Safety and Health Tech Tips

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Felling Hazard Trees With Explosives

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Felling hazard trees is extremely dangerous. It can also be dangerous to leave hazard trees standing, because they can fall unexpectedly. Removing hazard trees with explosives (figure 1) can be a safe alternative to cutting the trees down. Workers can be a safe distance away when the hazard tree falls. Explosives and ignition systems are safe and reliable when used properly. The Forest Service, U.S. Department of Agriculture, explosives program is one of the agency's safest programs. Certified blasters need a "Hazard Trees" endorsement on their certification card (figure 2) to fell hazard trees with explosives.

Figure 1—Fireline explosives have been wrapped around the trunk of this hazard tree. Note the catface (scar on the trunk), splits, cracks, and the separation of part of the trunk. Trees with these warning signs can be too dangerous for most sawyers to fell, but are excellent candidates for felling with explosives.

Highlights...

- Some trees with excessive decay or fire damage are too hazardous for sawyers to fell safely. Often, explosives can be used to fell such trees.
- Trees felled with explosives have jagged stumps that appear more natural than sawn stumps, an advantage in wilderness settings.
- In the Forest Service, only certified blasters with a "Hazard Trees" endorsement can use explosives to fell hazard trees.

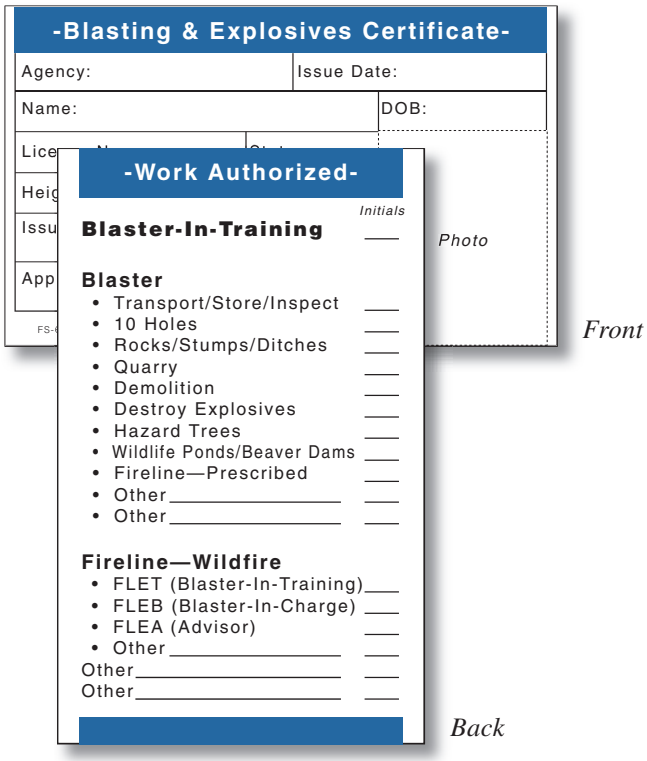

Figure 2—To remove hazard trees with explosives, blasters must have the "Hazard Trees" endorsement on their certification card.

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Hazard Tree Terminology

The Occupational Safety and Health Administration (OSHA) refers to hazard trees as danger trees. Under 29 CFR Part 1910.266(c), a danger tree is: "A standing tree that presents a hazard to employees due to conditions such as, but not limited to, deterioration or physical damage to the root system, trunk, stem or limbs, and the direction and lean of the tree."

The Forest Service's Health and Safety Code Handbook (FSH 6709.11, glossary) also uses the term *danger tree*. Forest Service employees have traditionally used the term *hazard tree* rather than danger tree. In this tech tip, hazard tree means danger tree.

Hazard Tree Awareness

Many factors can contribute to the risk posed by a hazard tree. This tech tip doesn't identify the conditions that make a tree dangerous. Information on hazard tree awareness can be found at

- *http://na.fs.fed.us/fhp/hazard_tree/*
- *http://www.fs.fed.us/treeclimbing/*
- *http://fsweb.boise-nf.r4.fs.fed.us/safety/*
  Click on the "Hazard Tree and Sawyer Resources" link. (This Boise National Forest Web site is available only to Forest Service and Bureau of Land Management employees.)

This tech tip replaces the 1994 tech tip, "Hazard Tree Felling With Explosives," produced by the Missoula Technology and Development Center (MTDC).

Tree Assessment

All trees must be thoroughly assessed before a felling operation. Determine whether the tree needs to be removed and if so, whether the tree can be removed safely. Be extremely careful when assessing the tree, especially if it shows signs of decay, excessive lean, or is on fire. Never approach a hazard tree from the direction of lean.

