employees within the fire and fuels program have worked year round if they so choose. The perception has been; work extra hard and you will have the opportunity to work year round. Lastly, the fire and fuels program manager is a highly dedicated and motivated individual and employee. He works hard and puts in extra time frequently. As expected, the program manager's work ethic has influenced the culture of the crew to reflect his personality. This is a highly motivated and performance oriented program and the engine module represents that.



Project planning and management:

"Management of beetle kill trees on the Forest has been increasing over the last decade. The scale of treatments has escalated to extensively treat public use areas. The scope of the fuels work has changed to include longer periods of time spent felling hazard trees. This level of work is increasing the exposure time of persons working with hazard trees while the tree felling hazards are increasing." (Shoshone NF, *Long Term Hazard Tree Management Safety Plan*; April 2010).

The objectives of the Crandall Ranger Station Hazardous Fuels and Hazard Tree Removal Project were to create defensible space and safe travel corridors by removing dead and identified hazard trees. The objectives were communicated verbally from the program planner to crews and crew leaders and were understood and supported at the ground level. While the objectives for the Crandall Ranger Station project seemed clear to the individuals doing the work, confusion and frustration from these same individuals exists with regard to the hazard tree identification and marking process. Many of the fire and fuels crewmembers believe the hazard tree evaluation process should have

input from those actually removing the hazard trees. While this does not have direct influence on the accident, it is evidence of disconnect between the planning of the work and the actual work performed.

A consensus among those interviewed signified the realization that completing projects in an environment of increasingly high tree mortality, as well as simply working with dead and dying trees (hazard trees by definition) costs more per unit of production than has been the case in the past. Some expressed a concern that there exists a lack of recognition of this important factor in planning and budgeting at all levels of the organization.

Capacity:

At the time of the tree felling accident at the Crandall Ranger Station, the Forest Leadership Team was convened and discussing the adequacy of the Forest safety organization. Questions have been raised whether or not additional capacity is necessary in the Forest Safety Program to address the added complexity of hazards, exposure time, and workload associated with extremely high tree mortality throughout the Shoshone National Forest. The interview process reaffirmed that fire and fuels crews on the Forest are moving from doing predominately fire and fuels work to an increasing focus on dead and hazardous tree removal. Questions arose as to whether the crews are being provided adequate program and project management, oversight, and training for this new paradigm.

During interview and discussion, a potential leadership capacity gap in the North Zone organization was identified. The ZFMO indicated that the Zone Fuels AFMO position has been vacant for approximately three years. A conscious decision was made by The District Ranger and the North Zone FMO to leave that position vacant in order to ensure that appropriate funding could be directed to the ground as well as to mirror a projected decline in fuels workload in the future. However, the increased workload associated with hazard tree removal and fuels treatments near recreation sites and other Forest facilities has postponed this anticipated decline. As a result, the North Zone FMO assumed the fuels planning and project management workload. This has limited the amount of oversight this individual has been able to provide to field crews implementing fuels and hazard tree removal projects. The current Zone Assistant Fire Management Officer has been detailed to another forest, contributing to the lack of oversight and program leadership.

Training and Mentoring:

During interviews and discussion, it was apparent that the fire and fuels crews on the North Zone of the Forest provided excellent training and mentoring to the beginning and intermediate sawyers. These crews had also worked to develop and implement additional felling safety procedures such as having saw teams, instead of individual sawyers, perform the size-up of hazard trees. This practice decreases the chance that something will go wrong during the cutting process, because two people are looking at each tree before it is cut to determine hazards, lean, defects in the tree, and placement of lookouts, or spotters. However, the advanced sawyers who are responsible for

training and mentoring of less experienced sawyers felt they have lacked opportunities themselves for advanced saw skills and risk management training. This was highlighted by a number of knowledge gaps demonstrated by advanced sawyers interviewed at the site with regard to understanding safety protocols, felling operations components, and recognition and mitigation of cumulative hazards.

There are questions from upstream decision makers whether or not we could do a better job at training our people in cutting bigger, predominately dead, and more hazardous trees. These managers are also wondering if there are better ways of making more informed risk management decisions by everyone from line officers all the way down to the ground crews.

Human Factors

Questions on exactly why the sawyer disregarded many standard operating procedures and guidelines arose by the end of the review team's first week in Cody. All participants in the initial FLA process had concerns on what triggered the decisions to cut the tree in the manner it was cut. The review team suggested bringing in a Human Factors expert, to help understand the sawyer's thought process and mindset. The document produced is included in the Human Factors Analysis Appendix.

The Human Factors approach provided a framework to understand the decisions made at the stump on September 14th. Applying the same framework to other aspects of this incident opened constructive dialogue for improvement of safe practices, decision making, and communication.

The Human Factors Analysis Appendix contains a general outline of events covered in the initial report, so can be read separately. It should be read as a related, more focused learning tool on perceptions and decision making.

LESSONS LEARNED (SHOSHONE NF):

- Review fire/fuels organization structure and workload. Develop and implement a workforce plan that includes an organizational structure appropriate for the expected hazardous fuels and hazard tree removal workload for the next 3-5 years.

- Thoroughly assess risk on all hazardous fuels and hazard tree removal projects, and utilize the appropriate tool(s) to reduce exposure to personnel and meet the objectives. Develop and solicit Indefinite Delivery, Indefinite Quantity (IDIQ) contracts for operated mechanical cutting equipment and/or other methods to cut trees.

- Review the Forest safety organization structure and current approach to risk management. Develop a safety organization that has the capacity to assist field crews, managers and line officers with risk assessments and mitigation actions; with the capacity to: 1)monitor projects to validate risk assumptions, 2)identify

new hazards or concerns, and provide an additional channel to communicate safety concerns.

- Continue work to have Forest included in the bark beetle theater in Region 2. Additional funding would provide the Forest Leadership Team the ability to choose from more options in a timely manner as well as help support the workforce and contracting needs to address bark beetle issues on the Forest.

