density and a higher percentage of underground primary distribution. Utilities serving a high percentage of rural areas tend to have lower values due to lower customer density and a higher percentage of overhead primary distribution.

With just one exception, all responding utilities characterize more than 50% of their system as either moderately or heavily treed, with an average of only 23% of a typical system being lightly treed. Utilities, on average, reported about the same amount of heavy and moderate tree density on their system at 37% and 39%, respectively. Clearly, most electric utilities have to deal with tree-related issues on a majority of their overhead system. Vegetation management is an important and core issue.[35]

All of the reporting utilities reported being affected by at least one type of major storm, with most reporting at least three. More than three-fourths of responding utilities reported themselves being subject to linear winds, tornadoes, and ice storms. Almost sixty percent of responding utilities reported themselves being subject to hurricanes. The least-reported was wild fires, at 36%.

At this point, the reader should have a basic understanding for the utilities that responded to the survey in terms of size, geographic location, tree density, and exposure to major storms of different types. The remainder of this section discusses survey results, and should be read with the context of the responding utilities in mind.

4.1 Tree Trimming

Question 7:
Briefly describe your distribution tree trimming cycle (e.g., 4-year cycle).

Of the respondents, 18 indicated a homogeneous cycle across their system, 10 indicated a combination of cycles depending upon various factors, and 4 indicated programs that are not based on cycle time.

Of the respondents indicating a homogeneous cycle across their system, cycle time ranged dramatically from one year to eleven years. Three utilities indicated an annual trim cycle. Most indicated a four or five year cycle. Only one utility indicated more than a five year cycle. This was a large utility that indicated more than three quarters of its system being moderately or heavily treed.

Many utilities use a combination of cycle times typically ranging between three and five years. Two utilities indicate shorter cycle times for main feeder trunks and longer cycle times for lateral branches. More commonly, utilities indicate shorter cycle times for urban feeders and longer cycle times for rural feeders. Presumably, this is because greater clearances can be achieved in rural areas, resulting in a longer time for branches to grow close to conductors. One utility indicates that cycle times are set based on growing conditions and the growth rate of trees.

Four utilities indicated that they do not use cycle times for tree trimming. Each of these utilities targets feeders with poor reliability that will benefit from tree trimming.

[35] No criteria were given for utilities for classifying parts of their system as heavily treed, moderately treed, or lightly treed. There are several ways to measure tree density, such as trees per mile and trees per acre. Since many utilities will not have this data, the survey intentionally allowed for qualitative judgments in this area.

Question 8:
About what percentage of your distribution trimming is outsourced?

A large majority of responding utilities (27 of 32) indicate that 100% of distribution trimming is outsourced. Two utilities indicate that 95% is outsourced, and two others indicate that 85% is outsourced. Only one utility performs most of its trimming with in-house resources.

Question 9:
Are you, for the most part, keeping up with your tree trimming cycle goals?

Fourteen of the responding utilities responded with an unqualified "yes" to this question. Another eight responded with a qualified yes of some sort. Eight of the responding utilities indicated that they are behind on their cycle goals, while two did not directly answer the question.

From these responses, it seems that a majority of utilities are, for the most part, keeping up with their tree trimming cycle goals, but falling behind on cycle goals is not uncommon.

Question 10:
Is there a separate budget for hazard tree removal?

Responses to this question were almost split down the middle. Fourteen utilities said that there is a separate budget for hazard tree removals. Two have recently implemented this policy, while one has a separate budget that has been set to zero for 2009. Seventeen utilities do not have a separate budget for hazard tree removals. One has a fund for all removals (including hazard trees), while another is considering a separate budget for epidemic diseased trees such as those affected by the Mountain Pine Beetle. One utility has a separate budget for some operating companies and no separate budget at others.

Question 11:
Are you, for the most part, keeping up with your goals for hazard tree removal?

Only four utilities stated that they were not keeping up with their goals for hazard tree removals, although another four stated that they had no set goals. The yes responses, however, should be taken in context. Question 26 indicates that sixteen utilities feel that they would benefit from more aggressive tree trimming a "moderate amount" or "a lot." Therefore, this question should be interpreted as a utility meeting its stated goals, but benefits may result from more aggressive goals.

One utility responds that it is able to keep up with its goals for hazard tree removal under normal circumstances, but not necessarily when epidemic tree diseases arise.

Question 12:
Is it more difficult for you to address hazard trees when you are behind on your trimming cycle? Explain.

Responses to this question are mixed. Eleven utilities state that it is not more difficult to address hazard trees when behind on the trimming cycle. For the responses offering commentary, the reasons relate to

having a separate focus on hazard trees that is apart from the normal trimming cycle. This is evidenced by phrases such as "separate crews," "separate program," and "we treat hazard trees as a priority."

Fifteen utilities state that it is more difficult to address hazard trees when behind on the trimming cycle. Reasons are varied, including lower priority for hazard trees, co-dependence of trimming and hazard tree programs, the lack of an independent hazard tree program, less opportunity for hazard tree identification, and budgetary constraints.

Six utilities gave ambiguous answers, such as "we do not get behind on our trimming cycle," "there is no hazard tree removal program," and "we do not make an effort to identify hazard trees."

Question 13:
On about what percentage of your distribution system do you trim "ground-to-sky," not allowing branches to exist directly above conductors? Thoughts and experiences on ground-to-sky trimming are welcome.

"Ground-to-sky" trimming practices vary widely. Ten utilities responded that they practice this method of trimming on 5% or less of their distribution system, including four that state "none." None of these utilities stated strongly that they feel that this low amount is appropriate. One utility states that this practice will begin as part of a system hardening initiative, and another recommends the practice.

Eight utilities responded that they practice ground-to-sky trimming on 90% or more of their distribution system. These responses are mostly descriptive and do not advocate the practice. Four more utilities perform ground-to-sky trimming on a majority of the three-phase portion of the distribution system. One of these responses states, "Moving from a ground-to-sky approach to this targeted approach has led to lower costs on our first and second cycles. It also improved reliability as we were able to get more of our system on-cycle." Another response reflects a different perception of cost by stating, "Ground-to sky trimming is a more costly method of trimming."

The remaining eight utilities give a variety of responses that typically range from 10% to 25% ground-to-sky trimming. Several utilities indicate that this is done in targeted areas with reliability problems. Other insights from these responses include, "If a tree is 'sky-trimmed' extensively there is a risk of later mortality," and "Ground to sky ... allows for more light penetration to the floor, which allows more growth from the ground ... targeted removal of overhang is a more conducive practice for us."

4.2 Tree Outages

Question 14:
Excluding major storms, approximately what percentage of outage events are due to: (a) Entire trees, outside of the right-of-way, falling into conductors, and (b) Other tree-related causes.

There was some confusion when answering this question. Some responded as to the percentage of all outages, while others responded as to the percentage of only tree-related outages. Therefore, the results should be interpreted carefully. With this said, the average response of entire trees was about equal to the average response of other tree related causes. For many utilities, entire trees falling into conductors is not just a major storm problem.

Question 15:
During major storms, approximately what percentage of outage events are due to: (a) Entire trees, outside of the right-of-way, falling into conductors, and (b) Other tree-related causes.

Like Question 14, there was some confusion when answering this question. Some responded as to the percentage of all outages, while others responded as to the percentage of only tree-related outages. Therefore, the results should be interpreted carefully. Similar to the non-major storm case, the average response of entire trees was almost identical to the average response of other tree related causes. However, the total percentage is about 50% more during major storms, showing that trees account for more damage during major storms.

This result is somewhat surprising since many feel that entire trees falling over become a greater issue during major storms. The survey results of Question 14 and Question 15 does not support this view. Although there are more vegetation-related failures during major storms, the split between entire trees falling and other tree-related events, in the opinion of the survey responders, does not change much.

Question 16:
Approximately what percentage of trees that fall into conductors has visible warning signs that could have been detected prior to the tree falling over?

Nineteen utilities bravely answered this question while thirteen others understandably responded with an "unknown" or similar answer. The responses ranged from "less than 1%" to 50%, which is a surprisingly large spread. The most common response was about 10%, implying that 90% of tree fall-in events are not preventable, on average, in the opinion of the responders.

4.3 Identification

Question 17:
Is the identification of hazard trees outside of the trim zone explicitly addressed in your vegetation management procedures?

Only eight utilities responded "no" to this question, with an additional utility responding "somewhat." Twenty-four utilities responded that they explicitly address the identification of hazard trees outside of the trim zone in their vegetation management procedures.

Question 18:
Do your private property easements allow for the removal of hazard trees within the right-of-way?

Twenty one utilities responded yes to this question. One stated that a portion of its private property easements do, and eight responded no to this question. However, it appears that private property owners typically allow hazard tree removal even if there is not a provision in the easement (see Question 28).[36]

Question 19:
Do your private property easements allow for the removal the removal of hazard trees adjacent to the right-of-way?

Only five utilities responded that, in most cases, their easements allow for the removal of hazard trees adjacent to the right-of-way. Another states that "a portion" of their private property easements address this issue. One of the responses cites its traditional easement language as follows:

> *... remove or modify from time to time trees, limbs, and/or vegetation outside the said right-of-way which the Grantee considers a hazard to any of its electric power or communications facilities or is a hazard to the rendering of adequate and dependable service to the Grantor or any of the Grantee's customers, by use of a variety of methods used in the vegetation management industry.*

Twenty-four utilities do not have easements that address hazard tree removal outside of the right-of-way. This effectively means that it is at the customer's discretion as to whether a hazard tree is allowed to be removed (although some utilities address this issue in their customer service agreement). Again, Question 28 shows that most customers allow hazard tree removal even if there is not a provision in the easement.

Question 20:
Do your public property easements allow for the removal of hazard trees within the right-of-way?

Fourteen utilities responded that, in most cases, their public property easements allow for the removal the removal of hazard trees adjacent to the right-of-way. This is slightly less than the number that responded yes to the same question regarding private property easements (Question 18). An additional four utilities responded with a qualified "yes" based on prior approval, small tree diameter, or varied treatment in different areas. Ten utilities responded "no," and one responded "unknown."

Question 21:
At your utility, would you characterize the focus of identifying off-right-of-way hazard tree as: (a) focus is weak; (b) focus is moderate; and (c) focus is strong.

There was a balance of responses to this question, with ten utilities stating that the focus is weak, eight stating that the focus is moderate, and fourteen stating that the focus is strong.

[36] In this question, "easement" is intended to represent the documented right to place facilities on private property, while the right-of-way represents the land on which utilities facilities exist. Most of the responses seemed to understand this intention.

Question 22:
About what percentage of identified hazard trees are discovered through the following: (a) Normal trimming cycle; (b) Dedicated circuit inspections; (c) Noticed by crews doing other things; (d) Customers; (e) Other (please explain).

The average responses to this question are as follows:

- The normal trimming cycle: 56%
- Dedicated circuit inspections: 21%
- Crews doing other things: 10%
- Customers: 9%
- Other: 4%

Clearly, most hazard trees are identified during the normal trimming cycle. However, for the companies that have dedicated circuit inspections that focus on hazard trees, half or more of hazard trees are identified through the inspection. Serendipitous identification through crews doing other things or by customers remains relatively small, but together still comprise almost 20% of identifications. There were only two "other" responses, both related to outage follow-ups.

Question 23:
Do you have a database of hazard tree information (i.e., location of removed trees, known hazards, customer refusals, etc.)?

Eight utilities state that they have a database of hazard tree information. Many of the remaining responses describe how information is kept in lieu of a database. For example, responses refer to spreadsheets, hard copies of information, and paper records. One utility notes that it is starting to use GPS equipment, and another notes that it is planning to deploy a GIS-based system in the near future.

4.4 Removal

Question 24:
Do you remove hazard trees located on customer property at your own cost?

Only three utilities stated that they do not remove hazard trees at their own cost. Most responses simply state "yes." One response qualifies that a tree will only be removed at the utility cost if it endangers utility facilities, which is likely the case for most utilities. Similarly, another utility responds that is will only remove an "immediate hazard," and that the customer is responsible for any additional work.

Question 25:
Are there any complications with hazard tree removal related to third-party-owned or jointly-owned facilities?

This question was intended to address third-party-owned or jointly-owned facilities, such as those involving telephone companies and municipalities. Five of the responders either did not answer or answered in a way that interpreted "third-party" to mean the land owner or customer. Of the remaining responses, nine-

teen utilities stated that this is typically not a problem while eight state that this is a problem. One states that, "complications are usually related to recovering shared costs." Another observes that, "communications companies do very little tree work to protect their facilities."

Question 26:
Do you have the ability to remove hazard trees located on customer property without the prior consent of the customer, such as condemning dead hazard trees? Please explain.

Twenty utilities state that they cannot remove hazard trees located on customer property without the prior consent of the customer. This means that a customer can refuse to have a known hazard tree removed. It also means that a hazard tree cannot be removed if the customer cannot be contacted. Ten utilities do have the right to remove hazard trees located on customer property without the prior consent of the customer. Many of the responses emphasize that there must be compelling situation, using terms such as emergency, eminent danger, severe hazard, and safety hazard. Several other responses indicate that, although they have the right to remove a hazard tree, customer consent is always sought.

Question 27:
Please describe how hazard tree removal requests are performed.

There are a variety of responses to this question, not all addressing specifically how customers are contacted with respect to removing a hazard tree on their property. All of the complete responses are available in Appendix B.

There seems to be two general approaches seen in the responses. The first is the use of a "door hanger" to notify customers of upcoming tree work on their property and possibly asking for a signature. The other is direct contact with the customer by a utility employee or representative. There are a variety of position titles mentioned that have responsibility for communicating with the customer and obtaining permission. These titles include: coordinator, contractor notification person, inspector, field inspector, certified arborist, qualified arborist, company arborist, facilitator, supervisor, forester, and general foreman.

Question 28:
About what percentage of hazard tree-removal requests are granted by customers?

Twenty three utilities responded that 90% or more of hazard tree removal requests are granted by customers. Of these, six stated that essentially 100% are granted (probably because it is required, see Question 26). Although this might seem high, recall that Question 26 revealed that eighteen utilities have the right to remove hazard trees located on customer property without the prior consent of the customer, essentially making customer consent desirable but unnecessary. Two responses indicated an 85% customer permission rate, another indicated an 80% customer permission rate, and another two indicated a 75% customer permission rate.

Question 29:
If a customer does not respond to a hazard tree removal request, can you remove the tree? Explain.

This question is similar to Question 26, which addressed the right to remove a hazard tree without prior consent. Fifteen utilities responded "yes" to this question, which is higher than the ten utilities that responded "yes" to Question 26. Two additional utilities stated that they can remove the tree in certain situations. This question, unlike Question 26, prompted many comments about legal issues, legal actions, legal departments, and the involvement of law enforcement officers.

Question 30:
If a customer initially refuses to have a hazard tree removed, are any follow-on persuasion activities performed? How effective have these been?