If a tree has a lot of decay, it could fall or roll while it is being cut, killing or injuring sawyers. Hazard trees do not have to be standing. Even when a tree is on the ground (figures 3a and 3b), binds can make it dangerous to cut. When a tree is above your skill or comfort level, do not attempt to fell or cut it—walk away. Leave the tree to be felled by a more experienced sawyer or a certified blaster.

Explosives can be a safe and reliable alternative for felling such trees. If explosives are used to fell a tree, the task becomes a blasting operation, subject to the rules and regulations in the Health and Safety Code Handbook.

Figure 3a—Not all hazard trees are standing. Steep terrain or binds in some trees lying on the ground could create hazardous sawing conditions.

Figure 3b—Downed trees can be severed with explosives placed on either side of the bole. Trees severed with this technique will contribute to a more natural looking trail corridor in wilderness areas.

Blaster-in-Charge

Once a decision has been made to use explosives to remove a tree, the blaster-in-charge controls the operation, including the placement of guards and lookouts, the

delineation of safety zones, and access to the area before and after the blast. The blaster-in-charge is responsible for the safety of the crew and decides where and how to place the explosive charges.

Load Calculations

Explosives are usually placed breast high on a tree. The amount of explosives needed to fell a tree depends on many factors, including the tree's diameter. Measure the diameter where the explosives will be placed. Internal and external loads require different amounts of explosives. Green and dead trees of the same diameter may require different amounts of explosives. Softwood and hardwood trees require different amounts of explosives.

The blaster-in-charge must adjust charges according to actual conditions. No absolute rule applies. If you question load calculations, err on the side of safety and use more explosives, not less, to ensure the tree is felled in one shot.

Placing Charges

Explosives can be used as internal or external charges, or a combination of the two. Unless a natural cavity can be used, a hole will have to be drilled into the tree before explosives can be loaded internally.

Hazard trees can be removed in groups. Experienced blasters may place charges on several trees in an area, and connect all the charges to a loop of detonation cord to remove all the trees simultaneously.

Placing Internal Explosive Charges

Less explosives are needed and the shock wave, noise, and airblast can be reduced by loading explosives internally.

Holes are drilled for the explosives (figures 4a, 4b, and 4c), which are placed into the hole, or the explosives' contents can be removed from the packing and squeezed or pressed into the holes.

Figure 4a—Auger bits can be attached to chain saw motors and used to bore holes in trees, allowing explosives to be loaded internally.

Figure 4b—Noise and airblast can be reduced by loading explosives internally.

Figure 4c—Three explosive charges were loaded in this hazard tree. Trees can be felled with less explosives when the charges are loaded internally rather than externally, but it is difficult to control the tree's direction of fall.

When blasters use only internal charges, they cannot accurately control the direction of fall. A combination of an internal charge and an external charge on one side of the tree may allow the direction of fall to be controlled.

Internal charges should not be used to fell a hollow or decayed tree. Just drilling a hole for the internal charges could weaken the tree, causing it to collapse unpredictably.

Placing External Explosive Charges

When charges are placed on one side of the tree (figures 5a and 5b), the blaster has some control over the direction of fall. The tree usually falls toward the side where the explosives are placed. The charge can be a bundle of explosives or the explosives can be shaped like a cone or pyramid with the detonator or detonation cord placed on top. The explosives may be taped to the tree or secured by wrapping plastic around the explosives and the tree.

Wrapping fireline explosives (FLE) all the way around the tree is an effective method for felling hazard trees, but least preferred because there is no way to control the tree's direction of fall. Small trees may be felled by wrapping multiple loops of detonation cord around the trunk.

Charges that are placed externally produce stronger shock waves and more airblast than charges that are placed internally. For example, the amount of explosives needed to fell large trees could produce enough airblast to damage structures within 2 miles. With internal charges, a similar blast could be detonated within 500 to 700 feet of structures without damaging them.

Figure 5a—Decay throughout this tree makes it too hazardous to fell with a saw. It was felled with one bundle of fireline explosives taped to the side of the tree.

Figure 5b—This tree's exposed, burned roots made it unsafe for felling with a saw. The external charge felled this tree safely.

Burning Trees

Special consideration must be given when felling trees that are burning. As part of your initial assessment, address these issues:

- Does this tree REALLY need to come down and why?
- Can we wait to let it come down on its own?
- If we can't wait, can we take the tree down safely?
- If the tree is felled with explosives, is there any chance that it may fall across a fireline?

The trunks, branches, or roots of burning trees may be weakened. Each burning tree has its own unique hazards that you'll need to recognize. If the top of a tree is burning, use only a water gel explosive or another type of explosive product that is approved for fireline construction. If the tree is burning at the base, do not fell it with explosives.