- Implement standard operating procedures and ensure the availability of trauma kits for personnel performing project work. Continue discussion with South Zone to standardize kits and their locations on vehicles.

- Improve use and implementation of the hazard tree marking system and integrate more closely with the personnel doing the cutting.

- Continue to work on radio repeater and communication systems, and establish field communication back-up plans.

- Continue established procedure for communicating coordinates of work sites and nearby helispots.

- Build capacity among crews for felling operations. This includes continued development, training and mentoring of A and B Sawyers, as well as focusing on Experienced B, C and C Certifier Sawyers to provide for advanced saw training, mentoring, and oversight. Inviting external cutting resources to provide cross-training and fresh perspective to the program is also an excellent tool to build capacity for sawing operations.

- Group education focused on improved interpersonal communication is recommended. Sessions should include Fire and Fuels program, and joint sessions with District, Zone and Forest staff.

- Build in time post incident assignment to reconnect with District and safely reengage with project work.

- Fully integrate Zone Fire Management Organizations with Ranger District functions, including scheduled weekly staff meetings.

- Provide opportunities for the Forest's Fire Management organization to directly communicate and interact with the Forest Leadership Team to provide input and to promote understanding of decisions affecting the organization.

RECOMMENDATIONS (REVIEW TEAM):

- Pursue communication training, education and practice. An advanced communications course or session similar to the ***Dialogos'*** "Art Of Thinking Together" or equivalent type session for a cross-section of the Shoshone National Forest, North Zone staff, and engine modules.

- Pursue developing and sending a team from the North Zone to the South Zone of the Shoshone, or an adjoining forest to conduct a less formal Facilitated Learning Analysis on any program area to promote cross-pollination of ideas and methods.

- Pursue identification of interested Shoshone personnel to nominate and send to the Simulation Design and Delivery course to provide more formal training for trainers, with a goal of expansion and improvement of simulations like the medical exercise conducted.

- Increase funding and support for the Regional Saw Coordinator and Forest Saw Coordinator positions to allow for on-site monitoring, training and development, and more interaction within all saw programs.

- Explore possible ties to the Bark Beetle Incident Team to create a saw technical specialist position to provide coordination, training, and oversight elements to Bark Beetle Forests.

- Explore the potential for linking up saw teams from the Shoshone with various Interagency Hotshot Crews working in the Bark Beetle Theatre for additional idea exchange, training and external perspective related to cutting techniques and risk management processes.

- Explore the Leadership Curriculum (L-180 through L-580) for opportunities to enhance leadership and communication in high risk operations across all staff areas on the Shoshone National Forest.

- Engage and pursue with Region 1 the development and instruction of the Advanced Faller course design. Additional direction should be explored for adding a risk management unit and or cutting scene complexity to the courseware. Consider instruction of these potential units throughout Region 2 to all sawyers.

- The AFEO should pursue developing his own presentation to deliver to regional saw conferences and other interested parties.

- Increase use of Human Factors analysis for accidents.

- Provide training and practice opportunities on increasing concentration and mindfulness (see Human Factors Analysis Appendix) for Shoshone National Forest employees.

- Evaluate and ensure funding is appropriate for the project risk and complexities that involve management activities in environments heavily affected by tree mortality.

Crandall Ranger Station Tree Felling Accident

Human Factors Analysis Appendix

HUMAN FACTORS ANALYSIS APPENDIX:

Previously an upstream oriented accident investigation protocol identified the need to explore human factors related to this incident at a deeper level. This suggests, in turn an APA level of analysis. Basic to the APA guide is "most employees involved in a serious accident or near miss, genuinely want to share what they believe *really* happened. They realize that everyone knows the final outcome. But, at the same time, they know that very few people truly understand why the decisions and actions leading up to the accident *made sense to them at the time*."

The most pertinent way to look at what makes sense to people is to invite them, during interviews, to explore the mental elements that interact to create their inner world of views, opinions, perceptions and motivations. In essence, we look for the mental causal elements, the most fundamental of all human causal elements.

The intent of a mental factors analysis is to better understand awareness, decision making, actions, and sensemaking from the perspective of those involved in an incident. Better understanding leads to learning and improved safe, performance. The relevancy of human factors is paramount in identifying the mental, cultural, and organizational processes that occurred during events on the Crandall Ranger Station Tree Felling Accident. Interactions between these factors are subtle and subjective, thus more difficult to retrieve and document compared to physical phenomena. Investigators are acutely aware of this and cultivate mutual trust between involved people and themselves to identify these processes as they emerged during the incident.

By noting what fallers were likely attending to as they made decisions during the incident, an understanding of human factors unfolds. With the feller, the relevant mental elements arise as casual agents as perceptions, feelings, beliefs and intentions. These individual mental elements in turn are in dynamic cultural relationships with other fellers and supervisors and arise as shared beliefs, crew image, mutual understanding and shared behavioral conventions. And these cultural elements arise in relationship to both stated and unstated organizational elements such as goals, policies, rules, regulations, rewards and punishments.

The most fundamental elements are those of the human mind. Our minds in turn are highly organized and conform to natural processes. These fundamental, natural mental processes set boundary conditions on how we use our minds in seemingly endless interactions as we take action in the world. When looking at cultures and larger organizations these same mental operational processes drive both cultures and organizations. As such what we call mental habits show up as cultural norms and

organizational rules and regulations. These three levels are never quite separated and merely reflect where the level of analysis is focused. An organization is easiest to “see” since it is more static and codified. Cultures are more dynamic and easier to “see” than the mind because they also involve outwardly observable behaviors. The mind is hardest to “see” because it involves processes observable only by a unique individual, who must have open truthfulness to accurately communicate what they observe.

