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OREGON FATALITY ASSESSMENT AND CONTROL EVALUATION
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Center for Research on Occupational & Environmental Toxicology
OHSU OREGON HEALTH & SCIENCE UNIVERSITY

Fatality Investigation Report

OR 2006-19-1

Young logger killed when yarder topples during setup

SUMMARY

On May 2, 2006, a 23-year-old logger, working as a chaser, was killed when a yarder tipped over and crushed him. The crew was setting up the yarder on a new logging corridor and was in the process of tightening the guylines. The chaser and the siderod (site foreman) worked together to spool the guylines onto guyline drums at the rear of the yarder. The chaser worked on the deck of the yarder on the top two drums, while the siderod worked from the ground on the bottom two drums. As the fourth and final guyline was being spooled, the siderod heard a coworker yelling, and saw the man motioning with his arm over his head, indicating the yarder was going over. He took off running and just made it past the tracks when the yarder toppled backward over the steep hillside. Still on the deck of the yarder, the chaser ran toward the cab, but did not manage to get inside before the yarder went over. The yarder operator inside the cab emerged with minor injuries.

The yarder in this incident toppled over backward as the guylines were being spooled taut on the drums during setup.

CAUSE OF DEATH: Blunt force injuries

RECOMMENDATIONS

- **Manufacturers should provide enhanced guidance for setting up yarder towers.**
- **Extra precautions should be implemented whenever loads approach the tower's maximum capacity.**
- **Operators need to consider leaving guyline locking dogs out during initial spooling of the guylines.**
- **New loggers should be trained to stay alert for hazards and be prepared for sudden emergencies.**

INTRODUCTION

On May 2, 2006, a 23-year-old logger, working as a chaser, was killed when a yarder tipped over and crushed him. OR-FACE was notified of the incident by Oregon OSHA the next day. The OR-FACE investigator was denied access to the site by the owner of the logging firm. This report is based on information from the Oregon OSHA report.

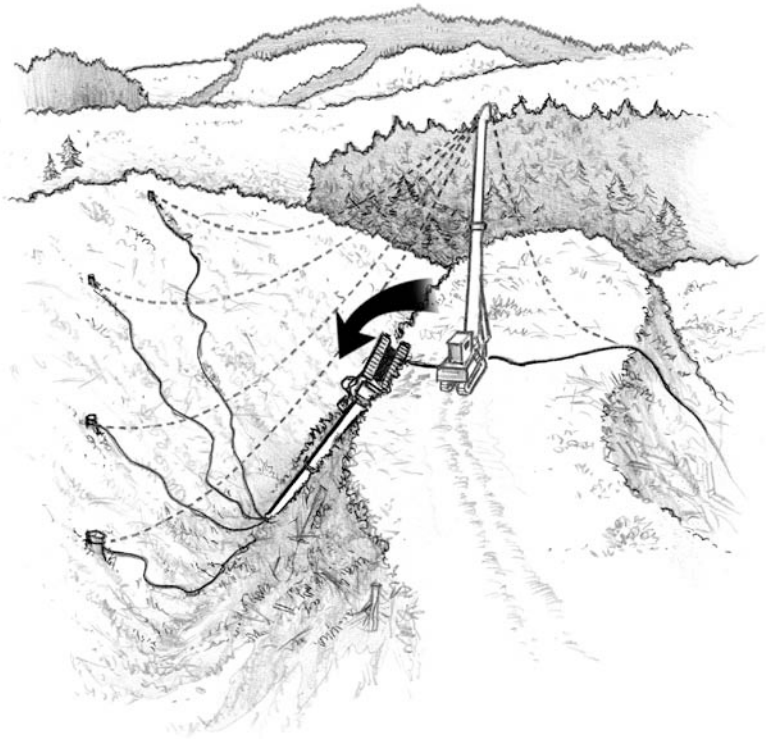
The logging firm, in operation since 1997, had 18 employees, with 9 at the logging site at the time of the incident. The firm had a written safety program.

The chaser had less than 5 months experience as a logger. He worked previously as a wildland firefighter. The siderod (site foreman), who was working with the chaser to spool the guylines on the yarder, had over 30 years of experience as a logger. The yarder operator had 20-30 years of experience operating yarders.

The yarding tower used in this incident had a standard leaning-tower configuration with four guylines attached to the rear of the yarder. The yarder model had a narrow undercarriage (124 in.), compared to modern yarders (144-168 in.), which contributed to instability. The yarder had tipped over three times in the past, the last time over 3 years earlier. Two of the events involved equipment failure; one involved failure of a guyline stump. In each instance the tower had tipped over forward.

INVESTIGATION

The crew finished logging a corridor and was in the process of turning the yarder to log the next corridor. The skyline was repositioned prior to moving the tower. The hooktender moved the guylines to the new anchor stumps to be used. There was no front guyline (called a snap guy) attached to the yarder in this instance, though the foreman reported a snap guy was used occasionally.



The yarder sat on a rock road atop a ridgeline and the ground fell off steeply, which created a challenge in rigging the rear guylines. The usable anchor stumps were quite a distance away from the yarder, located on a separate hillside.