Every responding utility stated that they perform follow-on persuasion activities after an initial refusal. The only exceptions were three utilities that did not provide an answer. Responses can be grouped into two categories: coercive and persuasive. Only five utilities indicated the use coercive techniques, while 24 indicated persuasive techniques. Some representative examples of coercive and persuasive tactics are as follows:

<u>Examples of coercive tactics</u>
- Notify the customer in writing that they will be responsible for damages.
- The City will remove the tree and apply the charge to the customer's municipal property taxes.
- We advise the customer that they will be held liable for any damages.

<u>Examples of persuasive tactics</u>
- Take down additional trees at customer request.
- Replace the tree with a short-growing species and/or grind stumps.
- Haul the brush or debris or negotiate some other work activity.
- Discuss the potential of the hazard tree creating an outage for the customer and the benefits of having the tree removed. By communicating and educating the customer to the real hazards of these situations, we are generally successful in persuading the customer to allow us to remove the tree.
- Offer replacement trees or shrubs.
- Currently trying to set up a voucher system with local nurseries to allow us to just hand local nursery gift card voucher to the property owner as incentive.

Question 31:
If a customer refuses to have a hazard tree removed, and the tree later damages the utility system, do you ever hold the customer financially liable for the resulting damage? Explain.

Seven of the thirty-two responding utilities indicated yes to this question. Three of these indicate that this is part of the negotiation process when attempting to get permission to remove a hazard tree. One response states, "We do advise customers in our final danger tree letter that we will hold them financially responsible." Another states, "This threat is used as part of the 'negotiation', but most situations do not

get assessed back to the property owner." None of the utilities responding "no" to this question say that the reason is due to customer-relationship issues.

Question 32:
About how much time, on average, elapses from the identification of a hazard tree until it is removed?
There were a wide variety of answers to this question, ranging from 1-3 days to 1-6 months. The most common responses ranged from 1-2 weeks (11 responses). Several of the responses separated eminent threats from less immediate hazards. One states, "One week, unless immediate action is necessary." Another states, "Imminent threats on done within days, others typically take a few weeks." Yet another states, "If the hazard tree is prioritized as a high it is addressed within 24 hours. If it is a low or medium, the tree will addressed within 14 days." None of the responses define their criteria for a hazard tree being an immediate threat.

Question 33:
After cutting down a hazard tree on a customer's property, do you remove the resulting wood?

Nine of the responding utilities reported that they will remove the resulting wood after a hazard tree is cut down on a customer's property. However, many of these responses qualify that this is only done at the request of the customer, or as part of the negotiation. Nine utilities simply responded "no," while fourteen responded with a "qualified no." Some of the qualified responses included the following statements:

<u>Some conditions where utilities may consider removing wood</u>
- Not typically but we have done so as part of a special reliability project.
- In an urban setting we may consider chipping the limbs, but we do not remove the log wood.
- Company policy is to leave the wood however realistically actually handled on case by case basis.
- Not normally; however, in a few cases, this has been done to avoid litigation.

Question 34:
When removing a hazard tree on a customer's property, do you ever replace the tree? Explain.

Responses to this question were mixed. Sixteen utilities responded that they do not replace the tree. Another six imply that this is only rarely done. Ten utilities state that they sometimes do provide a replacement tree after removing a hazard tree. Two of these responses indicate the use of tree vouchers rather than direct replacement. Some representative comments from the "yes" responses are:

<u>Some representative approaches to tree replacement</u>
- We may offer small replacement trees to facilitate removal in isolated incidents.
- We provide a pre-paid VISA card for the customer to use as they like. Educational materials are provided with the card to assist the customer in selecting a proper tree to plant near the power lines."
- Customers are offered tree vouchers through our Tree Replacement Program.
- We offer replacement trees or shrubs to compensate for the loss of the tree.

Question 35:
Do you have a program to identify and replace undesirable tree species? How aggressive is this program?

Twenty utilities state that they do not have a proactive tree replacement program. Eleven utilities state that they have a program, with most offering short descriptions (one utility did not provide an answer). Some of these descriptions include the following:

Descriptions of some tree replacement programs

- The program is extensive with letters to customers, a communication campaign involving multiple forms of media, public presentations, as well as participation in Arbor Day and Earth Day events and the like.
- "Right tree/right place" program. Usually only on palm trees.
- Based upon growth potential, cost, and system reliability.
- The whole program is centered on nurturing the growth of compatible vegetation. We do plant in some instances, however, lean heavily on Mother Nature to provide compatible shrubs naturally.
- We aggressively pursue removal of several troublesome species (i.e., cycle-busters).
- We aggressively target fast growing species. We try to work with city governments on tree ordinances, and we have even developed educational material that is made available publicly in an effort to inform customers and city code enforcement officials.

4.5 Best Practices

Question 36:
A certain percentage of trees die naturally every year. Do you feel that your utility, on an annual basis, removes enough dead and diseased trees to keep up with this natural process?

Ten utilities state that they are probably not removing enough dead and diseased trees on an annual basis to keep up with the natural tree mortality rate. Four utilities respond that they are not sure. The remaining eighteen utilities feel that they are generally keeping up with the natural process. Several of these responses state that hazard tree removal is sufficient in normal years, but not necessarily when unusual events occur. These responses stated the following:

Situations that may result in difficulty removing newly-developed hazard trees

- Under normal conditions exclusive of hurricanes and tornadoes, we generally keep up with this natural process.
- Exception is bark beetle infestation.
- We stay current, barring an infestation of some type.
- [We are] seeing a larger number of stressed trees uprooting and shedding major scaffold limbs due to drought/disease issues.

Question 37:
Would an increase in the aggressiveness of hazard tree removal reduce major storm damage (a) a little bit, (b) a moderate amount, or (c) a lot.

Sixteen utilities responded "a little bit," seven responded "a moderate amount," and eight responded "a lot." One utility did not provide an answer. No specific criteria was provided for these categories. No utility provided justification for its response, such as citing the mortality rate of tree species and the estimated number of trees in the "utility forest."

Question 38:
What else besides hazard tree removal (vegetation related) would be effective at reducing major storm damage?

There are a wide variety of responses to this question that can broadly be categorized into trim specifications, trim cycle, and miscellaneous. Because the responses are difficult to generalize, summaries of some of the responses in each category are now provided.

Trim specifications
- Widening right-of-way.
- Set minimum clearance and maintenance requirements for owners of trees.
- A dramatic increase in the maintained ROW along primary conductors.
- Removing additional overhang on laterals (single phase lines).
- A better trim specification. Currently the floor is not cleared and overhangs are allowed.
- Overhang removal (blue-sky or hinge point) targeting weak-wooded and other problematic species.
- Eliminate all tall-growing trees from beneath the power lines.
- Increased clearances at the time of pruning.
- Clear the right-of-way based on species & growth rate.
- Hard wood overhang removal.
- Palm tree skinning program.

Trim cycle
- Staying on trim cycle.
- Routine cycle trim maintenance.
- Reducing the cycle time while keeping the current ground to sky specification.
- Reduced cycle period.
- Increased tree removal/replacement.
- Mid-cycle inspections.
- More lateral (neighborhood) line clearing.
- Ability to complete a total annual work plan.

Miscellaneous
- Franchise rights that provide for tree abatement without the owner's permission.
- Cooperation of governmental entities, state, city and county, in addressing vegetation issues.

- Being notified by adjacent landowners of land use change. Many landowners have decided to clear cut their land ... there remains a strip of trees adjacent to the power line that inevitably fall the next time the wind blows.
- Educating the public and builders about planting the right trees in the right place.

Question 39:
Please describe any attempts to more effectively address hazard trees that did not work very well.

Twenty-seven of the responding utilities did not provide an answer to this question. The five responses are summarized as follows:

Ideal that did not work very well

- Lump sum bidding. Contractors' desire to make a profit put extra pressure on our supervisors to catch skipped hazard trees.
- Removing dead trees only.
- A stand-along hazard tree program (separate from the routine trimming cycle) was more effective.
- Lack of property owner notice and "buy-in" prior to initiating work has proven to be a deal-breaker for many political subdivisions.
- Having multiple screeners checking backlogged hazard trees did not work very well.

Question 40:
Please describe any attempts to more effectively address hazard trees that did work very well.

Seventeen of the responding utilities did not respond to this question. The fifteen responses varied widely, but can generally be categorized as workforce, increased effort, customers, and miscellaneous. Summaries of some of the responses in each category are now provided (some utilities provided multiple answers).

Workforce

- Use of retirees to assist in coordination and inspections.
- Having a two-man crew dedicated to removing hazard trees.
- Trouble & linemen calling in hazards.
- Holding the contractor responsible for tree outages caused by missed or skipped hazard trees over the entire trimming cycle.
- Continuous training and education of our contractor pre-inspection arborists.
- Controlling contractor employee turnover.

Increased effort

- More patrols by servicemen/linemen & full removal when the trees are identified.
- Increasing mid-cycle patrols to include single-phase laterals.
- Reclaiming of ROW line clearing practices in some limited areas.
- In a designated "natural" area, we obtained permission to clear cut everything below the lines and any dead trees within a fall arc of the lines. We chipped the wood and created a walking trail beside the lines. The City seemed to like this idea and we had no complaints from residents and users of the "natural" area. Tree contacts have significantly been reduced and reliability increased in an area that was performing poorly during storms.

Customers

- Proactive notice and negotiated agreements prior to work starting.
- Personal face to face contact with property owner.
- One on one education of the customer about hazard trees and the potential they have.

Miscellaneous

- Investigating and analyzing tree caused outages, then summarizing the findings and educating field forces on identification.
- Developing a hazard tree rating system.
- Implementing a system-wide vegetation management reliability program.
- Implementing a hazard tree quality control program that examines abatement decision making.
- Tracking and analyzing outages has led to identification of areas that require more extensive hazard tree identification and removal.

Question 41:
What would it take for your company to more effectively manage hazard trees?

Only three of the responding utilities did not respond to this question. The responses varied widely, but can generally be categorized as increased resources, data/analysis, approach, and legal/regulatory. Summaries of some of the responses in each category are now provided (some utilities provided multiple answers).

Increased Resources

- Increase in funding and/or resources for hazard tree removal (9 responses).
- Increase funding for tree replacement (4 responses).
- Dedicated budget for hazard tree removal (3 responses).
- A mechanism to allow for the concurrent recovery of vegetation related expenses (2 responses).
- A separate crew that can climb a tree and fell it into the woods. No need for a bucket truck or disposal when the forest is the adjacent land type.
- Specialized inspector to identify hazard trees.

Data/Analysis

- Better tree failure data that shows failure trends by species that include: how the tree fails (wholly, partially, or both), its rate of failure as a function of population, and the time of year the species is likely to fail.
- An analysis of weather's influences over failure patterns.
- Good data collection tools and analytical support.
- A good business case to show we get more value than the cost (mainly in reducing major storm costs).
- Better data to support an increase in funding.

Approach

- Mid-cycle inspections.
- Cycle trimming.
- Find a way to get beyond the "business as usual" pruning and create a hazard tree program.

- Only right-of-way expansion would address the "look-OK-but-fail-anyway" trees.
- Better education for the public and better facilitation of requests to have trees removed with the public.

Legal/Regulatory

- Stronger stance of regulatory agencies to back-up clearance and hazard reduction initiatives.
- Better support for tree removal from public agencies.
- Include tree removal as part of new easement agreements.
- Take firm legal action against property owners.
- Establishing statutory utility liability for damages caused by hazard trees that is based upon a negligence standard rather than a strict liability standard.

Question 42:
What would you recommend as a best practice for managing hazard trees?

Seven of the responding utilities did not respond to this question. The responses varied widely, but can generally be categorized as approach, data/analysis, overall UVM program, and miscellaneous. Summaries of some of the responses in each category are now provided (some utilities provided multiple answers).

Approach

- Use a stratified approach based on the importance of the facilities, e.g. use a complete tree walk-around process 40' on either side of the pole line for subtransmission lines and distribution feeder main; otherwise detect hazard trees on remaining facilities as viewed when walking along the pole line.
- We recommend a three-pronged approach. This includes hazard tree identification and removal by contractors as part of an ongoing proactive circuit trim maintenance program; vigilant reporting and removal of hazard trees identified by utility personnel during the course of operations; and prompt inspections with the appropriate actions taken following notification from customers of potential hazards.
- Mid-cycle patrols and outage investigations.
- Train pole inspectors to identify hazard trees during regular inspections.
- Use tree trimmers to identify during area trimming.
- Have an annual danger tree crew to find and address hazardous trees.
- Every six months, inspect main feeder lines for hazard trees in areas that would have a high customer impact if an outage occurred.
- Establish a quality control mechanism that objectively analyzes tree abatement decision making and require open dialogue about the QC findings.

Data/Analysis

- Know species risk, target specific areas known to be at risk.
- Gather species-specific tree failure data & utilize that data to drive tree-abatement decision making.
- Establish a reasoned method to analyze the risk (impacts) associated with tree failure and utilize that analysis in tree abatement decision making.
- Recognition of targeted problem species that need to be given special attention.

Overall UVM Program

- Remaining on cycle and doing mid-cycle inspections.
- Several years of consistent funding.
- Aggressive removal policy as part of routine circuit maintenance.
- Include this as part of the routine patrols made.
- Establish a patrol standard that includes hazard trees.

Miscellaneous

- Require ANSI standards in tree abatement practices.
- Put a high emphasis on customer satisfaction.
- Widespread education of the customers regarding removal/replacement and governmental ordinances that do not hinder the removal of hazard trees by utilities.
- Holding the contractor responsible for tree outages caused by missed or skipped hazard trees over the entire trimming cycle.

Question 43:
Any other thoughts or comments on the subject of hazard trees?

Only a few utilities took the opportunity to respond to this question, with most of these repeating content provided in previous answers. The most popular theme is that hazard tree removal is not absolutely necessary, and must therefore be justified by either a business case (i.e., more money is saved than is spent) or by reliability improvement. Another response reiterates that a large number of trees that fall into the system are apparently healthy. The only way to deal with these types of trees is to more aggressively remove or replace all trees that could fall into the utility lines, which is a difficult proposition from both a financial and a customer relations perspective.

5 Recommended Best Practices

Many of the utilities responding to the survey seem to be satisfied with their hazard tree program. Many claim that they are keeping up with the natural rate of tree mortality, assert that additional effort in hazard tree management will not reduce storm damage, and posit that they cannot think of anything additional or different that they could do to better manage hazard trees. Is it fair to use these utilities as the standard of best practice? The author's opinion is "no." Although these utilities may feel that they are addressing hazard trees in an appropriate and effective manner, they would be hard-pressed to *prove* that this is the case. With this in mind, this section presents best practices that, in the author's opinion, will ensure that hazard trees are being managed through a process that is cost effective, consistent, transparent, and data-driven.