Looking at how we make sense of the world and subsequently take actions involves a closer look at the unfolding mental processes. Consider this fundamental process: We can attend to only one object at a time. While we attend to one object, all other objects are excluded from awareness. Object awareness is formed by the convergence of three elements: A sensory organ (eye), a visual object, and eye consciousness. When these three are present then the convergence is briefly referred to as "contact." Micro seconds later comes perception or more correctly apperception, then a feeling tone, then grasping. An apperception, a perception which identifies objects, involves recognizing the object name or description stored in memory. Next a mental feeling tone arises from the past association with the object and if it is positive we attach to it, if negative we push it away, and if neutral we ignore it. This entire sequence unfolds so fast that it is virtually undetectable without appropriate mind training. Thus people are habitually propelled into unconscious actions sometimes resulting in unintended outcomes. It is crucial to note a sensemaking tenet that "We are rarely aware of what we will do until after we have done it." There is no little person inside our head to blame, nor should we blame ourselves for actions “we” aren’t consciously aware of initiating. Since up to 99 percent of the decision process is unconscious, we further identify why we are seldom in conscious control of what we later see we have done. With the above “in mind” we can further explore how our perceptions and beliefs distort reality, cloud our awareness and bias our decisions.

A general understanding of how your mind operates gives you insights for exploring accidents from a sensemaking perspective. It is further useful to explore additional complexities and interactions by considering the three levels of latent causal factors: mental at the personal level, cultural interactions at the crew level and organizational direction at the management level. For the present analysis the relevant persons are: at the personal level, the AFEO and at the cultural level, the SFEO. Since organizational concerns are well covered elsewhere in the report they are not present here. Thus, the central analysis here is sensemaking by the AFEO with a secondary analysis of the crew culture through the SFEO. Specifically, to focus "on the small amount of time surrounding the cutting of the tree".

THE AFEO

Prior to September 13th

The AFEO was a very experienced sawyer who first sought C faller certification in 2008. The next attempt at certification occurred in September, 2010 on two separate days, spaced over a week apart. The AFEO felt he already possessed the necessary C faller skill set prior to being tested, but was experiencing difficulties demonstrating them in the test environments. On the second day, September 9th, the AFEO successfully passed

the field evaluation and was subsequently recommended for C certification. The day of the accident occurred five days later on September 14th. Since the certification was still pending, the AFEO was technically still a B faller.

September 13th

Events on Monday, September 13th are relevant. The AFEO had been on a fire, where he was certified, for two weeks. Upon returning home he had the weekend off. He expected that the first day back to work on the district would be to finish paper work, read and answer emails and get caught up on reading memos, etc. However he and others were told they were going to the field to fall trees where he was to supervise two A sawyers. This was upsetting to the AFEO who wanted a day in the office. At the work site the AFEO and crew cut several trees before high winds led them to stop all falling. He then conducted an assessment of the site and developed a plan for falling trees in a general sequence. The crew then returned to the district early. The ZFMO subsequently asked the AFEO if he and the felling crew had even gone to the project site and performed any work. The AFEO found this comment bothersome. The AFEO communicated the ZFMO's concern to his supervisor, the SFEO, the morning of the accident and both found it upsetting. The AFEO also found out he must attend a 40 hour class he felt was not relevant and he was frustrated he would have to attend it.

On the day of the accident several work related perceptions were expressed during the interviews and thus likely held by the AFEO that day:

- Upon return to the district several events were upsetting
- Our work ethic was in question for the 13th
- The Zone yearly targets had already been met
- The work at the current site should be finished by the end of the week
- Extra production is needed to demonstrate we are a hard working crew
- Due to the remote work site we have only 3-1/2 to 4 hours each day to get our work done
- It's ok to take some safety shortcuts to increase production; we and others do it all the time; that's our reality

COMMENT:

Most of these perceptions can be taken lightly up to being viewed as very upsetting. The more you observe yourself reacting negatively to these perceptions, the more strength they have to unconsciously cloud your thinking. This is a direct result of attaching to those perceptions which automatically results in the subsequent decline in mental abilities. If you mindfully, lightly note these perceptions and deal with the simple circumstances underlying them you are in the best frame of mind to do something about them in a positive conscious manner. The last perception in the list is different in that it implies these habits are also embedded in the culture and organization. And to be sure habitually cutting corners eats away at safe behaviors until accidents provide the necessary wake up calls.

So what causes stress for the AFEO on the 13th? We need to consider the circumstances more closely. The ZFMO questions whether the crew even went to the work site. Upon hearing the comment the AFEO feels his work ethic is being questioned and experiences stress. A circumstance, such as a comment, is always neutral and incapable of creating stress. Stress comes from identifying with your perceptions and therefore believing them to be an intrinsic part of your circumstances. If a comment can cause stress then everyone who hears or reads the same comment would experience the same stress. This is not the case. When you attach to a belief and it is called into question the suffering is self-imposed and automatic. The root cause is attachment (see process 5 in the Human Factors Supplemental Information section).

If the AFEO experiences additional stress from the "work ethic" comment the next day on the morning of the accident, the stress comes into play because he recalls the initial event. His memory is the trigger event. Stress comes from reliving the event. In a similar vein, when the SFEO hears about the comment, he perceives it as negative and his stress follows. To the degree that any stress is affecting the AFEO on the 14th it will automatically interfere with awareness and subsequent actions.

September 14th: Late Morning

The crew consisted of five people on the 14th. Upon arriving back at the work site the AFEO continued to assess his previous day's felling plan for the target trees. Later the SFEO blew a hydraulic hose while operating a Bobcat which was used to pull downed logs out to the perimeter of the tree stand. He and his B faller left for town to buy a new hose and would not be returning that day. The AFEO then spent nearly an hour supervising one on his A fallers in felling a tree. At some point, the AFEO decided that he must fall one of the more difficult trees, technically a B tree. He added that he had passed up attempting to cut two C class trees until his C certification card was in his pocket; or until his supervisor or a C faller was present. The AFEO proceeded to fall several trees and related that he felt that he was in the "Zone" that day. He then decided now was the time to drop what he referred to as the "Integral Tree". With the falling of this particular tree, it would allow tree felling on the 15th to proceed more safely and allow cleaner extractions by the Bobcat. This was also to be the "Last Tree" of the day since it was later in the afternoon. Today he did not want to get back "Early" like the day before. Felling the Integral Tree would keep them on track to "Get the job done by Friday". He felt he was about to engage in a complex operation but could do it safely. Relevant perceptions at this time include:

- This tree must come down now
- I'm in the "zone" and my confidence level is high
- This is a class B tree with some complexities
- I can fall this tree safely like my earlier trees

COMMENTS:

These perceptions have a common thread that suggest the AFEO is overly certain about what he is about to do. The over certainty is not judged because the accident outcome is now known. Rather the certainty is implied due to the manner in which he

often emphatically states something is true as opposed to it being his own relative view about something. Reality is constantly changing with resulting uncertainties. To the degree you think reality is stable or fully knowable implies it is just a thought or story you tell yourself and others. The basis for his confidence is that his version of reality, like ours, is a memory and all memories are frozen and never quite reliable since the events they are based on have ceased to exist. Memories are static and stable where realities constantly change. Yet, despite the distortion, those memories control your actions anyway and as stated earlier they are almost always unconscious and undetectable.

September 14th: Early Afternoon

The AFEO proceeded to analyze the site around the tree again and decided on the specific way to accomplish it. After sizing up the lean of the integral tree he chose a target "bed" to drop the tree into. The bed was at the base of another large tree sloping up at a 45 degree angle off to his left. His major decision was whether to cut the tree above and to the left of the integral tree up on the creek bank or from below and to the right at the level of the stream bed. The safer option was to cut it from up on the bank since he could do the actual cutting at hip level. This would require him to cut through a large log on the ground in order to create an escape route to a safety zone. This side would involve more work to roll the cut log aside and it would be harder to remove the log with the Bobcat the next day.

Cutting the tree on the right side, in the safest manner, would have involved even more preparation. However he decided to use a preexisting path as an escape route. The existing path crossed a 3 inch deep, five foot wide stream that the crew had already been using. This path was not at the preferred, safer, 45 degree angle but it "should do the job". He cut off the end of a nearby log to improve this path. Establishing a safer escape path at a 45 degree angle would have taken significantly more time since two larger logs blocked the way. Cutting the tree from this side required sawing at shoulder height, thus there would be less control of the saw during the cutting process. In the end he chose the less safe side of the tree to save time and out of concern for more efficient log extraction by the Bobcat. He felt the margin of safety was sufficient, expected to nail the "bed" and that at worse he would miss it by 3 feet. He estimated that the butt of the tree would move no more than six feet to his right but that he would be long gone if it did. Several perceptions may be affecting the AFEO's behavior:

- Safety can be lessened to some degree
    - for higher production
    - to meet cutting targets
    - to make other operations easier…for Bobcat work
    - to save time
- Cutting the tree involved an acceptable safety margin
- Others cut safety corners so it's acceptable for us as well
- One escape route is enough
- Escape routes do not need to be cleaned of all hazards
- The 45 degree escape route is only a guide
- I'm in the zone and will stay in the zone until this tree has fallen

- It's acceptable to use a shallow stream for part of an escape route
- We don't usually reach a safety zone before the tree has fallen
- Each shortcut is independent of the others
- The actual conditions present didn't change a B tree into a C tree due to nearby associated complexities
- He felt he had C faller skills well before his recent recommended certification so was not attempting anything extra that day, just his normal routine

COMMENT:

At this point people, ignorant about how their own mind and the minds of others work, might begin to apply blame. After we know the outcome, and pair that outcome with a particular person, we tend to judge and blame them for the outcome. However knowing that around 99 percent of our actions are unconscious makes it frivolous and counterproductive to assume deliberate intent.

Since blaming others is an epidemic cultural norm it is relevant to further explore the implications. Consider a manager or supervisor applying punitive measures against the blamed person. What isn't immediately obvious is that the punisher is very likely to be mutually guilty. Blame is only appropriate when actions are conscious and the consequences knowable. To become consciously aware of what you are about to do, in turn, requires special mindfulness training. Since such training exists, managers failing to provide the training are equally responsible for the accident. Ethically, the punishing manager should receive the same punishment. And yes, you readers are in the same boat!

So maybe ignorance is bliss. It is unlikely such training will be implemented, and inherently problematical to posit blame without it. The Group Think solution is for none of us to train and spread the blamelessness around. Alternately we are not helpless. We should work to extinguish the habitual tendencies of the mind. We can become aware of how our minds work by directly observing them. In doing so we can become more responsible for our actions.

Although the AFEO is sufficiently aware of the safety hazards to pass C certification in the "heightened awareness" test environment he may at first be conscious of those same hazards when his normal work habits dominate but the concerns are likely erased from conscious awareness moments later. Recent efforts in becoming C certified should have kept him in a heightened safety zone. The accident simply shows that safety is a situational process: there in the test mode, gone in the production mode. This is not a characteristic of the AFEO as a person, per se, rather a natural characteristic of mental processes devoid of mindfulness. And mindfulness, as a mental factor, only comes from practicing specific mental exercises thus seldom present.

Returning to the above perceptions let's explore them with respect to other latent causal factors. Pure concentration involves a single object and excludes awareness of all other objects. This is the heart of "Don't text and drive." All our actions involve concentration

so we all have different levels of it. Concentration is usually a good practice in safe environments but not in risky or hostile ones. **We also need to note that the Eastern mental skill of mindfulness should not be confused with normal Western use of the term as a synonym for attentiveness.** We are always attentive of one object but very rarely truly mindful of the same object. Whereas concentration is exclusive, mindfulness is inclusive of all objects. We do not naturally acquire mindfulness and must undergo specific training to learn it as a skill. Thus the mental skill of mindfulness is rare. Concentration zooms in and stays focused and mindfulness zooms out to capture the "big picture." In risky environments we need both skills.

If the AFEO is in the habit of evaluating tree felling more from a production standpoint he may not clearly see that he is also becoming less sensitive to safety concerns. Reinforcement from his immediate supervisor, the Bobcat operator, is more potent than subtle clues from Mother Nature. Praise and awards for being a hard worker whisper "It is ok to cut safety corners" such as a single escape routes. What may not be obvious is that your mind makes these tradeoffs automatically, outside of conscious awareness.