Even on level ground, with a 60-foot tower, the guyline anchors need to be at least 50-60 feet away to achieve an angle for the guyline that is no more than 45 or 50 degrees from the horizontal. In this case, the most distant guyline was well over 700 feet away. To reach the anchors, at least 1,100 feet of 1-1/8 inch cables, called "tags," were attached to three of the four rear guylines. The tags added over 3,000 pounds to the weight of the guylines pulling on the top of the yarder tower. The additional weight put the total weight of the guylines dangerously close to the load limit of the tower.

Once the guylines were laid out and anchored, the young chaser and the siderod started to spool the guylines onto the guyline drums at the rear of the yarder. The chaser mounted the deck of the yarder to spool the top two drums, and the siderod worked from the ground on the bottom two drums. Three of the guylines were spooled, but not drawn taut, waiting for final adjustment once the skyline was raised on the front. As the yarder operator began to spool the fourth guyline, the siderod heard a coworker yelling, and looking over, he saw the man motioning with his arm over his head, indicating the yarder was going over. He took off running and just made it past the tracks when the yarder toppled over the steep hillside. The chaser, on the deck of the yarder, ran toward the cab, where the yarder operator was sitting. He did not manage to reach the cab before the yarder went over, and he was crushed beneath it. The yarder operator, protected inside the cab, emerged with minor injuries.

RECOMMENDATIONS/DISCUSSION

Recommendation #1. Manufacturers should provide enhanced guidance for setting up yarder towers.

Logging site supervisors need to control multiple factors to ensure the stability of a yarder tower in a skyline logging operation, and every setup is different. In this incident, the siderod, owner, and yarder engineer all had many years of experience, but were still unable to predict the forces on the tower. The incident demonstrates that small compromises in multiple areas can result in a catastrophic failure.

Few reference materials exist to help rig a stable leaning-tower setup. Manufacturers typically offer only basic details for proper tower rigging and safety. A more thorough outline of critical factors is needed to help loggers judge the complex loads involved. Yarder manufacturers should develop charts for many different yarding configurations, and illustrate the bounds for normal rigging in different circumstances. Model configurations should incorporate the following key issues.

- *Foundation.* Yarder stability requires a flat, level surface that is firm enough to prevent the tower from shifting under load. Uneven ground can result in unwanted tower movement. It may be necessary to crib or block up the tower to bring it to level. Some towers allow a certain leeway, but a completely flat, solid rock surface is the best solution.

- *Yarder base*. The yarding tower in this incident had a standard configuration of four guylines attached to the rear of the yarder. Modern yarders rely on the stability of the yarder base to balance the center of gravity in this standard setup. Older tower configurations increased

stability by placing guylines 360 degrees around the tower, with front guylines to prevent the tower from tipping over backward. The yarder model in this incident had a narrow undercarriage (124 in.), compared to modern yarders (144-168 in.). With three guylines drawn up on the spool, though not taut, there was a pre-load on the top of the tower that made it easier to tip over as the fourth line was spooled. The owner had occasionally used front guylines (snap guys) on this yarder, but did not judge the circumstances here to require them. Using snap guys is a difficult choice, because they can get in the way when moving logs on the landing.

- *Guyline angle.* The angles of a guyline relative to the tower is a critical factor in its load capacity. The applicable rule for guylines by Oregon OSHA states (437-007-0650(3)):

  > *Load-bearing guyline angles must not be greater than 50 degrees measured horizontally or that recommended by the machine manufacturer. If suitable anchors are not available or the terrain is so steep that the guyline angle exceeds 50 degrees or the machine manufacturer's recommendation, additional precautions must be taken, such as rearranging guylines to oppose the load, adding an additional guyline to oppose the load, or narrowing yarding roads.*

  The rule applies only to vertical tube towers, which "free float," resting against the yarder and supported solely by the guylines. Stability for leaning-type towers as the one in this incident is more complicated, because the tower is integrally affixed to the yarder base, which helps support it. Yarder manufacturers typically provide diagrams specifying horizontal placement for each guyline.

  A rule of thumb used by loggers calculates a distance out from the yarder at least as great as the height of the tower. On flat ground, placing a guyline anchor 1 foot out for every 1 foot up results in a 45-degree angle. Anchors should be no closer to the tower unless further precautions are taken to ensure stability. The flatter the angle, the greater the stability – until the line is fully horizontal. An anchor raised higher than the height of the tower will produce instability. Manufacturers specify a minimum angle.

- *Guyline reach*. This incident draws attention to the distance of the guyline anchors from the yarder as a risk factor in tower stability. Safety regulations do not define a limit, but a standard recommendation with earlier vertical towers stated that guylines should not extend out farther than 5 times the height of the tower. A standard for current yarders is unclear, because stability is also affected by the yarder base.

  Two points that are relevant in this incident need to be considered in the extension of the guylines: (1) a longer guyline produces more cable weight on that side of the tower; (2) a fully extended cable empties

Additional torque on the line due to the far extension of the guylines and the reduced diameter of the drum may have helped topple the tower.

the guyline drum and greatly increases the pulling force on the line when the guyline is being drawn taut.