The best practices presented in this section should be taken in context. First, many utilities will already have many of these elements in place. Second, each utility is in a unique situation with regards to hazard trees. Certain best practices, though appropriate for most utilities, may not be appropriate for all. In any case, all utilities are encouraged to examine the proposed best practices presented in this section. Some can be implemented at little-to-no cost, and others may allow hazard trees to be more effectively managed at a lower cost.

Recommendations are not intended to be a "one size fits all" approach. For example, a utility with very little tree exposure may not need to have any formal hazard tree program at all. Similarly, utilities where tree fall-ins result in a small percentage of customer interruption minutes (e.g., less than 5%) may not need to change their approach as long as they can demonstrate cost effectiveness.

Best practices are organized into three stages. The best practices in the first stage are inexpensive and relatively simple to implement. In addition to being potential quick wins, they also set the foundation for more ambitious actions. The best practices in the second stage are designed to be implemented in the medium term and generally require more utility effort, investment, and potentially change. Generally, the experience and data obtained from the first stage will be helpful when implementing the second stage. The best practices in the third stage should be considered after a utility has a very good handle on its hazard program including the costs and benefits of a more aggressive approach. Since the best practices in the third stage are potentially expensive, the utility will be in a good position to have a dialogue with regulators about benefits and rate implications.

First Stage

1. **Culture change.** In any organization, it is important to align goals with the culture. This allows the small decisions that are made by everyone everyday to work toward a common vision. In the case of hazard trees, it is important for all employees to be aware of the issue, its importance, the support of executive management in effectively managing hazard trees, and the expected benefits. A first step in hazard tree management is to identify an executive champion, execute an initial communications plan, and maintain continuing communications about status, wins, and future goals. Culture change is most important for utilities that need to significantly change their approach to hazard tree management.

2. **Separate hazard tree budget.** Most utilities are budget-driven. To ensure a sustained and consistent effort from year-to-year, it is important for hazard tree management to have its own budget separate from clearance activities. The way the work is managed and executed may not change, but the amount spent specifically on hazard tree management will be tracked side-by-side with tree pruning. This accomplishes several things. First, it allows the volume of work performed on hazard trees to be more easily tracked. Second, it provides additional transparency into hazard tree activities. Third, it makes it more difficult to reduce hazard tree spending disproportionately to tree trimming, as often happens when there is a single integrated UVM budget that experiences a reduction. A hazard tree budget can be part of another budget (e.g., UVM, all tree removals) as long as there is a separate estimate for hazard tree spend and separate tracking of hazard tree expenditures.

3. **Hazard tree data.** Cost-effective hazard tree management must be data driven. Therefore, it is important for utilities to have a robust data collection process for hazard trees. At a minimum, this should consist of three elements. First, all identified hazard trees should be documented in a standard form. Important information to collect includes the location, species, defect, distance from lines, date of identification, date of removal, and any information about gaining customer approval. It is helpful to include a GPS location of the tree so that information can be easily visualized in mapping software, but this is not essential. Second, a sample of trees that fall into the distribution lines should be examined by a qualified arborist to collect similar data, especially the species, distance from the power line, and whether there were visual defects that could have been identified before the tree fell over. Third, the outage management system should be able to capture basic data for all tree-related interruptions on the distribution system. This requires clear cause codes that can be assigned by linemen such as: tree fall-in within ROW, tree fall-in outside of ROW, broken tree branch, tree grow-in, and other tree cause (explain). The UVM group should obtain regular updates of the distribution outage information and be able to easily cross-reference this data to the richer, but less extensive data collected by arborists.

4. **Post-storm data collection.** Many trees fall down during major storms. When this happens, utilities are understandably focused on restoration rather than data collection. By the time a utility begins to think about the role of trees in storm damage, chain saws and chippers have typically removed most of the evidence. This data is invaluable when trying to manage hazard trees in a manner that is most beneficial during major storms. Therefore, a utility should have a plan that has damage assessors collect data on fallen trees while they are already out in the field. For example, damage assessment forms could have a check box labeled, "trees likely caused this damage," possibly with a selection of the types of trees that contributed to the damage. A process should be in place so that all damage assessment forms are retained so that the information can later be entered into a spreadsheet or database for analysis.

5. **Inspection procedures.** Hazard trees cannot be removed unless they can be identified. In order to improve the effectiveness of hazard tree identification, inspection procedures should be documented and the inspections should be performed according to these procedures. Typical inspection procedures should include who should perform inspections, when inspections should occur, and specific actions that should take place during inspections. These procedures may be different for different situations (e.g., dedicated hazard tree inspections, pre-inspections done by arborist prior to cycle trim, inspections done by linemen during circuit patrols, etc.). These procedures should specify, at a minimum, how far back from the lines to inspect, when the inspector should walk around the tree, and specific defects to look for in different tree species. It may be appropriate to have different procedures for different geographic areas.

6. **Maximize customer approvals.** Even if a utility can forcibly remove a hazard tree from customer property, it is always desirable to obtain customer pre-approval. Utilities should collect data on initial customer approval rates and ultimate customer approval rates. The benchmark data suggests that a 95% approval rate is reasonably possible to achieve. If approval rates are lower, the utility should employ more extensive negotiation tactics that may include negotiation training, customer education, debris removal, tree replacement, tree vouchers, and possibly the threat of financial liability. If not being done already, the utility should strongly consider paying for the removal of customer-owned trees that pose a hazard to utility equipment.

Second Stage

7. **Manage backlog.** There should be clearly documented goals and processes for the removal of identified hazard trees. Documentation should also exist to show that these goals are being met. Processes should be in place to ensure that imminent threats are addressed immediately. Hazard trees identified on pre-patrols should, of course, be removed when the tree crews arrive at the location. Hazard trees identified through other processes should generally be removed within one month. Showing that the hazard tree backlog is being well-managed establishes credibility, in addition to being a best practice.

8. **Maintain pruning cycle.** Unless the hazard tree program for a utility is, for the most part, separate from cycle clearance, it is important to maintain the pruning cycle. Since the pruning cycle is often the primary mechanism for hazard tree identification, being behind on the pruning cycle will result in being behind on hazard tree removals. In addition, utilities that are behind on their pruning cycle often, in an effort to catch up, shift focus and budgets from hazard trees to clearance work.

   Although not directly related to hazard trees, it should be emphasized that maintaining an optimal pruning cycle is less expensive from a life-cycle perspective than falling behind and then catching up. As discussed in Section 3, this is because the biomass addition to trees occurs exponentially, in addition to pruning difficulties that occur when branches begin to encroach upon conductors (see Section 3). In most cases, a regular cycle (implemented in a thoughtful manner) is the least-cost approach for parts of the system with a significant utility forest.

   Tree growth rates can vary from year to year based on precipitation and other factors. Therefore, a strict and inflexible pruning cycle is not the intent of this recommendation. Once a utility establishes its pruning cycle, it is appropriate in certain cases to defer pruning on certain scheduled parts of the system if there is evidence that pruning is not necessary.

9. **Hazard tree database.** Once a utility begins to manage their hazard tree program dynamically based on extensive field data, it becomes important to have a hazard tree database where all of the data can be gathered, maintained, and analyzed in an efficient and secure manner. At a minimum, this database should be a repository for the data collected according to Recommendation 3. The database should be able to track factors such as the number of hazard trees identified each month, the number of removals each month, the number of refusals, average removal time, and so forth. More advanced systems, if desired, can be based on a geographic information system (GIS) so that information can be displayed and analysis be done on a geographical basis. GIS has the additional advantage of being able to display a variety of additional data with the hazard tree data such as streets, circuits, plots, devel-

opment zones, municipal boundaries, satellite imagery, weather data, and a host of other easily obtainable data sources.

10. **Assess the utility forest.** An assessment of the utility forest is recommended for utilities that have a significant percentage of customer interruption minutes attributable to fall-in trees (e.g., 10% or more). The utility forest, as discussed in Section 3, consists of all trees capable of falling into the utility lines. An assessment of the utility forest will require a statistical sampling at various locations in the system. The result is an estimate of the total number of trees, by species, in the utility forest. Mortality rates for different tree species can be obtained from state forester data. The utility forest statistics, combined with tree mortality rates, results in the expected number of new hazard trees in the utility forest each year. This can be compared to the number of hazard tree removals to see if hazard tree removals are keeping up with the natural rate of tree mortality.

11. **Prioritize by species.** A combination of the utility forest data and the hazard tree data allows inspections and removals to be tailored by tree species. For example, a certain species of tree may only constitute 10% of the utility forest but is involved in 30% of fall-in events. This species should be given special attention for inspection and removal. In contrast, another tree species might consist of 40% of the utility forest but only 5% of fall-in events. This species can be addressed in a less strict manner. Inspections can also be tailored by species by documenting the typical types of defects that are common for that species. For example, certain species may be subject to decay as evidenced by a certain type of fungal growth, another species may be subject to cracks, another may be prone to large branch failures, and yet another may be subject to simply blowing over when it is the tallest tree in the area.

12. **Plan for epidemics.** Any hazard tree program will be extremely stressed should a tree epidemic occur such as a beetle infestation. If an epidemic occurs, the tree mortality rate will increase significantly and the existing level of hazard tree activity will be insufficient to identify and remove the infested trees. Therefore, utilities that have the possibility of a tree epidemic should have a written plan on how it will deal with this epidemic. This plan should address issues related to funding, resources, reliability, public relations, other stakeholder relations, and other factors.

Third Stage

Note on the Third Stage: These recommendations are recommended if utilities wish to significantly reduce the number of tree-related failures during major storms. Since most tree failures during major storms are apparently healthy trees (i.e., not hazard trees), some of the recommendations in the Third Stage go beyond hazard trees, are potentially expensive, and are sensitive to property owners. Therefore, utilities must carefully consider whether the benefits associated with these Third Stage recommendations justify the costs and other implications.

13. **Engage regulators.** After the appropriate elements of the first two steps have been successfully implemented, a utility will have a strong hazard tree program that is data driven, efficient, and cost efficient. At this point, the utility must decide whether it wishes to become, with respect to tree damage during major storms, more aggressive in terms of funding, legal constraints, political issues, or other issues that warrant involvement with the regulator. Since the existing program is very good, proposed costs and benefits should have high credibility with regulators.

14. **Address legal, regulatory, and political issues.** After the first two stages, the utility will have a good understanding of any legal, regulatory, or political issues that are hampering effective hazard tree management. Using data, the utility will be able to demonstrate the impact, and quantify the benefits of potential changes. Choosing its battles wisely, the utility can now attempt to change one or more of these situations in a collaborative fashion. It is not advisable to address these issues before good data and analyses are available.

15. **Targeted annual inspections.** For utilities interested in being more aggressive with regards to hazard trees, dedicated annual inspections can be performed for critical parts of the system. For example, a utility might identify twenty percent of its feeders that it deems critical to minimize damage during a major storm. The three-phase portions of these feeders could then be inspected on an annual basis for hazard trees (these inspections could be coupled with an overall inspection of the circuit). This inspection is completely separate from trim cycle work. Aggressive utilities may choose to perform annual inspections on all three-phase portions of the system. Targeted annual inspections should be based on a credible cost-to-benefit analysis.

16. **Targeted danger tree removal.** During major storms, many of the trees that fall over could not have been identified ahead of time. Therefore, the only certain way to dramatically reduce the number of fall-in events during a major storm is to reduce the utility forest. Broad-based widening of all rights-of-way is almost certainly cost prohibitive (in addition to being unacceptable to many stakeholders). However, targeted danger tree removal can be considered on critical parts of the system that are especially important to have a minimum of damage during a major storm.

    Danger tree removal does not involve the removal of all trees within a certain distance to the conductors. Rather, only trees that have the potential to fall into the conductors are considered for removal or replacement. For example, a utility might currently remove all trees within twelve feet of the conductors. Targeted danger tree removal might include the removal of all trees between twelve and twenty feet of the conductor that have the potential of falling into the conductors. The utility should be aware that this type of removal strategy might result in increased growth of other trees due to the availability of more sunlight and less competition for soil nutrients.

    Many property owners will probably be less-than-enthusiastic about targeted danger tree removal, perhaps to the extent that makes this recommendation impossible or undesirable to implement. However, targeted danger tree removal is the only sure way to dramatically reduce the number of tree fall-ins during major storms. There is emerging research on the effects of canopy thinning to reduce tree damage from strong winds, but this research has focused on small-diameter trunks and is not applicable to utility danger trees, which tend to have large trunks.

    Any utility that pursues targeted danger tree removal should keep detailed data so that, over time, the impact of the widening can be determined.

17. **Targeted ground-to-sky pruning.** Branches over conductors pose a hazard to the conductors. Furthermore, overhanging conductors greatly increase the probability that a tree will strike the conductors if it should fall over. Therefore, ground-to-sky pruning will be effective for improving both daily reliability and storm reliability.

    Once ground-to-sky pruning is established, it is often slightly less expensive to maintain as long as taller lifts and/or climbing is not required. As discussed in Section 3, this is because of the exponen-

tial biomass growth characteristics of trees. Less biomass on the trees results in less biomass to remove on an ongoing basis. In addition, pruning over live conductors is often less efficient than pruning away from the conductors.

Transitioning from under pruning to ground-to-sky can be initially expensive, although these costs can typically be capitalized as a right-of-way permanent asset improvement. Transitioning to ground-to-sky will also typically involve an extensive amount of customer outreach and coordination with many other stakeholders.

Despite these challenges, utilities should consider using ground-to-sky pruning on critical parts of the system that are especially important to have a minimum of damage during a major storm. Some utilities might also consider not allowing branch overhangs on all three-phase portions of their distribution system. At a minimum, this should involve pruning as high as the lift will reach, with an attempt to prune above the "hinge point," where a branch that splits at the trunk will swing to the trunk without hitting the conductors. Any utility that pursues a transition to ground-to-sky pruning should keep detailed data so that, over time, the costs and impacts can be better understood.

18. **Customer outreach.** If and when a utility decides to change its approach to UVM in a way that affects customers, the utility should develop and implement a customer outreach program. The goal of this program is to educate customers on what will be done, why it will be done, when it will be done, the associated benefits, and the process for communicating concerns or comments to the utility. This plan should be developed from the customer's perspective and the benefits that the customers will receive. It should also allow for customer input so that those who wish can feel that they are part of the process and have the ability for their voice to be heard and considered.

    Customer interaction with respect to trees presents both an opportunity and a risk. Trees are a sensitive issue for many customers. A thoughtful customer outreach program presents the opportunity for utilities to strengthen their relationship with customers. An insufficient or misguided customer outreach program, in contrast, could irritate customers and result in backlash.