If we note here the relevant feeling tones we can see the mental process more clearly. Over time positive production feeling tones make these thoughts more prevalent and negative feeling tones for safety issues make these thoughts less prevalent. This process can continue until safety thoughts are erased automatically once they occur and never become conscious. The AFEO's supervisor can provide oversight feedback to the feller that he has drifted too far into unsafe practices, as can the organization. However, his supervisor (the Bobcat operator) is in his own production mode and not likely to see the unsafe acts of others as they are occurring. Upstream other supervisors are likely numb to their own mental habits as they perform their own habitual work load and not likely to have provided recent oversight.

What the AFEO perceptions suggest is that he focuses on safety concerns one at a time, in isolation (concentration and one object at a time). His mind bounces from one concern to the next failing to zoom out to see all these small safety infractions are connected just outside his normal awareness. His very actions have changed a B tree into a C tree "situation" and he is not aware of the change. He, like us, is overly confident of his own opinions and actions. The positive side of certainty is confidence and the negative side is that such certainty does not fully exist, leaving us prone to mental errors. His knowing is that of books, rules and static memories of previous felling operations. He, like us, lacks enough mindfulness to see that:

- Everything is constantly changing
- Life is problematical since nothing lasts
- No permanent and unchanging self exists that is in control.

When we are mindful we see the present moment clearly and know the appropriate actions to take. We are vigilant and resilient, open to whatever is coming our way. Normally by clinging to static beliefs and perceptions we habitually fail to see what is present due to our clouded minds. The AFEO is caught up in his own web of views, not fully open to life's inherent unpredictability. C certification does not imply mastering of a static set of skills, rather that you now have the necessary minimum skills to continue

teaching yourself for as long as you are a sawyer. And very few of us are certified in *observing* our own mental processes.

In summary, we can point out that the AFEO is ringed by many potential hazards. He has but one exit. His escape route crosses a shallow creek bed with known hazards. Or perhaps we can describe his predicament as NO EXIT, related to a book of the same title by existential philosopher Jean Paul Sartre. Sartre reminds us "A man is a slave to the objects he possesses" and that there is no exit from them. Perceptions, views and beliefs are mental objects to be wary off. Unconscious mental habits encircle us leaving NO EXIT unless they too are mitigated. Mindfulness neutralizes habits and offers truer resiliency.

September 14: Mid Afternoon

The AFEO then began to initiate the cutting process. He realized that it was more difficult to gun (steer) the tree down on lower right side while cutting shoulder high. After the undercut, he paused to sight along the gun line while being somewhat off balance. He felt he was still in line with falling the tree in the bed and it would take too much time to walk around to better determine the probable path from above. Although he now had doubts, he recommitted to his chosen option and continued to cut. Although there were weak to strong signals the cut isn't going as well as expected he felt it would be less safe to pause very long. There was a pop and he grabbed the saw and started to leave. However he returned when the tree didn't fall. As he continued cutting the backcut another pop occurred and he extracted the saw and started to leave. Within two steps he fell and the log unexpectedly moved 16 feet towards his right hitting him before he could get up and escape. Relevant perceptions likely include:

- Once committing to a plan, stay with it (Action Tunneling)
- Although the tree was solid and holding and no one but himself at risk he felt he could not stop and go back to clearing the log to the left and finish the cut from the much safer position where he also had greater gunning control to fell the tree into the desired bed
- View that things are happening to you and that you have little to no control to change them
- View that an escape route though shallow water is safe enough.

COMMENT:

These perceptions suggest that once the AFEO started sawing he showed little resiliency or openness to changing his action. This is sometimes called "Action Tunneling" and is inherent to those who unknowingly cling to those same actions. To stop, reassess and start anew means you made a mistake. And the thought that you made a mistake has an unpleasant feeling tone so you avoid it by returning back to the original action. Clinging and grasping have "stuck" you to the chosen action. He is aware of the subtle warnings that the cutting is not going as expected but unable to take the time to see the situation mindfully, gun (sight) the undercut again and notice the tree is now aimed 20 feet to the left of his expected "bed". Mindfulness dissipates habitual

behaviors. To mindfully recognize you are stuck frees you. And the freedom of mindfulness is the heart of true resiliency.

September 14th: Reactions to the Accident

After being pinned by the end of the log against a rock one of the A fallers hurried to the scene to cut off the end of the log to free the AFEO. The AFEO heard a second A faller calling in the accident per established protocols and yelled at him to stop since he was ok. Once the end of the log had been removed the AFEO got up and walked back to the road asserting he was fine. Once to the road he began to feel the pain and started to go into shock. Until that time he insisted he was still ok. Possible perceptions here are:

- The embarrassment of having an accident
- This looks bad for a C faller to make mistakes he routinely counsels his present A fallers not to do
- Denying he is injured or may be injured before the required medical assessment is completed.

COMMENT:

These perceptions are very common in injured people and derive from a sense of Self, Ego or Identity. The AFEO feels embarrassed in front of peers, becomes defensive and denies to himself and his peers that he is or could be injured. Having been pinned by the log and cut free he is no longer in danger and his best action is to stay put until the A fallers can check him out for injuries. Moving often compounds injuries and the AFEO is forgetting his own training. This situation is worse because he supervises the two A fallers and they may be reluctant to tell him firmly to stay in place while he is telling them he isn't hurt. The A fallers are performing extremely well, given the situation.

AFEO's initial denial may well have translated into not reporting the incident at all if his injuries had been minor. After all there was his own and the crews image at stake.

Days After the Accident:

Concerning the accident the AFEO related that he perceived:

- I saw each hazard near the tree separately, not collectively
- We have made shortcuts before with no problems
- I expected to gun the tree into the intended bed and not miss by more than three feet (versus the 20 feet he missed by)
- The cut end or the tree moved way beyond my expectations
- I never expected to slip and fall
- I initiated actions too quickly on something this complex
- When asked my pain level at the road I said "5" though it felt more like a "10"
- I left the leaning tree in place for stream bank stabilization after estimating the added safety risk as minimal
- Escape routes, through shallow water, are deceptive

- The tree was leaning so bad I expected it to go quicker without much resistance
- I got lazy and should have spent more time cutting out better escape routes
- I should have cut it from the left side
- Failed to follow my own safety advice
- Quantity overrode quality concerns
- In summary: "My fault, my mistakes; I got complacent and should have gone slower. I learned something about myself."