The first point, the weight of the guylines, was indicated by Oregon OSHA as one probable cause that contributed to this incident. The second point, the pulling force (torque) on the guyline drum, may have been an additional factor. When a guyline drum is almost empty, the diameter is reduced and the torque on the line is increased to as much as twice the pulling power as when the drum is nearly full (torque on a line is inversely proportional to the diameter of the drum; think of the variable forces of bicycle gears on the chain – refer to Samset, 1985). With the guylines extended nearly the maximum distance, the yarder operator may have misjudged the force on the line while spooling it taut.

- *Guyline tension.* No gauge is provided on a yarder to tell the operator when a guyline is taut or indicate how much force is being exerted on the top of the tower. Judgment in rigging tower guylines relies mostly on experience. An experienced operator can determine the tension in a guyline fairly closely by listening to the guyline motors and feeling the reaction of the yarder to the applied pressure. Other methods include pounding on the line to feel how tight it is, or watching for deflection (belly) in the line. All of these methods are susceptible to error. In normal rigging situations, the latitude for error in drawing up the guylines has proven acceptable; but in extreme rigging situations, as in this incident, a better source of measurement and control is needed.

Regarding each of these factors in a yarder setup indicates the types of uncertainty that appear when ordinary circumstances change. This incident emphasizes the need to use model setups to help even experienced yarder supervisors determine when additional guylines and other safety measures are necessary.

Recommendation # 2. Extra precautions should be implemented whenever loads approach the tower's maximum capacity.

A wide margin of safety needs to be maintained in the load limit of a yarder setup. In crane operations, situations where the hoisted load is above 75% of the crane's rated capacity are considered critical lifts, requiring extra precautions. A similar consideration might be used for yarding towers. Numerous factors, including the weight of the rigging as in this incident, increase the risk. The narrow undercarriage of the yarder contributed to this incident, but any yarder could be susceptible to the same hazard if additional forces are introduced to its standard rigging and anchor setup. Extra weight or steep angles in the guylines, hung-up lines, uncertain ground, and other factors can increase force to an unacceptable level.

This incident emphasizes that the extra weight of the cables needs to be taken into account. Following the incident, a rough engineering analysis determined the top of the tower could sustain 10,000 pounds of force before tipping over. The tags alone added 3,000 pounds to the weight of the guylines. The use of snap guylines on the front of the yarder, or partially raising the skyline, could have helped offset the extra weight.

The stability of the tower while rigging up is a primary concern. The siderod and other site engineers that plan a yarding layout must know the load-bearing capacities and operational limits of their equipment. Relative to other hoisting operations, yarders operate with lower safety factors to accommodate smaller equipment capable of traveling on primitive logging roads. Once properly rigged, preserving the stability of the yarder tower against an overload condition relies on an "order of failure," designed so the different cables will fail in succession – choker cable, mainline, skyline – ultimately preserving the tower.

Crane operators have slowly adopted the use of electronic load sensors to assist operator judgment. The electronic devices can produce visual information, an audible alarm, and also shut down the motor on a line that exceeds capacity. The American National Standards Institute recommends the use of electronic sensors on cranes, though cost and mechanical failure of the sensors remain controversial issues. A NIOSH report on crane tipovers points out that electronic sensors may be susceptible to false readings, and can only help but not replace the judgment of an experienced operator. Yarder owners may want to consider the use of electronic load sensors as an additional tool to assist operator judgment. The array of forces that apply to a yarder, however, is more complex than a crane, and it is not clear that current electronic sensors can be successfully, or affordably applied to yarders.

Recommendation #3. Operators need to consider leaving guyline locking dogs out during initial spooling of guylines.

According to the Oregon OSHA report, the yarder operator had placed the guyline locking dogs into the locked position as he was raising the guylines. By placing the dogs in the locked position, the operator is able to ratchet the guylines in, but unable to spool them off quickly. The dogs do need to be locked during the yarding phase of the operation to prevent the guylines from unspooling when a load is placed on the skyline, but it is generally not necessary to lock the dogs during the initial tightening of the guylines. There is usually enough resistive force in the guyline motors and assembly to prevent the guylines from unspooling. The dogs can be locked once the final point of tension is reached.

No rule or standard operating procedure relates to the guyline dogs during the initial tightening of the guylines. In this instance, if the dogs had not been in the locked position, the operator might have been able to dump the guylines and prevent the tower from going over.

Recommendation #4. New loggers should be trained to stay alert for hazards and be prepared for sudden emergencies.

This incident resembles several other fatal logging incidents in recent years, where a sudden hazard threatened a novice logger working side by side with an experienced lead worker, and the experienced worker was able to escape to safety, while the new logger did not. In each instance, the lead worker was more aware of the surrounding environment and responded immediately when a crisis erupted. Logging safety trainers should emphasize to new workers the need for constant vigilance for unexpected hazards: glancing around, staying aware of the environment, and being immediately responsive to communication signals from coworkers. Naturally, new workers are more likely to get absorbed in the challenge of doing their job correctly. They need

to understand, too, that part of their job involves staying alert and responsive to ensure their own safety as well as the safety of coworkers.

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