What benefits can be expected from the above recommended best practices? The recommendations in the first two stages will result in a well-managed and data-driven hazard tree program. A utility may already be doing a good job with respect to hazard trees, but the recommendations in the first two stages will allow the effectiveness of the hazard tree program to be demonstrated based on budgets, processes, and data. For most utilities, the best practices in the first two stages will allow for an increase in the cost-effectiveness of hazard tree management, and modest reductions in daily and storm tree in-falls. Most of these recommendations can be implemented either with little cost or with short-term costs that result in long-term savings (e.g., maintaining an optimal pruning cycle).

In the survey, many utilities claim that only ten percent or less of in-fall trees could have been identified as hazard trees prior to failure. If this is the case, more aggressive hazard tree removal would only provide incremental storm benefits. Consider a major wind storm where eighty percent of damage is due to in-fall trees, with eight percent of damage due to identifiable hazard trees. Assume that a utility implements an aggressive hazard tree program that is able to identify and remove seventy five percent of all identifiable hazard trees *on the entire system.* This implies a six percent reduction in overall storm damage, reducing a fourteen day storm to a thirteen day storm. This may not seem like much, but each day of storm restora-

tion is very expensive and the cost of such a hazard tree program may be justifiable based on reduced storm costs. The economics will vary for each utility, but are worthwhile to examine.

The economics of hazard trees should include societal benefits. Each dead and diseased tree in a populated area will eventually fail and have to be removed. Even if the tree does not do any damage, the cost difference between reactive removal after failure and proactive removal is minimal, since the cost is dominated by the amount of biomass involved. Therefore, the additional societal cost for utilities proactively identifying and removing hazard trees, not considering damage, is equal to the cost of identification and program management. Assuming that the cost of hazard tree identification and program management is fifteen percent of overall costs, society is better off if the reliability benefits and reduced storm damage benefits exceed about fifteen percent of the overall program costs (not including the benefits of reduced customer property damage). This analysis does not necessarily extend to forested areas where fallen trees are not removed. Regulators must ultimately decide how much utility hazard tree management effort is appropriate for inclusion in rates, but there is already strong precedent for utilities to pay for the removal of trees on customer property and to recover these costs through rates.

Significant reductions in storm damage can be achieved by reducing the utility forest and by reducing the amount of branches that overhang conductors. The societal economics for hazard trees do not apply in these cases, requiring the benefits to exceed the full costs for justification. However, storm benefits could be substantial. Consider again a major wind storm where eighty percent of damage is due to in-fall trees. If a utility reduces the utility forest on a critical circuit by fifty percent, storm damage on this circuit will be reduced by forty percent.

Based on survey results, some utilities have a highly developed hazard tree management program, many have a good program with opportunities for improvement, and some have programs that are not effectively managing hazard trees. In addition, there are many differences across utilities in terms of service territory, vegetation density, vegetation type, storm characteristics, and other factors that necessarily impact their approach to hazard tree management. These recommendations are not intended to be a "one size fits all" approach, and each utility must therefore thoughtfully determine its own best approach to hazard tree management.

6 Conclusions

A survey has been performed on utility hazard tree management. Thirty-two utilities responded, geographically representing the US from north to south and from east to west. The survey captured information regarding existing practices and recommended practices in the areas of tree trimming, tree outages, hazard tree identification, hazard tree removal, and hazard tree best practices.

Many of the utilities responding to the survey seem to be satisfied with their hazard tree program. Many claim that they are keeping up with the natural rate of tree mortality, assert that additional effort in hazard tree management will not reduce storm damage, and posit that they cannot think of anything additional or different that they could do to better manage hazard trees. Although these utilities may feel that they are addressing hazard trees in an appropriate and effective manner, most would be hard-pressed to *prove* that this is the case. Based on this and the overall survey results, the author has assembled a list of eighteen best practices that will help to ensure that hazard trees are being managed through a process that is cost effective, consistent, transparent, and data-driven.

These best practices should be taken in context. First, many utilities will already have many of these elements, or their equivalent, in place. Second, each utility is in a unique situation with regards to hazard trees. Certain best practices, though appropriate for most utilities, may not be appropriate for all. In any case, all utilities are encouraged to examine the proposed best practices. Some can be implemented at little-to-no cost, and others may allow hazard trees to be more effectively managed at a lower cost.

Recommendations are not intended to be a "one size fits all" approach. For example, a utility with very little tree exposure may not need to have any formal hazard tree program at all. Similarly, utilities where tree fall-ins result in a small percentage of customer interruption minutes (e.g., less than 5%) may not need to change their approach as long as they can demonstrate cost effectiveness.

Best practices are organized into three stages. The best practices in the first stage are inexpensive and relatively simple to implement. In addition to being potential quick wins, they also set the foundation for more ambitious actions. The best practices in the second stage are designed to be implemented in the medium term and generally require more utility effort, investment, and potentially change. Generally, the experience and data obtained from the first stage will be helpful when implementing the second stage.

The best practices in the third stage should be considered after a utility has a very good handle on its hazard program including the costs and benefits of a more aggressive approach. These recommendations are recommended if utilities wish to significantly reduce the number of tree failures during major storms. Since most tree failures during major storms are apparently healthy trees (i.e., not hazard trees), some of the recommendations in the Third Stage go beyond hazard trees, are potentially expensive, and are sensitive to property owners. Therefore, utilities must carefully consider whether the benefits associated with these Third Stage recommendations justify the costs and other implications.

First Stage
1. Culture change
2. Separate hazard tree budget
3. Hazard tree data
4. Post-storm data collection
5. Inspection procedures
6. Maximize customer approvals

Second Stage
7. Manage backlog
8. Maintain pruning cycle
9. Hazard tree database
10. Assess the utility forest
11. Prioritize by species
12. Plan for epidemics

Third Stage
13. Engage regulators
14. Address legal, regulatory, and political issues
15. Targeted annual inspections
16. Targeted danger tree removal
17. Targeted ground-to-sky pruning
18. Customer outreach

The recommendations in the first two stages will result in a well-managed and data-driven hazard tree program. A utility may already be doing a good job with respect to hazard trees, but the recommendations in the first two stages will allow the effectiveness of the hazard tree program to be demonstrated based on budgets, processes, and data. For most utilities, the recommendations in the first two stages will allow for an increase in the cost-effectiveness of hazard tree management, and modest reductions in daily and storm tree in-falls. Most of these recommendations can be implemented either with little cost or with short-term costs that result in long-term savings (e.g., maintaining an optimal trim cycle).

In the survey, many utilities claim that only ten percent or less of in-fall trees could have been identified as hazard trees prior to failure. If this is the case, more aggressive hazard tree removal will only provide incremental storm benefits. Consider a major wind storm where eighty percent of damage is due to in-fall trees, with eight percent of damage due to identifiable hazard trees. Assume that a utility implements an aggressive hazard tree program that is able to identify and remove seventy five percent of all identifiable hazard trees *on the entire system.* This implies a six percent reduction in overall storm damage, reducing a fourteen day storm to a thirteen day storm. This may not seem like much, but each day of storm restoration is very expensive and the cost of such a hazard tree program may be justifiable based on reduced storm costs. The economics will vary for each utility, but are worthwhile to examine.

The economics of hazard trees should include societal benefits. Each dead and diseased tree in a populated area will eventually fail and have to be removed. Even if the tree does not do any damage, the cost difference between reactive removal after failure and proactive removal is minimal, since the cost is dominated by the amount of biomass involved. Therefore, the additional societal cost for utilities proactively

identifying and removing hazard trees, not considering damage, is equal to the cost of identification and program management. Assuming that the cost of hazard tree identification and program management is fifteen percent of overall costs, society is better off if the reliability benefits and reduced storm damage benefits exceed about fifteen percent of the overall program costs (not including the benefits of reduced customer property damage). This analysis does not necessarily extend to forested areas where fallen trees are not removed. Regulators must ultimately decide how much utility hazard tree management effort is appropriate for inclusion in rates, but there is already strong precedent for utilities to pay for the removal of trees on customer property and to recover these costs through rates.

Significant reductions in storm damage can be achieved by reducing the utility forest and by reducing the amount of branches that overhang conductors. The societal economics for hazard trees do not apply in these cases, requiring the benefits to exceed the full costs for justification. However, storm benefits could be substantial. Consider again a major wind storm where eighty percent of damage is due to in-fall trees. If a utility reduces the utility forest on a critical circuit by fifty percent, storm damage on this circuit will be reduced by forty percent.

Based on survey results, some utilities have a highly developed hazard tree management program, many have a good program with opportunities for improvement, and some have programs that are not effectively managing hazard trees. In addition, there are many differences across utilities in terms of service territory, vegetation density, vegetation type, storm characteristics, and other factors that necessarily impact their approach to hazard tree management. These recommendations are not intended to be a "one size fits all" approach, and each utility must therefore thoughtfully determine its own best approach to hazard tree management.

Appendix A – Benchmark Survey

Directions

- Please send to rbrown@quanta-technology.com by May 13, 2009. Sooner is appreciated!
- Answer each question to the best of your ability. Educated guesses are welcome. If you cannot make an educated guess, please respond "don't know" or leave blank.
- Commentary, context, experiences, thoughts, and other contributions are always welcome. I will compile all of this collective knowledge in the benchmark report.
- For this survey, "hazard tree" is defined as a tree that (1) has the ability to fall into overhead conductors, and (2) has some visible risk factor such as being dead, diseased, structurally weak, or excessively leaning.
- If your company has multiple utilities with different practices (e.g., Exelon has ComEd and PECO), feel free to fill out a separate survey for each utility.
- The focus of this survey is hazard trees near the distribution system.
- **Check boxes:** to check, double click on the box, select "checked," and press "OK."

General

1. Name of responder: [answer]
2. Utility: [answer]
3. Number of electric customers: [answer]
4. Circuit miles of overhead primary distribution: [answer]
5. About what percentage of your system is:
   a. Heavily treed: [answer]
   b. Moderately treed: [answer]
   c. Lightly treed: [answer]
6. What types of major storms do you have?
   a. Hurricanes: ☐
   b. Linear winds: ☐
   c. Tornadoes: ☐
   d. Ice storms: ☐
   e. Wild fires: ☐
   f. Other (explain): ☐ [answer]

Tree Trimming

7. Briefly describe your distribution tree trimming cycle (e.g., 4-year cycle): [answer]
8. About what percentage of your distribution trimming is outsourced? [answer]
9. Are you, for the most part, keeping up with your tree trimming cycle goals? [answer]
10. Is there a separate budget for hazard tree removal? [answer]
11. Are you, for the most part, keeping up with your goals for hazard tree removal? [answer]
12. Is it more difficult for you to address hazard trees when you are behind on your trimming cycle? Explain. [answer]
13. On about what percentage of your distribution system do you trim "ground-to-sky," not allowing branches to exist directly above conductors? Thoughts and experiences on ground-to-sky trimming are welcome. [answer]

Tree Outages

14. Excluding major storms, approximately what percentage of outage events are due to:
    a. Entire trees, outside of the right-of-way, falling into conductors: [answer]
    b. Other tree-related causes: [answer]
15. During major storms, approximately what percentage of outage events are due to:
    a. Entire trees, outside of the right-of-way, falling into conductors: [answer]
    b. Other tree-related causes: [answer]
16. Approximately what percentage of trees that fall into conductors has visible warning signs that could have been detected prior to the tree falling over? [answer]

Identification

17. Is the identification of hazard trees outside of the trim zone explicitly addressed in your vegetation management procedures? [answer]
18. Do your private property easements allow for the removal of hazard trees within the right-of-way?
19. Do your private property easements allow for the removal the removal of hazard trees adjacent to the right-of-way?
20. Do your public property easements allow for the removal of hazard trees within the right-of-way?
21. At your utility, would you characterize the focus of identifying off-right-of-way hazard tree as:
    a. Focus is weak: ☐
    b. Focus is moderate: ☐
    c. Focus is strong: ☐
22. About what percentage of identified hazard trees are discovered through the following:
    a. Normal trimming cycle: [answer]
    b. Dedicated circuit inspections: [answer]
    c. Noticed by crews doing other things: [answer]
    d. Customers: [answer]
    e. Other (please explain): [answer]
23. Do you have a database of hazard tree information (i.e., location of removed trees, known hazards, customer refusals, etc.)? [answer]

Removal

24. Do you remove hazard trees located on customer property at your own cost? [answer]
25. Are there any complications with hazard tree removal related to third-party-owned or jointly-owned facilities? [answer]
26. Do you have the ability to remove hazard trees located on customer property without the prior consent of the customer, such as condemning dead hazard trees? Please explain. [answer]
27. Please describe how hazard tree removal requests are performed. [answer]
28. About what percentage of hazard tree-removal requests are granted by customers? [answer]
29. If a customer does not respond to a hazard tree removal request, can you remove the tree? Explain. [answer]
30. If a customer initially refuses to have a hazard tree removed, are any follow-on persuasion activities performed? How effective have these been? [answer]
31. If a customer refuses to have a hazard tree removed, and the tree later damages the utility system, do you ever hold the customer financially liable for the resulting damage? Explain. [answer]
32. About how much time, on average, elapses from the identification of a hazard tree until it is removed? [answer]
33. After cutting down a hazard tree on a customer's property, do you remove the resulting wood? [answer]
34. When removing a hazard tree on a customer's property, do you ever replace the tree? Explain. [answer]

35. Do you have a program to identify and replace undesirable tree species? How aggressive is this program? [answer]

Best Practices

36. A certain percentage of trees die naturally every year. Do you feel that your utility, on an annual basis, removes enough dead and diseased trees to keep up with this natural process? [answer]
37. Would an increase in the aggressiveness of hazard tree removal reduce major storm damage:
    a. A little bit: ☐
    b. A moderate amount: ☐
    c. A lot: ☐
38. What else besides hazard tree removal (vegetation related) would be effective at reducing major storm damage? [answer]
39. Please describe any attempts to more effectively address hazard trees that did not work very well. [answer]
40. Please describe any attempts to more effectively address hazard trees that did work very well. [answer]
41. What would it take for your company to more effectively manage hazard trees? [answer]
42. What would you recommend as a best practice for managing hazard trees? [answer]
43. Any other thoughts or comments on the subject of hazard trees? [answer]

Appendix B – Survey Responses

General

1. Name of responder:
2. Utility:
3. Number of electric customers:
4. Circuit miles of overhead primary distribution:
5. About what percentage of your system is: heavily treed, moderately treed, and lightly treed:
6. What types of major storms do you have: hurricanes, linear winds, tornadoes, ice storms, wild fires, other (explain)?