COMMENT:

Many of these perceptions suggest that the AFEO's predictions were inaccurate. It also suggests he is less skillful in practice than he views himself to be because he has yet to factor in unconscious determinants of behavior. Since the entire crew and maybe other forest crews are cutting safety corners too, the causal factors extend further upstream. Many of the safety regulations, which were not followed, were those put in place because too many other sawyers, like the AFEO, could not accurately predict safety margins. Admitting he made mistakes, he is now willing to embrace the chainsaw safety regulations because he now recognizes why the procedures where implemented in the first place.

Other thoughts on his perceptions really reflect that our minds can only be aware of one object at a time so we fail to see possible interactions and cumulative effects of many seemingly small events. Since our minds habitually lag behind actual reality, we are wise to act as if actual events are worse than what we perceive. We can look at the physical complexities at the accident site and wonder how, in mitigating hazards one by one in your mind, you can miss the collective hazard. But now you know up to 99 percent of the real controlling factors are unconscious, thus your surprise when events take a bad turn. Physical traps are simply reflections of mental traps and are indications of how you view the world, how you organize your thoughts and that you have yet to discover and factor in your all too frequent mental accidents. Doing nothing is the **habitual** status quo; a sickness unto death.

In summary, if the AFEO radically changes his perspective by becoming more aware of his unconscious mental operations, he will become one of our best sawyers because of what he has learned and has yet to learn. Life itself has given him a warning and wakeup call. The subtle warnings are always there, just harder for most of us to perceive. He has demonstrated to us he has the C "skill set" and just needs to factor in how his own mind can lead him astray, and then work to establish a new relationship with his mind, and remember that we all routinely make mental errors. The rest is to never stop learning. After all....Mother Nature seldom gives us third chances.

THE SFEO

Before the Accident:

Taking a briefer look at cultural concerns begins with considering the AFEO's interactions with his immediate supervisor, the SFEO. The interviews suggest the SFEO's perceptions included:

- We are a hard working crew, yet safety conscious
- We produce quantity as well as quality
- We just received both the Crew of the Year Award and one member (the AFEO) received the Safety Person of the Year Award; what went wrong? Note: awards were announced after the accident
- We actively promote HRO concepts
- We normally work in pairs and critique each other
- We are a tightly knit, well balanced crew
- I can provide the oversight for myself and crew
- We seldom need a C faller to help us
- "That's Our Reality".

COMMENT:

What playfully comes to mind here is that "The apple didn't fall far from the tree" with respect to the crew culture and the larger supporting organization. Though different in many ways the AFEO and SFEO have many similar views and similar over confidence in those views, in common. This comes positively from a crew with open communication and common goals. Over time however crew members reinforce each other's good and bad habits. A term used, perhaps too frequently, by the SFEO is "That's Our Reality" as if reality were a fixed entity that sometimes pushes you into cutting corners. More correctly, we perceive reality as being more certain than it is. Reality perceptions are always distorted because they are static memories which don't change so "trick" us into seeing more predictability than actually exists. The bottom line here is that it is our perceptions and identifying with them that causes the added risk taking. And this process is normally unconscious.

When the crew's cultural views don't match those of other similar crews it has been called "Group Think." Group Think tends to blind its members to the same mistakes and the group loses resiliency. This was evident in the field since examination of other cut trees showed similar safety infractions by other crew members. To dissipate Group Think usually requires a visit from the "Stranger." The Stranger is an outsider who doesn't have the group's thinking habits. The Stranger sees the fallacy of the group's thinking and actions because they haven't yet become numb to them. This suggests this crew, this Zone and this Forest can benefit by interacting with other crews, Districts and Forests by promoting something akin to two week exchange programs to see each other's strengths and weaknesses. We are more likely to see the mistakes of others than our own. The Stranger can also be a felling expert who specializes in helping other sawyers.

We heard the entire Forest has embraced HRO principles. Some maybe spoke more correctly that "We talk HRO principles" in contrast to using them in our activities. We heard that "HRO principles have been shoved down our throats." What is missing in some of these perspectives is how HRO concepts can translate into personal positive values and actions. One example mentioned several times is personal and organizational resiliency that arises with mindful awareness of weak feedback signals; catching and altering unsafe practices before they become accidents. No one mentions

practicing the specific training necessary for learning the mental skill of mindfulness so on this forest mindfulness is a synonym for attention. Thinking you already have mindfulness precludes actually acquiring it. We need to recognize our mind's natural tendency to procrastinate and habituate everything we do with the subsequent loss of awareness. If "Variety is the spice of life" we must embrace changes to fully enjoy life as it comes at us. "Lighten up, be playful with Life, and Work Smart."

There are many references in the body of the report talking about the changes occurring as the organization as a whole reacts to increasing problems related to the bark beetle infestation and timber death. All parties know change is necessary but see the situation from different perspectives. Forest Staff (the organization) concerns were summarized as "We're logging out there." Add in that logging is one of the most hazardous occupations in the world, magnifies the associated risk change. "Logging is a young man's job" reflects the high injury and death rates or loggers smarten up and work safe or leave the profession. Now note the difference in the crew's (work culture's) perspective: "That's what we've been doing for years."

Another way to express the current situation is that of transition. Inevitably, an accident is the natural consequence that brings individuals, cultures and organization face-to-face to look squarely at change and associated risks. Just as we as individuals don't know what we'll do until it is done, neither does the culture or organization. After all organizations, on all scales of focus, are driven by and are but a reflection of mental organization. Though mental leads and cultures and larger organizations follow, to learn one level well gives you insights into all levels.