- Never use explosives when they may catch fire.
  - Never attempt to move explosives that are burning.
  - Do not attempt to extinguish explosives that are burning.
  - Move everyone a safe distance away from burning explosives and let the explosives burn.

Fuzzy Stumping

Trees felled with explosives leave stumps that look as if the tree broke off naturally. Felling trees with explosives to create this natural look (figure 6) is called "fuzzy stumping." In areas where sawn tree stumps may not be appropriate, such as in wilderness settings, felling with explosives may be preferred to felling with a saw.

Crews sometimes have emergency permission to use chain saws in designated wilderness areas, for instance, during fire suppression. Followup operations with explosives could leave the stumps or fallen logs looking more natural.

Figure 6—Explosives not only remove hazard trees, they leave a stump that appears as if the tree broke off naturally.

Approved Detonation Systems

Always use a detonation system that is not susceptible to the hazards of electromagnetic radiation. The FS–9, SD-500E Osprey, and Rothenbuhler 1664 radio-controlled, remote detonation systems are approved blasting systems. In addition, nonelectric shotshell-primer initiators and electronic spark initiators may be used for nonelectric detonation. Exploding bridgewire (EBW) detonators, nonelectric systems (figure 7), or combinations of the two can be used to initiate charges.

Figure 7—Place a nonelectric blasting cap on top of fireline explosives after they are taped to the outside of a hazard tree.

Tips for Hazard Tree Blasting

Assess each hazard tree thoroughly. Can it be cut safely or would it be safer to use explosives?

Consider using explosives to create fireline and to remove hazard trees—all as part of the same site blasting plan.

Weigh all factors carefully before deciding whether to use internal or external charges.

Be aware of conditions that could affect airblast: weather, clouds, wind, topography, and lack of tree cover.

Notify residents and businesses at least 24 hours before blasting in the vicinity of buildings.

Use more explosives than calculations indicate when felling green trees. Hardwoods require more explosives than softwoods.

Place external charges on the side where the tree is intended to fall, but never assume a tree will fall in the direction you intend.

Always detonate the blast from at least 500 feet away. Keep everyone at least 500 feet away from the hazard tree unless safety dictates that you need to be farther away.

Outdated fireline explosives can't be used to build fireline on a wildfire, but surplus stocks of explosives nearing the end of their shelf life (1 to 2 years) can be used to fell hazard trees (figure 8).

Always follow the rules and regulations in the "Guide for Using, Storing, and Transporting Explosives and Blasting Materials" and applicable Federal, State, and local regulations.

Figure 8—Fireline explosives that have been stored properly can be used safely to fell hazard trees, even if the explosives have been stored longer than their shelf life. Don't use outdated fireline explosives in emergency situations.

Availability of Qualified Hazard Tree Blasters

The blaster examiner in each region maintains a list of qualified hazard tree blasters. In addition, many forests have a lead blaster who may be able to provide the names of local blasters who are qualified hazard tree blasters. In 2008, the Forest Service had between 225 and 250 certified blasters across the country, many of whom are qualified hazard tree blasters.

Explosives used to remove hazard trees are readily available from nationwide distributors and usually can be delivered within a day. During fire season, distributors often build up supplies and may have fireline explosives ready for immediate delivery. Many forests maintain a cache of explosives that can be shared as needed.

About the Author

Bob Beckley received a bachelor's degree in political science from the University of Montana in 1982. He began his Forest Service career as a timber technician on the Nez Perce National Forest. Bob was a smokejumper when he came to the Missoula Technology and Development Center in 1990. He works as a project leader in the explosives and recreation programs, and also serves as the T&D public affairs specialist.

Library Card

Beckley, Bob. 2008. Felling hazard trees with explosives. Tech Tip 0867–2325–MTDC. Missoula, MT: U.S. Department of Agriculture Forest Service, Missoula Technology and Development Center. 8 p.

This tech tip describes how to use explosives to fell trees that are too hazardous to be felled with saws. Trees felled with explosives have jagged stumps rather than the artificially flat stumps left by a saw. Jagged stumps have a more natural appearance, which can be an advantage in wilderness settings. In the Forest Service, blasters not only need to be certified to work with explosives, but they must have a "Hazard Trees" endorsement to fell trees with explosives.

Keywords: blasting, danger trees, fuzzy stumping, hazard trees, safety at work, widow makers, widowmakers, wilderness management

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Additional single copies of this document may be ordered from:

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Electronic copies of MTDC's documents are available on the Internet at:

http://www.fs.fed.us/eng/t-d.php

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Forest Service and Bureau of Land Management employees can search a more complete collection of MTDC's documents, CDs, DVDs, and videos on their internal computer networks at:

http://fsweb.mtdc.wo.fs.fed.us/search/

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