Table B-1. Summary of Responses to Questions 1-6

Utility	Customers	Ckt Miles of OH Dist.	% System Tree Density			Types of Major Storms				
			H	M	L	H	LW	T	IS	WF
AEP Texas Central	810,890	24,868	22	26	52	x	x	x		x
AEP Texas North	199,000	12,950	15	28	57		x	x	x	
Baltimore Gas & Electric	1,220,000	9,345	---	---	---	x			x	
Black Hills Power	202,100	5,100	25	60	15		x	x	x	x
CenterPoint	2,080,000	21,050	25	57	18	x	x	x	x	
CHELCO	42,000	2,816	50	50	0	x	x	x		x
Cleco Power	272,877	11,000	50	40	10	x		x	x	
CPS Energy	692,000	8,000	50	30	20	x	x	x		
Dayton Power & Light	514,000	10,500	25	50	25		x	x	x	
Duke Carolinas	2,500,000	54,000	30	50	20	x	x	x	x	
Duke Midwest	1,600,000	16,000	7	58	35	x	x	x	x	
Entergy Texas	395,000	10,985	50	35	15	x	x	x	x	
Enwin (Canada)	84,644	451	20	40	40		x	x	x	
Florida Power & Light	4,500,000	35,000	50	30	20	x			x	
Hawaii Electric	294,371	899	25	50	25	x				
Idaho Power	480,000	19,387	---	---	---		x		x	
Kansas City Power & Light	800,000	25,000	28	60	12		x	x	x	
Nova Scotia Power (Canada)	467,317	15,982	40	30	20	x		x		
Oklahoma Gas & Electric	770,000	26,300	45	25	30		x	x	x	x
Oncor	3,100,000	56,200	74	19	7	x	x	x	x	x
PacifiCorp	1,700,000	45,000	35	30	25		x	x	x	x
PECO Energy	1,600,000	12,000	65	20	15	x	x	x	x	
PG&E	5,200,000	113,500	60	25	15		x	x	x	x
PPL	1,380,887	27,965	25	30	45	x	x	x	x	
Puget Sound Energy	1,000,000	10,800	60	35	5		x			
Progress Energy Florida	1,600,000	18,100	30	50	20	x	x	x		x
Southern California Edison	4,851,312	98,500	10	20	70		x		x	x
SW Public Service Co.	400,000	16,000	33	33	34		x	x	x	x
Tampa Electric	670,000	6,400	25	50	25	x	x	x		x
Texas New Mexico Power	228,000	1,926	40	50	10	x	x	x	x	
Toronto Hydro (Canada)	682,560	2,665	60	30	10		x		x	
Xcel Energy	3,326,436	51,700	39	42	19		x	x	x	x
Average	**1,364,481**	**24,075**	**37**	**38**	**24**	**56**	**84**	**78**	**75**	**38**
Low	**42,000**	**451**	**7**	**19**	**0**			**(% of utilities)**		
High	**5,200,000**	**113,500**	**74**	**60**	**70**					

1. H=High; M = Medium; L = Low
2. H = Hurricanes; LW = Linear Winds; T = Tornadoes; IS = Ice Storms; WF = Wild Fires
3. Additional responses included: Floods (x2), Thunderstorms (x2), Micro Climates, Supercells, and Heat Waves

Tree Trimming

7. Briefly describe your distribution tree trimming cycle (e.g., 4-year cycle):
   - 4-year cycle (x3)
   - 5-year cycle (x4)
   - Cycle length varies by region and in some cases by circuit, due to the variety of growing conditions, species and outage causing factors. In general, cycles range between 3 and 5 years, with a few circuits on two-year cycles of maintenance.
   - Our distribution circuit tree trimming program emphasizes performing maintenance on circuits with extensive tree- and wind-caused System Average Interruption Duration Index (SAIDI) outage minutes or Top 10 % circuits with consideration given to the amount of time since the circuit was last trimmed. Although the selection process is driven by circuit reliability and performance, average cycle targets are set for different voltage classes of circuits. The target averages for the three voltage classes are as follows: (a) 35kV – Three-year cycle average; (b) 12kV "Normal" (i.e. 12kV circuits with standard 10' ground and 20' aerial easements) – Five-year cycle average; (c) 12kV "Narrow" (i.e. 12kV circuits in inner-urban areas with restricted easements and 10' ground easements with no associated aerial easements) – Three-year cycle average.
   - 3 yr. avg. for feeders and 6 yr. avg. for laterals.
   - 3-yr cycle
   - 4 year urban, 6 year rural.
   - 12-15 month cycle.
   - 1 year cycle – we patrol and trim every mile every year.
   - 12 Month cycle with a mid cycle patrol-trimmed every 12 Months and checked every 6 Months.
   - 4.5 yrs (3 yrs – feeder;5 yrs – laterals).
   - 4-yr goal
   - Reliability Based Vegetation Management Program. This methodology uses reliability performance of each feeder from tree related outages to determine the optimal trimming cycle for each feeder.
   - 3-yr cycle
   - Combination of 4-yr and 5-yr cycles.
   - We use a 4-year cycle for urban circuits (greater than 35 customers per circuit mile) and a 6-year cycle for rural circuits (less than 35 customers per mile).
   - Multi year cycle on each feeder
   - Transitioning to a 5 year cycle
   - 11-yr cycle
   - 4 to 6.5 years
   - 3-5 years
   - The distribution system is maintained on an average cycle of 5.3 years. The cycle in urban areas is between 3 and 4 years, while the cycle in rural areas is approximately 6 years.
   - Currently, cycle is driven by poor performing circuit records; target was a 4 year cycle, but concentrating on worst circuits has impacted overall cycle period dramatically
   - Hazard trees – annual cycle
   - Instead of a cycle-based approach, that requires vegetation to be trimmed based on a time continuum without regard to actual performance/reliability, we have adopted a performance-based approach based on SAIFI, SAIDI, and CAIDI targets as indicators for trimming need (x2)
   - 4-yr and 3-yr, depending upon the state

8. About what percentage of your distribution trimming is outsourced?
   - 100% (x27)
   - 95% (x2)
   - 85% (x2)

- 5% (x1)

9. Are you, for the most part, keeping up with your tree trimming cycle goals?
   - Yes (x14)
   - Most areas are between 85% and 100% on-cycle
   - Yes. Our goals for trimming trees on the distribution system are driven primarily by reliability performance. We are achieving these goals. (x2)
   - Yes, for the most part (x2)
   - No (x4)
   - Working to get to a 4-year cycle
   - We have to trim about 5,500 circuit miles per year to maintain our trimming cycle, which we are consistently trimming less.
   - Not currently on a prescribed cycle
   - Yes, mostly but has been deteriorating somewhat in some places
   - 85-100% on-cycle
   - Hazard trees – yes
   - Yes. We believe we are doing a reasonable job of keeping up; however, the annual rain fall drastically changes the growth rate of trees, so it is impossible to eliminate tree issues.
   - Our overall tree trim cycles have been, for the most part, improving over the past few years, improving our cycle times continues to be a major goal and objective

10. Is there a separate budget for hazard tree removal?
    - No (x16)
    - Yes (x11)
    - Yes, recently implemented (x2)
    - No. However, we are considering a separate budget for "epidemic" diseased trees (e.g., Mountain Pine Beetle) as the problem grows.
    - Not specifically, we have allocated fund for all removals which included hazard trees.
    - Some operating companies yes, others no.
    - Yes. However, the budget is $0 for 2009. Some hazard trees are still being cut, but they are being targeted within another budget line item called "Hot Spots". The line item for Hot Spots has not been inflated to incorporate hazard tree funding.

11. Are you, for the most part, keeping up with your goals for hazard tree removal?
    - No (x3)
    - Yes (x19)
    - Yes, except for special conditions such as epidemic tree diseases.
    - Yes, hazard trees are addressed on an "as-identified" basis.
    - Yes, would like to do more.
    - A recent study was performed that indicates a need for increased hazard tree removal if we are to improve reliability.
    - No set goals (x3).
    - Yes, to the extent that we are able to target visibly hazardous trees. Identifying the visually healthy and straight trees that fail due to high winds and/or saturated soil conditions has proven to be more difficult.
    - We have not determined the need to establish a goal for Hazard tree removal; this is incorporated into our overall plans for distribution cycle trimming.

12. Is it more difficult for you to address hazard trees when you are behind on your trimming cycle? Explain.
    - No (x5)
    - No, we use separate crews for the danger trees.
    - No, we maintain the same guidelines.

- No. We treat hazard trees as a priority.
- It would be but this has not been an issue for us.
- No. Hazard trees are removed from the distribution system wherever identified. However, hazard trees are primarily identified and removed during normal circuit trimming maintenance activities.
- Mile targets are a priority, removals follow.
- Yes, as we try to work the two programs together to reduce set up and travel costs.
- Yes
- We do not get behind on our trimming cycle; it remains a top priority. Hazard trees are included in our annual patrol.
- We identify during routine patrol and clear within 30 Days.
- Yes, typically in tough economic times this is a budget line item that is mitigated.
- We do not have a separate patrol for identifying hazard trees.
- We are typically on schedule so this is not an issue.
- Yes. There would be a higher volume of hazard trees if we were behind on our trimming cycle. The hazard trees left are closer to the lines, increasing the risk of an outage.
- Yes - schedule work costs would then be increased, causing funding for hazard mitigation to be less; regardless of schedule progress, current mid-cycle patrols are performed to minimize volume of hazardous conditions.
- Yes, it becomes more difficult to address hazard trees, as we need to be more selective, when we are behind on the trimming cycle.
- Without the right-of-way being managed, hazard trees are often hidden amongst the forest.
- We do not make an effort to identify hazard trees.
- Yes, because without prescribed cycles we aren't visually inspecting all of our circuits on a routine basis.
- Sometimes, but we usually do the hazard tree program anyway. Same crews do both hazard tree and cycle maintenance.
- There is no hazard tree removal program
- No, we maintain the same guidelines
- No. Cycle-maintenance trimming is a separate program from hazard tree identification/removal. We monitor vegetation-related reliability on a daily basis, inspecting all outages for greater than 50 customers interrupted. In addition, we use input from the field and reliability data to track where hazard tree outages are occurring, and conducts "danger tree patrols" as needed each year to target these areas. In general, deciduous trees are most visible in the spring and fall, while stressed conifers are visible year-round.
- Yes; resources are focused on hitting the poor performing circuits and trouble areas rather than performing truly preventative maintenance work.
- Addressing hazard trees and our reliability based line clearance maintenance program have independent schedules.
- Yes, it is more difficult to address hazard trees when behind on the trimming cycle because resources are transitioned to the trimming program to ensure mileage goals are met.
- Ten years ago when we were it was difficult. When we're keeping up, we regularly inspect our lines, and have good handle on hazard trees.
- Hazard trees on our distribution facilities are not a major operational issue for us, as such this question does not apply.

13. On about what percentage of your distribution system do you trim "ground-to-sky," not allowing branches to exist directly above conductors? Thoughts and experiences on ground-to-sky trimming are welcome.
    - Varies due to special projects, etc.
    - Target 100% of multiphase portions of circuits. Single phase portion of circuits we maintain trees based on their likelihood of causing an outage or posing a public safety risk. Moving from a ground-to-sky approach to this targeted approach has led to lower costs on our first and second cycles. It also improved reliability as we were able to get more of our system on-cycle. However, we anticipate costs to level out or increase incrementally in subsequent cycles because trees that were not a threat in past cycles will need to be maintained.

- About 10%. We manage all of our 34.5 kV subtransmission lines and some habitual poor performing distribution feeders on a blue sky basis.
- Subject to the rights provided to the Company in easement documents, we essentially practices 100% ground-to-sky trimming for all distribution primary conductors. Our guidelines require contractors to clear laterally from the conductors a minimum distance based on the voltage (35kV – 10+ feet; 12kV – 7+feet), then clear vertically to twice the height of the pole or as high as a lift truck or mechanized equipment can reach. Any higher limbs are shortened in length so that they will not extend above or beyond the conductor closest to the tree. Subsequently, if these limbs break or fall, they will hinge and miss the wires.
- Less than 10% Thoughts and experiences on ground-to-sky trimming are welcome.
- None (x3)
- 5%
- Less than 1 % of our distribution system is pruned ground to sky. However, 100% of the transmission system is pruned in this manner.
- 3% in Mountain areas prone to heavy snow/ice loading.
- 10% .We only remove defective overhang when it is found or circuits feed a large number of critical customers. Ground to sky in my opinion allows for more light penetration to the floor, which allows more growth from the ground. In addition, by allowing more light penetration the phototropic properties of trees would dominate and allow limbs to grow into the space once occupied by full shade. The approach of targeted removal of overhang is a more conducive practice for us. We look for defects in limbs and tree, i.e. attachments, declining limbs, etc.
- Done on ALL 3-phase feeders (no exceptions)
- With additional funds that we will have from our system hardening budget we will be able to afford to get the additional clearance and start trimming "ground-to-sky"
- We try for 100%.
- Approx 30% (3-phase segments only)
- Currently, there is no ground-to-sky trimming as a rule and it is only performed on some PSE jobs. Several circuits are selected for ground-to-sky trimming for test and analysis purposes. Ground-to-sky trimming was done often from the early to late 1990's. Benefits of improved circuit reliability were seen from this type of tree trimming. However, VM program philosophies and budget capacities changed over time, favoring less aggressive trimming on more frequent cycles.
- We are in our 5th year of implementing a sustainability program where the goal is to re-establish the right-of-way from the ground in effort to switch to IVM on distribution. IVM has been traditionally only implemented on transmission. Percentage of "ground – sky" work = 40%.
- Not currently doing this but recommended that we should. Some Political issues with the rate payer against trimming or removing trees on their property.
- trim below our conductors to the sky. Therefore we don't adhere to a strict ground to sky policy.
- 90% ground to sky. Contract allows contractors to trim as high as the bucket can reach on front property. Back property is ground to sky, since it is climbed. And only some line miles have trees above line. This specification is subject to disagreement internal to the company. However, no business case has been convincing yet to convert to ground to sky on all line miles, including front property.
- 100%, we cut 10 feet minimum either side of the primary line ground to sky and follow up with a stump treat spray program.
- 50%. Ground-to-sky trimming is more beneficial on 3 phase lines. Ground-to sky trimming is more costly method of trimming.
- Target 100% of multiphase portions of circuits (multiphase is roughly 40% of system). Single phase portion of circuits we maintain trees based on their likelihood of causing an outage or posing a public safety risk. Moving from a ground-to-sky approach to this targeted approach has led to lower costs on our first and second cycles. It also improved reliability as we were able to get more of our system on-cycle. However, we anticipate costs to level out or increase incrementally in subsequent cycles because trees that were not a threat in past cycles will need to be maintained.
- An estimated 25% of all line miles have been trimmed "ground-to-sky." We believe this is a beneficial program in certain areas and times i.e. along the main trunk of the feeder, and will certainly help during ice

storms. However, if a tree is "sky-trimmed" extensively there is a risk of later mortality. In addition, high winds tend to throw limbs into the conductors from outside the ROW, rather than dropping straight down.