The roughest times come from transitions. Just as a family death, divorce or moving leads to the most stressful times individually, transitions, whether between incident management teams or in an organization that is searching for a new identity, follow the same trends. We aren't sure where we are going but is far better to embrace the change and stay alert than to fret, cloud our minds and spin further out of control. Change is constant and inherently good but we catch up to it in jolts; so it sure feels uncomfortable during the transition.

After the Accident:

Perceptions concerning the accident include:

- How could this happen to the Crew and Safety Person of the Year?
- He stayed in there too long cutting
- We may have made too much of the ZFMO's comment on the lack of work the day before
- We knew we had made our yearly quotas yet felt pressure to finish the unit by the end of the week
- It was a B tree but the way it was sequenced turned it into a C tree.
- There was no one paired with the AFEO that day
- He had no viable escape route
- Even if I had not left to fix the Bobcat, I would have been operating the Bobcat so would not have been checking up on the AFEO.

COMMMENT:

It is much easier to see habitual mistakes in retrospect. A problem with good supervision on a small crew is the tendency to “Go Native.” Meaning to become a worker, just like the rest of the crew. This is concentrating too much on the work itself. With mindfulness the SFEO needs to look at the big picture, get off the Bobcat, put on his supervisor hat and persona and critique the crew as a Stranger. It would be better if the SFEO or Zone got a designated Bobcat operator out to the field units as needed. In a similar vein the SFEO may want to become C certified himself or at least be familiar enough with C skills to provide better oversight and feedback to his crew.

September 30th: An Accident Scene Investigation "ASI"

The AFEO had agreed to meet with some of the team to return to the accident site. Concerned that the normal response is to become defensive amidst a group of investigators looking over his shoulders we opted to ask the AFEO to join our team. The AFEO was to be our felling expert and conduct an ASI. As such we asked him not to focus on what happened but to just follow physical evidence and tell us in detail what he was observing and what the evidence meant.

Initially the AFEO was hesitant to go directly to "the stump" as it was too traumatic. Showing some resilience, another team member suggested starting the process by analyzing the stump, butt end, and other downed logs associate with the tree cut by one of the A fallers. The AFEO warmed into this analysis and demonstrated a wealth of knowledge showing us he indeed did have the prerequisite skill to size up and mitigate related felling hazards. When quizzed, he also had some misunderstandings. When the SFEO agreed with the AFEO we learned the mistake was common to both of them. (As the one most ignorant of the fine art of felling trees, I learned a lot about complexities involved).

After a break the AFEO came back to the immediate area of the accident and soon began to look at the physical evidence and tell us what it meant. He took time to discuss the hazards and his reasons and expectations concerning mitigating them. Next he executed a detailed sequence of actions showing where he went, what he did there, and why he did it that way. One team member followed his actions of gunning the saw and was surprised to see that when sighted from below in the position the AFEO had been in, the sight line was near the base of the tree. The surprise came because when looking at the sight line up at the level of the stump, the sight line was lined up pretty much where the tree fell. This did not make up for the many errors but was clearly related to why the AFEO's expectations were so far off the actual outcomes. As a team it was quite literally worth the extra effort to "see what they saw at the time of the accident" and to "... truly understand why the decisions and actions leading up to the accident *made sense to them at the time*. We have come full circle back close to where we started. We have learned much and are grateful for the chance to have learned it. We hope what the AFEO and accident taught us extends to readers and others as well.

SUMMARY COMMENT:

Like HRO principles, it is far easier to learn Human Factors (HF) language than to put the concepts into action. HRO's and HF concepts become meaningful only when they are internalized as good habits. With HF, this means when you begin *observing* how your own mind works. We use our minds all the time but seldom spend time *observing* or improving them. Without such observation we fail to note mental habits cause most of the problems in our life. In our society we tend to be long on knowledge and short on wisdom. With wise attention we will be *observing* that we make mental errors all day long. When we are in high risk environments we continue to make the same mental errors. Errors become more apparent in high risk environments as accidents because the consequences of those errors are more severe.

You can start by learning the five key processes that are covered in the next section. The more you explore the five processes the more you can account for most of your actions. At a much deeper level we need to improve our minds in low risks environments through concentration and mindfulness practices. Then our new skills and enhanced minds will function automatically, effortlessly in the high risk environments to keep us safer. To advance from a High Reliability Organization into a Mindful Organization requires the active promotion of the mental practices of mindfulness to all their employees. Mindful Organizations are inherently wiser, happier, healthier and safer.

HUMAN FACTORS SUPPLEMENTAL INFORMATION

Latent Mental Factors

An analysis of latent mental causal processes helps uncover human factors "beyond the edge of normality. "By noting what fellers were attending to as they made decisions during the incident, an understanding of latent mental factors unfolds. This process is dependent on investigators paying "appropriate attention" to the witnesses and events. Investigators in turn, bring their own biases to an investigation. What follows is an analysis based on a blend of Eastern and Western psychology. The observations cited below are those that can be observed in your own mind by looking inward, thus experiential as opposed to theoretical, hypothetical, or academic. This is an invitation to explore the Crandall Felling Incident and your own mental processes.

It is useful to point out briefly how our minds work by noting five key processes observable in your own mind:

(1). We can attend to only one object at a time. While we attend to one object, all other objects are excluded from awareness. An alternate way to say this is that attention to objects proceeds in a linear, sequential manner, one after the other. This in turn implies we are unable to assess interactions between two or more objects.

We switch attention many times per second giving us the perception of seeing and hearing at the same time, yet we still cannot truly multitask. Tree fellers can learn to work with their own mental processes to improve awareness in risky environments through "appropriate attention" to the immediate and expected hazards.

(2). Our cognitive processing capacity is limited. This can be shown by an example of driving a car. To drive a car mindfully in the safest manner, distractions need to be minimized. Talking or listening to the radio while driving reduces situational awareness. Using a cell phone while driving reduces driving awareness, resulting in accident rates similar to those of drunk drivers. Text messaging on cell phones is an even worse distraction and more likely to lead to fatalities than simply talking on a cell phone.