- On all primary voltage lines, except handful of property owner refusals.
- For hazard trees that are pruned from the conductors 100% are "ground to sky"
- We do not practice "ground to sky" trimming in any easement or right-of-way. Our target is to remove tree overhang from all primary voltage conductors. On any given circuit, we leave overhang on portions that consist of only secondary voltage conductors.
- All primary
- We do not trim ground to sky
- 10%
- The use of "ground-to-sky" clearing is predicated upon the area we are working as well as our past practices. Such clearing becomes a decision based upon the ability to perform such clearing, customer base, location, politics, etc., as well as the financial implications of doing so. Our specification for overhang requires 15 feet of clearance above our distribution facilities, no overhang is allowed on Transmission facilities.

Tree Outages

14. Excluding major storms, approximately what percentage of outage events are due to:
    a. Entire trees, outside of the right-of-way, falling into conductors: Unknown (x5), <1 (x8), 1, 1.7, 2, 3, 3, 5, 5.5, 7, 10, 10, 19, 35, 46, 53, 60, 75, 75, 75, 80
    b. Other tree-related causes: No answer (x5), 1, 1, 3, 5, 6, 6, 7, 7, , 8, 10, 15, 15, 16, 16, 16, 20, 20, 20, 22.5, 25, 25, 25, 25, 25, 26, 30, 47, 65, 90
15. During major storms, approximately what percentage of outage events are due to:
    a. Entire trees, outside of the right-of-way, falling into conductors: Unknown/no answer (x8), <1. (x4), 1, 2, 2.7, 5, 5, 5, 7, 10, 19, 23, 40, 45, 51, 65, 70, 75, 75, 80, 80, 85
    b. Other tree-related causes: Unknown/no answer (x8), 1, 2, 6, 9, 10, 10, 15, 15, 15, 15, 16, 16, 20, 20, 24, 25, 25, 40, 55, 60, 60, 70, 80, 90
16. Approximately what percentage of trees that fall into conductors has visible warning signs that could have been detected prior to the tree falling over? Unknown/no answer (x13), <1 (x1), 1, 3, 5, 7, 7, 10, 10, 10, 10, 10, 10, 10, 20, 23, 25, 30, 36, 50

Identification

17. Is the identification of hazard trees outside of the trim zone explicitly addressed in your vegetation management procedures?
    - Yes (x19)
    - No (x8)
    - Separate Procedure
    - Yes, contractors are instructed to identify all hazard trees during the course of work activities.
    - Yes. We remove dead trees within 45 ft of the center line on both cycle maintenance and the annual danger tree survey and removal. The annual dead tree survey and removal is completed on three phase lines only. A problem is that we have a lot of trees falling that do not appear to be dead. Also, often we will miss some dead trees during the survey.
    - Somewhat
    - Yes. It should be noted that we do not define a hazard tree as "dead., diseased, structurally weak, or excessively leaning trees". To us, a hazard tree is a tree considered a potential threat to the safety and reliability of our facilities growing within, or immediately adjacent to, the normally maintained right-of-way.

18. Do your private property easements allow for the removal of hazard trees within the right-of-way?
    - Yes (x16)

- No (x2)
- No easements
- No, although when we deem the tree requires work, we cite our Customer Service Agreement.
- Our distribution R/W's are of indeterminate width and typically encumber an entire property for trimming or removal of trees.
- A portion of our easements include rights to remove hazard trees within the right-of-way.
- We have specific rights in ROW regardless of private or public property.
- Yes, but easements are rare in the distribution system.
- No (x4)
- If an easement exists, then we can remove volunteer trees that are less than 4" dbh
- Firstly, we started acquiring easements after privatization in 1992. Before that we constructed all of our lines on rights of way associated with the government roads. The answer is yes in most cases. Requires discussion and negotiation in some municipalities.
- No, although when we deem the tree requires work, we cite our Customer Service Agreement.
- Highly variable, we are all over the place on this one. This is based upon our history as well as the type of easement, as well as the inclusion or exclusion of Danger tree or Hazard tree rights in the easement document.

19. Do your private property easements allow for the removal the removal of hazard trees adjacent to the right-of-way?
    - No (x14)
    - Yes (x2)
    - No, although when we deem the tree requires work, we cite our Customer Service Agreement.
    - Our distribution R/W's are of indeterminate width and typically encumber an entire property for trimming or removal of trees.
    - A portion of our easements include rights to remove hazard trees adjacent to the right-of-way.
    - We have limited rights outside of ROW.
    - Yes (in most cases)
    - No - unless expressly provided for in the easement; again, easements within distribution are rare.
    - Most.
    - No easements
    - With property owner's approval
    - government road rights of way, the answer is No. On right-of-way acquired since 1992, the answer is yes. The amount of right-of-way constructed since privatization is negligible when considering the total amount of line constructed.
    - Generally yes. We have varying easement language but for the most part have a "within and without" clause which gives us the right to trim threatening vegetation outside of our easement.
    - No, although when we deem the tree requires work, we cite our Customer Service Agreement.
    - Yes, where we have secured easements we typically have the right to "remove or modify from time to time trees, limbs, and/or vegetation outside the said right-of-way which the Grantee considers a hazard to any of its electric power or communications facilities or is a hazard to the rendering of adequate and dependable service to the Grantor or any of the Grantee's customers, by use of a variety of methods used in the vegetation management industry." The Company's practice, however, is to attempt to gain customer consent to remove hazard trees regardless of the provisions in the easements.
    - No; however State Tariff allows removal.
    - Sometimes.
    - Highly variable, we are all over the place on this one. This is based upon our history as well as the type of easement

20. Do your public property easements allow for the removal of hazard trees within the right-of-way?
    - Yes (x11)

- No (x10)
- We have specific rights in ROW regardless of private or public property.
- Yes, if less than 4" dbh
- Most of the time (x2)
- Sometimes (x2)
- If prior approval is received
- Unknown
- Not always specific language
- Highly variable, however we do have leverage for trees within the ROW due to County and City ordinance
- No answer (x1)

21. At your utility, would you characterize the focus of identifying off-right-of-way hazard tree as:
    a. Focus is weak: xxxxxxxxx
    b. Focus is moderate: xxxxxxxx
    c. Focus is strong: xxxxxxxxxxxxx

22. About what percentage of identified hazard trees are discovered through the following:
    a. Normal trimming cycle: 0, 0, 10, 20, 25, 25, 25, 30, 35, 35, 45, 47, 48, 50, 50, 60, 60, 65, 70, 75, 75, 80, 80, 85, 85, 85, 90, 90, 90, 97
    b. Dedicated circuit inspections: 0, 0, 0, 0, 0, 0, 0, 1, 2, 5, 5, 5, 5, 5, 10, 15, 18, 20, 25, 25, 25, 30, 44, 45, 47, 50, 50, 70, 70, 70
    c. Noticed by crews doing other things: 0, 0, 0, 0, 0, 1, 1, 1, 2, 5, 5, 5, 5, 5, 5, 7, 10, 10, 10, 10, 20, 20, 20, 23, 25, 30, 30, 35, 90
    d. Customers: 0, 0, 0, 1, 1, 1, 1, 3, 5, 5, 5, 5, 5, 5, 5, 5, 5, 8, 10, 10, 10, 10, 10, 10, 15, 15, 20, 25, 30, 30
    e. Other (please explain): Outage follow up (5%), Outage follow up (80%)
    f. No answer: xx

23. Do you have a database of hazard tree information (i.e., location of removed trees, known hazards, customer refusals, etc.)?
    - Yes (x5)
    - No (x15)
    - Spreadsheets
    - No. However, we keep hard copies of that information with our maintenance maps so we can attempt to address them on our next cycle.
    - No, we have some paper records.
    - For customer refusals only.
    - We have a vegetation database that we use to log all circuit information and a customer database to log all complaints/refusals.
    - Yes, information can be identified by feeder.
    - Yes, but it was just recently created (January 2009).
    - Not currently, however, our Forestry Planners have just been issued GPS to begin an identification program.
    - This information is maintained but not in a single-source database.
    - No; but planned for GIS software system being installed this year.
    - We maintain a evolving list of properties with delayed pruning issues

Removal

24. Do you remove hazard trees located on customer property at your own cost?

- Yes (x22)
- Yes, if it endangers our facilities.
- Yes-Sometimes just top below lines.
- No
- We remove immediate hazard at own cost, customer is responsible beyond that
- Most of the time.
- No, too expensive.
- Infrequently.
- This is variable, and is determined by need; we may remove at our cost or just top the tree at our cost and leave removal to the customer.

25. Are there any complications with hazard tree removal related to third-party-owned or jointly-owned facilities?
    - No (x16)
    - Yes (x4)
    - Yes. Our contractors are required to obtain property owner permission prior to removing trees.
    - Yes; complications are usually related to recovering shared costs.
    - Yes, communications companies do very little tree work to protect their facilities.
    - We notify customers prior to removal & have their authorization.
    - Not really, we will share the cost if the tree is on municipal land and it is shared between the utilities and the municipality in some cases the transportation dept.
    - Sometimes
    - No answer (x2)
    - Yes. Identifying the land owner can complicate the issue.
    - No; except that they accept no responsibility to share in the cost or liability (phone/cable TV/etc).
    - Generally no.
    - Obtaining a signed permit can be more difficult when the property third-party-owned.
    - From time to time, we encounter a customer who refuses to allow us to remove a hazard tree in an area where we have no easement – roadside pole placements, for example.

26. Do you have the ability to remove hazard trees located on customer property without the prior consent of the customer, such as condemning dead hazard trees? Please explain.
    - No (x14)
    - Yes (x2)
    - Yes, if eminent danger.
    - Yes, although severity of hazard dictates whether the tree is addressed without consensus.
    - We have the ability but perform pre-notification in advance of the work.
    - No. We seek the customer's permission and work through a, "refusal," process to resolve disagreements.
    - During emergency or reliability concern.
    - Yes. If it is a safety and reliability hazard we will remove and resolve issues later.
    - No—we must have property owner's permission to remove any tree greater than 4" dbh
    - Customer consent not required however we do provide notification to customer that tree will be removed.
    - No, customers are required to sign removal forms
    - We could have the right to remove hazard trees on customer property without their consent, but we always notify the customer and get their consent first.
    - Yes, however our normal policy is to notify before the work is completed
    - We contact the customer prior to any removal
    - Yes. The Company's practice, however, is to attempt to gain customer consent to remove hazard trees regardless of the provisions in the easements.
    - Generally, No on improved properties.
    - In Washington and Oregon, yes by statue. If other states no. We will remove a hazard tree regardless of our authority to do so if, in our judgment, it presents an imminent threat.

- This is really a decision making process dependent upon the severity of the Hazard Tree situation, basically we handles these on a case by case basis. These are operational decisions, the level of condemnation as a legal tool has not been utilized to date.

27. Please describe how hazard tree removal requests are performed.
    - Coordinator patrols a circuit, identifies trees to be removed, gets permission and assigns contractor crew.
    - We leave a door card with a description of the required work and a contact number for questions. We may seek a signature from the customer acknowledging the work prior to removal.
    - Contractor notification person contacts the property owner to arrange for the work.
    - If a customer contacts us to report a hazardous tree, a Customer Service Order is generated and forwarded to an assigned tree contractor. The contractor will dispatch an inspector within five business days to visit the location to assess the request and notify the customer of assessment results. The contractor then obtains any necessary property owner permission and schedules the work for completion within 21 days of the original request. If urgent action is necessary, the contractor will remove the tree as soon as possible. If our field personnel identify and request a tree removal, a work order will be issued to a contractor to schedule and perform the work. If urgent action is required, a tree crew is redeployed from its current work site to address the hazard.
    - Typically on ROW rural areas don't require a formal request process. For private property issues customer contact and subsequent approval is required.
    - Evaluated by Certified Arborist and risk/cost assessed.
    - Company Arborist evaluates request and then secures written permission, if beneficial for the Company. Company contractor schedules removal with the customer.
    - Our contract pre-inspection company employees identify trees that require abatement work and seek customer permission for the work.
    - Customer contact-permission to complete-share costs.
    - Customer will contact us, field inspectors will site visit and speak with customer to obtain a consent waiver, crews will perform work.
    - Any time a potential hazard tree is identifies, by whatever means, a qualified arborist will investigate & determine the potential hazard & the tree is prioritized.
    - Customers call into our call center and request a tree be trimmed or made safe.
    - Identify hazard tree, provide written notification to customer, remove tree.
    - Hazard is assessed by arborist and removed immediately if an imminent threat, or scheduled as assessed.
    - ID hazard, notify customer, homeowner signed documentation prior to any and all tree work.
    - All removal requests are performed on a case by case study. First the request is directed to vegetation management. The site is then investigated to determine if it warrants a removal.
    - Basically we don't receive any. Where we have set up a program with a municipality, we will compile a database of trees and priorities for removal. The database would identify all the 3rd party cost-share partners.
    - We do not perform hazard tree removals.
    - Immediate, imminent threats are addressed quickly. Non-imminent threats are communicated to the property owner and arrangements made for future removal.
    - Facilitator contacts customer
    - It is verified or identified by the Supervisor over that department. Then contact is made to the customer.
    - Requests are generated either through customer calls or utility personnel. Each ticket is investigated by a forester to determine if it is hazard tree. Vegetation Management Department prioritizes requests as low, medium, or high. A tree prioritized as high is addressed immediately.
    - leave a door card with a description of the required work and a contact number for questions. We may seek a signature from the customer acknowledging the work prior to removal.
    - When a hazard tree is identified, a field personnel or contract tree crew general foremen identify the property owner and make contact. When contact is established, negotiations are conducted regarding the amount of post-removal cleanup necessary to satisfy the customer. After an agreement is reached and permission is granted, the tree is removed.

- Request evaluated by in-house or contract 'inspector'; if initiated by property owner, we work with property owner to eliminate as much of the hazard as we feel responsible for (try to leave anything not impacting our system for the property owner to handle, but will do all if this is the only way to negotiate what we need); direct our contracted tree crew to perform the work as negotiated. If the request is initiated in-house, go through same process to notify and explain to property owner and negotiate a result acceptable to both parties.
- Door hanger / Letter contact.
- As trees are identified, a contract employee or a company employee will contact the property owners to resolve tree hazard.
- As hazard trees are identified, property owners are contacted to resolve the problem.
- A vegetation management representative contacts the customer, and explains that a hazard tree has been identified on the customer's property. The utility representative explains the potential impact to electric facilities and the policy to leave all wood. He then obtains a signed removal permit allowing the utility and its contractor to remove the tree and leave the wood on site.
- Our certified arborist will approach the property owner and explain the circumstances, and arrange to have the tree removed. If they refuse, we'll send them a letter notifying them of our impending action (assuming we have time. If not, we'll send out a crew and remove the tree.
- If this is an immediate threat we handle it right away, if it is not, we handle this as we do all other requests for tree work.
- n/a (x1)

28. About what percentage of hazard tree-removal requests are granted by customers?
    - 100% (x4)
    - 99.9% (x2)
    - 99% (x2)
    - 98%
    - 95% (x3)
    - 90% (x8)
    - >90%
    - 90-95%
    - 90%
    - 80%
    - 85% (x2)
    - 75% (x2)
    - 25%
    - Don't know (x2)
    - n/a (x2)

29. If a customer does not respond to a hazard tree removal request, can you remove the tree? Explain.
    - Yes if eminent danger
    - Yes, although severity of hazard dictates whether the tree is addressed without consensus.
    - Yes - where we have rights.
    - Removal of a hazard tree without customer consent would require us to take legal action against the property owner unless such right is provided for in the easement documents.
    - Yes for public, no for private.
    - No, but if it is immediate threat we can if we post notice for 2 weeks.
    - No (x5)
    - Usually after negotiating or following our, "refusal," process we are able to abate the tree.
    - If reliability or fire hazard we force remove with or without consent.
    - Yes. It may involve legal action.
    - Yes, our utility by state law has the right to remove any tree we feel is a threat to our facilities.

- Yes, we have the right through the Municipal Licensing Standards Act.
- If it is inside the right-of-way, the tree will be removed regardless. If it is on customer property and access is denied after explanation, it may become a legal issue.
- No- signed documentation needed prior to removal.
- No, most times we do not have the right to remove it. If a right-of-way agreement provides such rights, we will notify the property owner of our rights and work with them to resolve the situation.
- Not sure we have ever encountered this problem. If on our right-of-way; yes. If not, this would be a matter for our legal dept.
- Not if the tree is on private property
- If it is an imminent threat we will. If not, we may choose to simply make the tree safe and leave final removal to the property owner
- Depends on the locations as to how we might proceed.
- Yes, although severity of hazard would dictate whether tree is addressed without consensus
- Yes, if there is an easement in place that allows ETI to remove the hazard tree. If there is no such easement in place, the Company does not have the right to remove the hazard tree.
- No; but portions of tree that may cause immediate threat may be pruned.
- Yes, if the tree is in the easement. We usually leave a notice explaining tree work will be done on given date. We show up on date with crew and law enforcement officers and complete tree work; however, this can lead to litigation.
- Yes, we usually leave a notice explaining tree work will be done on a given data. We show up on date with crew and law enforcement officers and complete tree work. Legal gets involved if necessary.
- No. If a customer does not respond and we are unable to obtain a signed permit for the removal, then we cannot remove the tree.
- Yes
- Yes, but this is really a decision making process dependent upon the severity of the Hazard Tree situation, basically we handles these on a case by case basis.
- n/a (x1)

30. If a customer initially refuses to have a hazard tree removed, are any follow-on persuasion activities performed? How effective have these been?
    - Occasionally take down additional trees at customer request.
    - Yes. Our company vegetation management supervisors will make a contact and attempt to persuade the customer. Sometimes we will offer to replace the tree with a short-growing species and/or grind stumps in order to get a desirable removal.
    - Almost never occurs but we do have a protocol that is set-up for this purpose.
    - Our actions depend on the situation and the immediacy of the hazard. If the contractor cannot secure removal, the pertinent utility representative will be notified. We may offer to haul the brush or debris or negotiate some other work activity to help facilitate the removal.
    - Very high acceptance rate for removal of hazard trees on private property.
    - Depends on the degree of risk for outage/safety.
    - Yes. Notify the customer in writing that they will be responsible for damages.
    - Yes. Very effective. In the event that the customer does not agree, our contractors continue to engage the customer sometimes utilizing incentives. If the customer continues to decline the work, we will initiate a, "refusal," process where the customer is notified in writing of the utility's duty (in our state, hazard tree removal is required by law) to abate a hazard tree while explaining the customer's role in complying with that duty.
    - If refused-we force remove.
    - Yes. Fairly effective once we explain why we would like to remove the tree.
    - No answer (x3)
    - A vegetation management coordinator or the forester will talk with the customer and explain the hazards to life and property because of that tree. If the customer still refuses, then we have them sign a form acknowl-

edging that the hazards were explained to them and the document is filed in the vegetation management customer database.

- If the customer refuses the City will remove the tree and apply the charge to the customers municipal property taxes.
- We make every attempt to have the customers' support removing the tree. If not, we us law enforcement and/or legal means. Usually the persuasion activities are effective, however.
- Yes- follow-up letter; 95% effective.
- Yes, we discuss the potential of the hazard tree creating an outage for the customer and the benefits of having the tree removed. By communicating and educating the customer to the real hazards of these situations, we are generally successful in persuading the customer to allow us to remove the tree.
- We have a program entitled "right tree in the right place" and we offer replacement trees or shrubs to compensate for the loss of the tree.
- We can advise the customer that they will be held liable for any damage caused by the tree should it fall into the lines. We are also able to contact the City arborist who has more authority to require removal of the tree.
- Yes. 50% of the initial refusals reconsider.
- Yes, a Forester will arrange to meet with customer and attempt to educate customer and seek permission to allow for removal. About 90% of the time both parties are able to resolve the issue.
- Yes. Our company vegetation management supervisors will make a contact and attempt to persuade the customer.
- Generally, the Company is successful in gaining consent to remove hazard trees
- Sometimes
- Yes; negotiated replacement trees and/or other pruning or tree removal options have been utilized with great success. Currently trying to set up a voucher system with local nurseries to allow us to just hand local nursery 'gift card' voucher to the property owner as incentive.
- Contact by VM representative, generally good results.
- Yes. We usually leave a notice explaining tree work will be done on given date.
- Yes, we get the trees taken care of.
- If the customer refuses to have a hazard tree removed, the vegetation management representative explains the impact of a hazard tree falling on the electric facilities. If the customer still refuses, then the location and hazard tree information is documented and tracked in the database. Usually the customer does not change their mind in allowing us to remove the hazard tree.
- We have an involved process where we follow a technician with their general foreman or supervisor., If they don't get anywhere, a company forester will visit. We reinforce the same message each time. It is usually effective. However, we do not hesitate to act without authorization if need be.
- Yes, we strive for resolution in on form or another.

31. If a customer refuses to have a hazard tree removed, and the tree later damages the utility system, do you ever hold the customer financially liable for the resulting damage? Explain.
    - No (x14)
    - Don't know.
    - We have not had the opportunity to cross this bridge.
    - No. Currently examining these options.
    - Yes (x2)
    - Yes-It would have been documented.
    - Sometimes. If a refusal form is signed by the customer and they are advised of their liability we have in the past billed the customer for restoration costs.
    - We do not allow it to get to that point, however, if it did get to that point, yes, the customer would be liable for damage to our system.
    - Not to my knowledge.
    - This is attempted by our regional customer service offices. Not sure how successful they have been; probably not very successful.

- We advise the customer that we will however we do not have a mechanism to track the fact that this discussion was held and unless the incident occurs shortly after the notice to the customer, we would absorb the costs of replacing the line.
- We do advise customers in our final danger tree letter that we will hold them financially responsible for damage to our facilities but it doesn't occur very often.
- No, For a number of reasons, including the difficulty in proving the facts necessary to succeed in a legal suit against a customer.
- Attempt to, and this threat is used as part of the 'negotiation', but most situations do not get assessed back to the property owner that I am aware of.
- We have not had to yet, but we have billed a tree contractor for damages when they missed a tree that later caused a problem.
- To date we have not had such an event, it would be interesting to challenge this, however, I would expect we would purchase the tree or rights to it before we went down the path of liability.
- N/A
- No answer (x1)

32. About how much time, on average, elapses from the identification of a hazard tree until it is removed?
    - 1 week, unless immediate action is necessary.
    - 1-3 days (x2)
    - 30 days (x3)
    - 6-8 weeks
    - Less than 3 weeks
    - No answer (x1)
    - Imminent threats on done within days, others typically take a few weeks.
    - Two weeks.
    - Depending of hazard-no longer than 30 days.
    - 10 business days (x2)
    - Less than 15 days
    - 0-6 weeks
    - About 1 week (x2)
    - Immediately if imminent threat.
    - No more than 30 days.
    - 8-10 weeks
    - Depends on discussion with the customer but generally, if it is going to be removed then the work happens within about a week of the identification.
    - 30-60 days
    - 1-6 months, depending on the process.
    - 1 week to 10 days
    - If the hazard tree is prioritized as a high it is addressed within 24 hours. If it is a low or medium the tree will addressed within 14 days
    - Less than 3 weeks
    - Dependent upon many variables (line criticality, public safety, political nature, etc), but average is one week
    - 4 weeks.
    - It depends on the severity. If the tree is coming over, it's a matter of hours. Otherwise, I'd say 10 days.
    - Highly variable, from immediately to 2-3 weeks dependent upon the severity of the situation.

33. After cutting down a hazard tree on a customer's property, do you remove the resulting wood?
    - No (x9)
    - Yes, in most cases, unless permission to leave it.

- No, although there have been exceptions.
- Not typically but we have done so as part of a special reliability project that involved a significant amount of wood.
- Normally, the debris is left for the property owner to dispose of.
- We will ask the customer.
- Yes; about 30% of the time the large wood is removed (4" or greater in diameter). About 80% of the time the small wood is either hauled away or chipped and scattered on the property. However, our preference is to allow the customer to manage the debris that remains from their tree.
- Not normally but in some negotiated circumstances.
- Most of the time no. but debris removal can be used as part of the negotiation.
- No, unless it is in an urban setting & we may consider chipping the limbs, but we do not remove the log wood.
- If customer requests—otherwise wood is left on site.
- our vegetation program, the tree is removed. Branches will be chipped and removed from yards and all wood larger than 4" diameter will be left for the customer on the property. Dead wood is non-chippable and will also be left on the property. If it is cut by a trouble or lineman, (i.e. storm-caused event) everything is left.
- Company policy is to leave the wood however realistically actually handled on case by case basis.
- It is negotiated or often, yes, it is removed.
- We remove the wood if the removal is planned. If it is as a result of a storm then we cut the tree clear of the line and leave the tree for the customer to clean up.
- Depends on the location and situation.
- Subject to negotiations with the customer.
- Is part of the negotiated agreement with the property owner; normally chip up brush and stack the cord wood. Try to leave as much as possible.
- Generally no.
- Not normally; however, in a few cases, this has been done to avoid litigation.
- We typically do not dispose of the wood. If a contractor is used to remove the tree, he may use a chipper for the brush and smaller limbs and haul them off.
- It is case specific, but typically no. We do chip brush in many cases. In some Cities we are required to haul all debris, so in those cases we do haul wood away.
- Nearly always.
- This is variable, and many times is negotiated with the customer.

34. When removing a hazard tree on a customer's property, do you ever replace the tree? Explain.
    - No (x15)
    - Yes (x2)
    - Yes. Sometimes we will offer to replace the tree with a short-growing species in order to get a desirable removal.
    - Not typically.
    - Yes. We may offer small replacement trees to facilitate removal in isolated incidents.
    - If they request we have certificates for nursery purchases.
    - Yes. At our Arborist's discretion.
    - Not directly. Instead, we provide a pre-paid VISA card for the customer to use as they like. Educational materials are provided with the card to assist the customer in selecting a proper tree to plant near the power lines. So while not directly replacing the tree, some customers may choose to do so with the card.
    - Sometimes but rarely.
    - Rarely. Again replacement can be used as part of the negotiation.
    - Customers are offered tree vouchers through our Tree Replacement Program.
    - Yes. We have a program entitled "right tree in the right place" and we offer replacement trees or shrubs to compensate for the loss of the tree.

- While we have replaced trees in the past, this is not a generally used practice.
- Yes; normal negotiated replacements are given to the property owner to plant, but we have actually planted some, all dependent upon negotiated terms to get required clearances.
- Case specific, but usually no.
- No, because the customer owns the tree and the utility is assisting the customer with the removal of the hazard tree and related liability, and reducing the cost incurred by the customer.
- No, however, it is a tool we may at some time need to utilize.

35. Do you have a program to identify and replace undesirable tree species? How aggressive is this program?
    - No (x17)
    - Yes, but it is not aggressive.
    - No. We replace undesirable tree species upon customer request.
    - No answer (x1)
    - Yes. The program is extensive with letters to customers, a communication campaign involving multiple forms of media, public presentations, as well as participation in Arbor Day and Earth Day events and the like.
    - Yes-right tree/right place program. Usually only on palm trees.
    - No. We have a Gift Certificate program that is used strictly as a negotiation tool & not a 1:1 replacement. We also participate in a community tree planting program.
    - We do have extra funds available now to remove fast-growing volunteer trees that are 8" dbh or less but we still have to have property owner permission on any tree between 4-8" dbh.
    - Yes, based upon growth potential, cost, and system reliability. This is part of our tree replacement program.
    - Yes. The whole program is centered on nurturing the growth of compatible vegetation. We do plant in some instances, however, lean heavily on Mother Nature to provide compatible shrubs naturally. We used to plant speckled alder on the rights of way adjacent roads however, this program was stopped in favor of more aggressive vegetation management.
    - Yes, moderate.
    - Yes, an informal program discussed continually with contractors. We aggressively pursue removal of several troublesome species ('cycle-busters').
    - Yes. We aggressively target fast growing species. We try to work with city governments on tree ordinances, and we have even developed educational material that is made available publicly in an effort to inform customers and city code enforcement officials.
    - Yes. We aggressively target fast growing trees.
    - Yes. Ten years ago, it was very aggressive. Many of the trees that are left are large, and not cost effective to remove in our judgment.
    - No, however we do target a number of these in our day to day operations.

Best Practices

36. A certain percentage of trees die naturally every year. Do you feel that your utility, on an annual basis, removes enough dead and diseased trees to keep up with this natural process?
    - No (x9)
    - Not sure, program is 1 year old.
    - Yes (x12)
    - Probably not.
    - Yes. Under normal conditions exclusive of hurricanes and tornadoes, we generally keeps up with this natural process. Dead trees are routinely reported by customers as well as identified by the contractors and our personnel during ongoing operations.
    - In general yes, although the answer depends upon many factors that are mostly local in nature..
    - No reply (x1)

- Yes - Exception is our bark beetle infestation where the state has funded the removal of large quantities.
- We stay current on our 3-year cycle, barring an infestation of some type, yes we keep up with the natural process.
- Unknown (x2)
- Yes, for normal years; however, coming out of a several year drought, we may be seeing this change. Are already seeing a larger number of stressed trees uprooting and shedding major scaffold limbs due to drought/disease issues.
- Yes, but only if they are in the easement and if the tree represents a hazard to our facilities.