(3). Our minds automatically condition and habituate our actions and thinking unless we learn to observe and extinguish this process. This means almost all of our decisions are made on autopilot without reflection, and reflection is usually just another automated process. Said another way, we have a habit of distraction, continually avoiding the present moment. Only those who have taken the time to watch and understand how these processes unfold in their own minds become aware of their habitual ways of responding and learn to stay in the present moment. Roughly 99 percent of our thoughts and actions are habitual, automatic processes.

(4). Our mental routines go with us wherever we go. Because our mental routines are mostly unconscious, they are simply part of who we are. We do not suddenly become more aware and make better decisions in risky environments. We become worse due to all the added stresses associated with those environments. We routinely go off on mental "side trips" (such as daydreaming) throughout the day and seem surprised at our capacity to miss situational cues that can result in poor decisions in environments where the consequences are more severe. The underlying mental processes remain the same.

(5). There are three mental poisons that cloud your mind: Attachment, Aversion and Ignorance. Out of ignorance (of how our minds function) we attach to objects we find pleasant and avert or avoid objects we find unpleasant. Upon attaching to an object, it is only a matter of time until we experience a negative consequence from that attachment. Attachment to food we find pleasant can result in the overeating with downstream consequences of added pounds and increased health risks. The overeating can become routine if we are talking to someone else (or ourselves), listening to the radio, etc. and lose track of how much we are eating. "Wise attention" is to taste and stay aware of the food, alert to note when the body tells us that it is "quite full." Consider a life-threatening event under extreme pressure while on a fire: To the degree we note or focus on the fire threat itself, it interferes with taking expedient action, such as getting into a fire shelter quickly. Averting and avoiding objects that arise are especially troublesome in risky environments. When elements of fear, self doubt, and confusion arise, they are usually ignored or erased from conscious awareness; often when clear awareness is a necessity for mitigating the immediate life threatening event.

Summary of Mental Factors During Accidents

When analyzing accidents, the natural assumption for those of us looking over their shoulders, is that involved persons did what they did knowingly and deliberately. We then focus on what they did "wrong" rather than on what involved people, from their perspective, were doing "right." Looking back, we see only that events unfolded in the observed sequence and we then error in thinking the events are connected in a causal chain. We miss the multiplicity of choices available at each decision point and focus only on those actually acted upon. By looking closer at latent mental factors we can identify a number of factors that may have influenced awareness, decisions and subsequent actions.

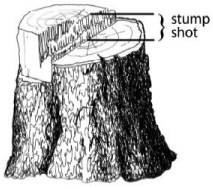
Almost all of our actions have subconscious determinants and so extra effort is needed to stay resilient and bring our own behavior under intentional control. The battle between conscious and unconscious control of behavior is the pivotal effort for increasing awareness and making wise decisions and actions under first routine, then with practice, under extreme conditions. Becoming more conscious of how our minds work is the best way to shift from trying to follow an unending number of rules to principal based actions. Principal based actions can reduce confusion and exert a force that counters latent subconscious actions that if followed, even briefly, shift people into higher risk actions under present situational pressures. Trigger points for these actions can reduce the amount of time and thinking to initiate appropriate actions and for noting when we are being overwhelmed and need to withdraw. Most people use trigger points

for outward events but few have similar trigger points for degrading mental processes. We can better understand and become more responsible for our minds by learning mindfulness meditation which generally enhances the other mental factors and specifically enables us to use information, training, and past experiences more efficiently while inviting new insights.

Studies of the health hazards of smoke show that smoke over the course of a summer depresses the immune system by about 7 percent. Meditation boosts the immune system by 7 percent or more and is a natural way for firefighters to deal with the health effects of smoke. With respect to improved immune systems and stress reduction, meditators have about a 30 percent reduction in illnesses and the associated medical and subsequent insurance costs. Therefore, learning meditation skills makes good economic sense as well. The true core of organizations, cultures, and people, are human minds. When we quote the finding that human error accounts for 80% of all accidents and fatalities, we are referring to errors made by those very same minds. We begin to learn about latent mental errors by *observing* our own mind.

GLOSSARY:

13/13 or 18/8	Terms used to describe the length of time a permanent seasonal federal employee could work based on 2 week pay periods. A 13/13 is guaranteed to work 13 pay periods (26weeks) and could be placed in furlough for up to 13 pay periods.
AFEO	Assistant Supervisory Operator
Faller A	An individual being trained or evaluated in introductory level, noncomplex chain saw operations. Work of A sawyers must be under the supervision of a qualified Faller B or Faller C.
Faller B	An individual certified at the Faller A level who has demonstrated sufficient judgment, skill and knowledge to be trained or certified in moderately complex chain saw operations. Certified Faller B individuals may work independently on project or fireline assignments up to their level of skill. They demonstrate the judgment to decline assignments that exceed their skill level.
Faller C	An individual who has demonstrated judgment and proficiency in correctly handling complex sawing and felling in wildland fire operations.
Feller Buncher	A type of harvester usually used in logging with an attachment that can rapidly cut trees and easily move them.
Gun/Gunning	Gunning a tree to be felled uses a line on the saw that allows the faller to accurately “gun”, or determine where the tree will land. When the saw is placed correctly into the face cut of the tree, the line should point at the intended lay.
Lay	The position in which a felled tree is lying or the intended falling place of a standing tree.
Production Pressure	Pressure to put efficiency, output, or continued production ahead of safety.
SFEO	Supervisory Engine Operator
Stump Shot	The height difference between the horizontal cut of the undercut (face, or notch) and the backcut. The difference in height establishes an anti-kickback step that will prevent a tree from jumping back over the stump toward the faller. It is the facecut side of the holding wood.
ZFMO	Zone Fire Management Officer



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View the *Crandall Felling APA 3D Reconstruction.mp4* (movie) at the Wildland Fire Lessons Learned Center

View the *Crandall Felling APA 3D Reconstruction.skp* (3D model) in Google Sketchup at http://geta.firenet.gov

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