37. Would an increase in the aggressiveness of hazard tree removal reduce major storm damage:
    a. A little bit: 16
    b. A moderate amount: 7
    c. A lot: 8
    d. Unknown 1

38. What else besides hazard tree removal (vegetation related) would be effective at reducing major storm damage?
- Widening Right-of-way
- Don't know / no response (x4)
- Overhang removal; targeting weak-wooded and other problematic species for overhang trimming and/or complete removal, e.g. black locusts (removals), silver maples (blue-sky or hinge point overhang removals – very dependent upon construction type, e.g. spacer cable/tree wire/field spun vs. 3-phase open wire, single phase pole-top-pin etc.
- It would be beneficial to eliminate all tall-growing trees from beneath the power lines.
- More lateral (neighborhood) line clearing.
- Aside from increasing the removal of hazard trees, the strategies are to improve storm restoration times, not reduce the cause.
- Set minimum clearance and maintenance requirements for owners of trees.
- Increased clearances at the time of pruning; franchise rights and state laws that provide for tree abatement at the utility's discretion & without the owner's permission; greater enforcement of certain provisions of fire prevention laws that require landowners to reduce vegetative fuels on their properties.
- Palm tree skinning program and hard wood overhang removal.
- Ability to complete a total annual work plan, herbicide application, mowing, customer education.
- The utility must clear the right-of-way based on species & growth rate. If there is a brittle wood tree or a fast growing tree then more clearance may be necessary.
- Staying on a 4-yr trim cycle
- Undergrounding, break-away service drop connectors, reinforced service mast, storm guys, aggressive storm hardening on the trees, branch stiffening and reducing wind load through the trees.
- Mid-cycle inspections.
- Removing additional overhang on laterals (single phase lines); burying lines; modified construction.
- Being more proactive in our maintenance program.
- Being notified by adjacent landowners of land use change. Many landowners have decided to clear cut their land for the economic return and when this is completed, there remains a strip of trees adjacent to the power line that inevitably fall the next time the wind blows.
- Routine cycle trim maintenance
- Nothing
- Reducing the cycle time while keeping the current ground to sky specification. Our models show this would be worth the cost, but would require spending current O&M increase to pay for a future O&M reduction. This is a really hard sell. Most reliability improvements for us are paid using Capital investment to pay for future O&M reduction. This is not possible with cycle pruning, which is mostly O&M. We can capitalize danger trees, but the real problem is identifying the actual hazard trees, as we discussed earlier. An important point is that the cycle specifications are a key to reducing storm costs. The type of utility pruning where the floor is not maintained and you only trim above and below and to the side a small distance will

not help storm costs. We have measured the difference in cycles at the preferred specification vs. actual storm costs and found our model predicts damage pretty close to actual results. But, once again, getting to a preferable cycle costs up front O&M which is hard for management to commit.

- A better trim specification. We trim a minimal distance from the conductors in all directions. The floor is not cleared and overhang is allowed. Side pruning is limited to 10 ft.
- Educating the public and builders about planting the right trees in the right place.
- We believe the only way to reduce major storm damage in any recognizable way would be a dramatic (greater than 30 feet to either side of the conductor) increase in the maintained ROW along primary conductors. This, however, may be both cost and customer prohibitive.
- Reduced cycle period / increased routine pruning; increased amount of targeted tree removal/replacement; greater 'hardening' of line equipment to withstand momentary contacts during storm events.
- Cooperation of governmental entities, state, city and county, in addressing vegetation issues. City and county officials hamper our efforts, or do not help with adverse customer reaction to tree trimming and attempt to pass ordinances that hamper our efforts.
- Cooperation of governmental entities, state, city and county, in addressing vegetation issues. City and county officials hamper our efforts, or do not help with adverse customer reactions to tree trimming and attempts to pass ordinances to hamper our efforts. A mechanism other than the current rate making process to allow for concurrent recovery of vegetation management related expenses.
- Removing additional overhang on weak wooded tree species. Ground to sky clearance on 34kV voltage primary. Preventative maintenance on isolated open wire secondary lines.
- We have found that a systematic vegetation management cycle does wonders.
- Sufficient and consistent Line Clearing funding can improve both storm and non-storm performance. This can also improve overall restoration times after any type of storm event.

39. Please describe any attempts to more effectively address hazard trees that <u>did not</u> work very well.
    - None/no answer (x26)
    - Lump sum bidding. Contractors' desire to make a profit put extra pressure on our supervisors to catch skipped hazard trees.
    - We are just embarking of a hazard tree removal program now. We have called it storm hardening in the past, however, our regulator has not permitted extra spending for such work.
    - Removing dead trees only.
    - We determined that a stand-along hazard tree identification and removal program (separate from the routine trimming cycle) was more effective.
    - Lack of property owner notice and 'buy-in' prior to initiating work has proven to be a deal-breaker for many political subdivisions we must all work with.
    - Having multiple screeners checking backlogged hazard trees did not work very well. It is better to designate 2 screeners who screen/identify and permit systematically the removal of hazard trees.

40. Please describe any attempts to more effectively address hazard trees that <u>did</u> work very well.
    - None/no answer (x16)
    - Use of retirees to assist in coordination and inspections.
    - Investigating and analyzing tree caused outages, then summarizing the findings and educating field forces on identification, controlling contractor employee turnover, and face-to-face customer contact to get agreement on tree removal. Holding the contractor responsible for tree outages caused by missed or skipped hazard trees over the entire trimming cycle.
    - We believes our current program of hazard tree identification and removal during the course of planned circuit maintenance activities work very well.
    - Piloting a reclaiming of ROW line clearing practices in some limited areas.
    - Personal face to face contact with property owner.

- Developing a Hazard Tree Rating System; implementing a system-wide vegetation management reliability program; continuous training and education of our contracting pre-inspection arborists. Implementing a Hazard Tree Quality Control program that examines abatement decision making.
- One on one education of the customer about hazard trees and the potential they have.
- More patrols by servicemen/linemen & full removal when the trees are identifies. Having a 2-man crew dedicated to removing hazard trees.
- Trouble & Linemen calling in hazards.
- Increase mid-cycle patrols to include laterals (singe phase).
- In a designated "natural" area, we obtained permission to clear cut everything below the lines and any dead trees within a fall arc of the lines. We chipped the wood and created a walking trail beside the lines. The City seemed to like this idea and we had no complaints from residents and users of the "natural" area. Tree contacts have significantly been reduced and reliability increased in an area that was performing poorly during storms.
- Investigating and analyzing tree caused outages, then summarizing the findings and educating field forces on identification, controlling contractor employee turnover, and face-to-face customer contact to get agreement on tree removal. Holding the contractor responsible for tree outages caused by missed or skipped hazard trees over the entire trimming cycle.
- We are still looking.
- Tracking and analyzing outages has led to identification of areas that require more extensive hazard tree identification and removal. For example, insect infestation or disease may cause more hazard trees to disrupt service in a localized area than would otherwise occur. Outage data can indicate the location of those areas.
- Proactive notice and negotiated agreements prior to work starting.
- Screen for hazard trees post leaf-out. Prioritization system is effective.

41. What would it take for your company to more effectively manage hazard trees?
    - No answer (x3)
    - Budget increases to allow for more tree replacements.
    - We would need better data to support an increase in funding.
    - We believes its current program is effective.
    - Resources (manpower).
    - Increased funding and additional resources.
    - Budget for hazard tree removals and take firm legal action against property owners.
    - 1) Better tree failure data that shows failure trends by species that include: how the tree fails (wholly, partially, or both), its rate of failure as a function of population, and the time of year the species is likely to fail. An analysis of weather's influences over these failure patterns would also be valuable. 2) Better support for tree removal from public agencies and fire protection authorities would also be helpful. 3) Establishing statutory Utility liability for damages caused by hazard trees that is based upon a negligence standard rather than a strict liability standard.
    - Reliability program-we are mostly compliance only.
    - A dedicated budget to support identification, communication with customers and resources to do the work.
    - If it became a problem than we would address it during our normal trim cycles.
    - Increased inspections & budget $'s.
    - Mid-cycle inspections.
    - Funding; tree replacement program (Right Tree Right Place); include tree removal as part of new easement agreements.
    - Good data collection tools and analytical support, along with consistent funding for hazard tree management.
    - An identification program and a price setting mechanism. In addition, a separate crew that can climb a tree and fell it into the woods. No need for a bucket truck or disposal when the forest is the adjacent land type.
    - Some form of specialized inspector to identify hazard trees (very expensive).
    - Cycle trimming

- good business case. A necessity for this business case would be the ability to identify actual hazard trees accurately. Such knowledge is necessary, but not sufficient. We would also have to show we get more value than the cost, which would mainly be in reducing major storm costs, which can range from $10 to $100 million per year.
- Better education for the public and better facilitation of requests to have trees removed with the public. Also, our utility would have to find a way to get beyond the "business as usual" pruning methodology currently in use and create a hazard tree program.
- Dedicate a portion of budget dollars to address hazardous trees located on transmission and distribution lines
- Budget increases to allow for tree replacements.
- We believe we are effectively managing the VISIBLY hazardous trees, and only ROW expansion would address the "look-OK-but-fail-anyway" trees.
- Stronger stance of regulatory agencies to back-up clearance and hazard reduction initiatives; increased budget
- We are managing hazard tree issues adequately.
- We believe that we do a reasonably good job at vegetation management; however, a mechanism to allow for the concurrent recovery of vegetation related expenses would stimulate a more aggressive program.
- A mechanism to allow for the concurrent recovery of vegetation related expenses.
- Increase funding and designated resources.
- $5 million
- Overall this is not a major issue for us.

42. What would you recommend as a best practice for managing hazard trees?
    - No answer (x7)
    - Holding the contractor responsible for tree outages caused by missed or skipped hazard trees over the entire trimming cycle.
    - Use a stratified approach based on the importance of the facilities, e.g. we use a complete tree walk-around process 40' on either side of the pole line for subtransmission lines and distribution feeder main; otherwise detect hazard trees on remaining facilities as viewed when walking along the pole line.
    - We recommends a three-pronged approach. This includes hazard tree identification and removal by contractors as part of an ongoing proactive circuit trim maintenance program; vigilant reporting and removal of hazard trees identified by utility personnel during the course of operations; and prompt inspections with the appropriate actions taken following notification from customers of potential hazards.
    - A consistent means of patrolling.
    - Know species risk, target specific areas known to be at risk.
    - 1) Gather species-specific tree failure data & utilize that data to drive tree-abatement decision making. 2) Establish a patrol standard that includes hazard trees. 3) Establish a reasoned method to analyze the risk (impacts) associated with tree failure and utilize that analysis in tree abatement decision making. 4) Require ANSI standards in tree abatement practices. 5) Put a high emphasis on customer satisfaction. 6) Develop a parallel reliability-focused program. 7) Establish a quality control mechanism that objectively analyzes tree abatement decision making and require open dialogue about the QC findings.
    - Reliability inspection and maintenance program.
    - Wide spread education of the customers, removal – replacement, governmental ordinances that do not hinder the removal of hazard trees by utilities.
    - Search & destroy method is the only effective way to do it.
    - If you had the budget to do so, send a work planner out every six months to inspect main feeder lines for hazard trees in areas that would have a high customer impact if an outage occurred.
    - Increased inspections & prompt removals.
    - Remaining on cycle and doing mid-cycle inspections.
    - Mid-cycle patrols and outage investigations.
    - Several years of consistent funding.

- Train pole inspectors to identify hazard trees during regular inspections or use tree trimmers to identify during area trimming.
- Aggressive removal policy as part of routine circuit maintenance to prevent trees from becoming hazardous in the future
- Remove as many as possible
- An annual danger tree crew to find and address hazardous trees
- Holding the contractor responsible for tree outages caused by missed or skipped hazard trees over the entire trimming cycle.
- Include this as part of the routine patrols made; recognition of targeted problem species in your area that need to be given special management attention.
- Periodic visual inspections.
- The majority of the tree problem in south and west Texas relate to otherwise healthy trees that have the size and ability to excessively bend (palm trees) under high winds, are large healthy trees that become uprooted and fall in high. winds (especially if the soil is saturated), or trees that parts break off in high winds and the parts land in the power lines.
- Prioritization Guidelines (18 point system) based on voltage, defects, failure potential and species.
- Annual inspections with a designated tree crew in a particular area.
- Developing a quick and efficient method for dealing with these when they occur.

43. Any other thoughts or comments on the subject of hazard trees?
    - No / No answer (x18)
    - Thank you [author: you are welcome!]
    - Good Survey [author: thank you!]
    - Not as yet – perhaps next year. Thank you for the opportunity to participate [author: you are welcome!]
    - With a catastrophic storm event with sustained high winds (95+ miles per hour), many trees fail that do not meet the hazard tree definition for this survey. Without these obvious, defined characteristics, most homeowners would be unreceptive and reluctant to allow the utility to arbitrarily remove trees based on "...we could have a hurricane and if the conditions are absolutely right, it may fall on the power lines." Removal costs on this basis to accomplish the work would be enormous.
    - If you had the budget to do so, send a work planner out every six months to inspect main feeder lines for hazard trees in areas that would have a high customer impact if an outage occurred.
    - Right now on our system, squirrels and lightning cause more outages than hazards trees do.
    - Cost/Benefit not good enough for us at this time and politically challenged.
    - The evidence shows that most tree outages come from falling/failing trees rather that limb outages. But we spend more money trimming than we do on tree removal. A few of us are considering why utilities actually maintain RW. Our model shows that reliability based solely on customer interruptions is not why RW is maintained. That is, the value of customer reliability to the utility, either per CI or per CMI, is not worth the money we spend. But there is still a reason why utilities maintain RW, and it is likely in the preservation of the asset itself. Vegetation will totally destroy the asset if we did not prune. So many utilities prune just enough to keep the asset, but not enough to prevent customer interruptions. Utility management intuitively understands this "asset retention" policy, even if they cannot or will not state it openly. Preventing customer interruptions is therefore secondary to the real reason utilities maintain RW. This hypothesis is not particularly popular however, although I think it may be true. So don't put it down as what my utility thinks. What does this have to do with hazard tree removal? Hazard tree removal is not really necessary for preservation of the asset. But it does appear necessary if you want to reduce customer interruptions, and it may also play a significant role in reducing future O&M costs in reduction of storm costs.
    - We make a conscious effort to identify and address hazardous trees.
    - The practices of our operating company take into account experiences and knowledge from our parent company's other operating companies.
    - Although trees off-easement do cause problems on occasion, in our region the biggest problem is still regrowth from trees within the easement.

- Most of our off ROW tree issues are with green trees that no one can identify or predict will fall into conductors due to soil conditions, amount of moisture, root health, location of trees and their height or dead trees from drought and insect infestations.
- The removal of dead and declining trees, including dead overhangs, is one of the best ways to reduce vegetation related outages and improve reliability on the distribution system. There needs to be separate budgeted dollars, designated resource allocation, and explicit criteria of the hazard removal program for it to be effective.
- We view hazard trees as a component of our overall vegetation mgt program. Hazard tree removal is more of an issue on Transmission facilities that it is with our Distribution facilities due to the FERC 003-1 TVMP requirement. Since we are moving toward a 3 year trim cycle on our distribution facilities the importance of Hazard tree removal will be reduced due to our increased level of systematic maintenance.