UTILITY VEGETATION MANAGEMENT FINAL REPORT

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COMMISSIONED TO SUPPORT THE FEDERAL INVESTIGATION OF THE AUGUST 14, 2003 NORTHEAST BLACKOUT

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The principal authors of this report have over 50 combined years of experience in dealing with all matters related to UVM programs, industry practices, laws, and standards. CN Utility Consulting, LLC has performed industry assessments of UVM laws and regulations, and has been directly involved with the promulgation and development of various industry standards. Most recently, CNUC completed what is considered to be the largest and most comprehensive UVM benchmarking study ever completed in the industry. This comprehensive study included the active participation of 55 utility companies (large and small) in North America, and covered the full gamut of UVM-related subjects.

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I. EXECUTIVE SUMMARY

TREE AND POWER LINE CONFLICTS

It is generally accepted that the single largest cause of electric power outages occurs when trees, or portions of trees, grow or fall into overhead power lines[1]. Virtually every electric customer in the US and Canada has, at one time or another, experienced a sustained electric outage as a direct result of a tree and power line conflict. While this is a more common problem on distribution lines, transmission tree-related outages are also experienced on a regular basis. While not as visible to the public as tree related outages, tree and power line conflicts have also caused significant wildland fires in both the US and Canada.

Electric utility companies actively work to mitigate these threats. In fact, Utility Vegetation Management (UVM) programs represent one of the largest recurring maintenance expenses for electric utility companies in North America[2]. Utilities and regulators generally agree that keeping trees and vegetation from conflicting with overhead conductors is a critical and expensive responsibility of all utility companies concerned about electric service reliability and fire mitigation.

REPORT BACKGROUND

CN Utility Consulting, LLC (CNUC) was commissioned to perform the following tasks in support of the federal investigation of the August 14, 2003, Northeast Blackout:

1. Collect and analyze information and data regarding transmission right-of-way vegetation management practices of three electric utility companies in order to assess the strengths and weaknesses of each company's vegetation management program. The utilities are American Electric Power (AEP), FirstEnergy (FE), and Cinergy.
2. Identify generic best practices for transmission-level vegetation management to enhance system performance and transmission reliability.
3. Assist in the field investigation and prepare a written Initial Report regarding the August 14th vegetation-related faults on the following circuits:

- **Stuart – Atlanta (345kV) AEP**
- **Star – South Canton (345kV) FirstEnergy**
- **Harding – Chamberlin (345kV) FirstEnergy**
- **Hanna – Juniper (345kV) FirstEnergy**

INITIAL REPORT FINDINGS

Prior to the publication of this report, CNUC completed the Initial Report[3] required in Task Three. The Initial Report provides the results of the field investigations performed at AEP and FE. Portions of the report are included in this publication.

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[1] While this varies between utilities, it is generally accepted that tree related outages are one of the most significant threats to the delivery of electricity.
[2] While this varies between utilities, it is generally accepted that UVM expenses are one of the largest expense items associated with maintaining overhead transmission and distribution electrical systems.
[3] Available at the Federal Energy Regulatory Commission Web Site: http://www.ferc.gov/cust-protect/moi/uvm-initial-report.pdf

Major Finding of the Initial Report

During our field investigation we determined that overgrown trees, as opposed to excessive conductor sag, were the cause of each of the faults investigated in Task Three. Further, we concluded that had all the trees, which contributed to the August 14th outage, been adequately pruned or removed prior to the event, the blackout would likely have not occurred.

Broader Review of Preventing Tree and Power Line Conflicts

The topic of preventing tree and power line conflicts requires a comprehensive review of various issues that influence UVM programs. As we discuss throughout this report, the conditions and influences that contributed to the August 14th tree and power line conflicts currently exist throughout the US and Canada. We are convinced that the conditions scrutinized in this investigation are not isolated or limited to the utilities involved in the August 14th Blackout. The conditions that led up to this event can be found in most States and Provinces throughout North America.

FINAL REPORT FINDINGS

In addition to detailing the specific findings about the August 14th Blackout, this report presents an overview of the UVM industry to provide a technical and industry context for understanding the findings. Information is provided about UVM organizations, work issues, legal and regulatory requirements and restraints, professional standards, and the need for improvement in electric industry practices and utility oversight. The findings in this report are based on our investigation, years of direct experience in UVM related issues, and our understanding of general industry practices through our recent benchmarking of UVM activities in North America[4].

This report also satisfies the requirements of Task One by assessing the strengths and weaknesses of the UVM programs at AEP, FE, and Cinergy.

Major Finding Related to Task One

Our findings in brief are that the three utilities studied in this report generally conduct their UVM operations within the range of current "average" industry standards. Given that the line to ground faults that precipitated the blackout have been determined to be a result of inadequate vegetation management practices, we believe and strongly recommend that the industry "average" or standard needs to be substantially improved.

REPORT RECOMMENDATIONS

Reducing the likelihood of future similar occurrences will require significant changes in both the UVM industry and, we believe, the appropriate oversight agencies. Additionally, the initial improvement will cost more money, though we believe that over time a more consistent and systematic approach will result in lower costs. This investment will also result in significantly improved electric service reliability for utility customers, and a reduction in emergency repair costs through the reduction of outages.

This report contains many general and specific recommendations directed at a wide and diverse audience. We could not discuss all of these recommendations in this Executive Summary but offer the following table that indicates where additional specific recommendations can be found.

[4] CNUC completed what is considered to be the largest and most comprehensive UVM benchmarking study ever completed in the industry. This comprehensive study included the active participation of 55 utility companies (large and small) in North America, and covered the full gamut of UVM-related subjects. The study is the property of CNUC and the participating utilities.

For the purposes of this Executive Summary, we are providing the following two sections of "key" recommendations for utility companies, and the agencies and organizations charged with their oversight.

Key Recommendations for Utility Companies

The conditions and influences that contributed to the August 14th tree and power line conflicts currently exist throughout the US and Canada. As we have outlined in this report, there are ubiquitous problems and issues that need to be addressed by utility companies, and the UVM industry. The following are abbreviated recommendations regarding how to improve current practices at utility company UVM programs

a. Improve current systems for managing UVM workload and schedules.
b. Ensure adequate and consistent UVM funding based on actual required work.
c. Adopt consistent and industry-accepted Best Practices for UVM operations.
d. With support of oversight agencies, improve public education regarding appropriate plantings near power lines, and in explaining the necessity of the work.

Recommendations for Oversight and Enforcement of UVM Activities

Current oversight of UVM activities by appropriate agencies or organizations is inadequate. While there is no shortage of concern regarding preventing tree and power line conflicts in the wake of blackouts, we believe that there needs to be a more consistent, focused, and public interest-based approach to overseeing the efforts of utility companies in this critical activity. The following are recommendations regarding how to improve current oversight and enforcement of UVM activities:

a. Develop clear and consistent UVM program expectations and standards regarding utility company performance.
b. Develop incentives/penalties for compliance.
c. Enforcement and oversight should be routine.
d. Oversight organizations need to publicly and politically support UVM activities where appropriate.

ADDITIONAL INFORMATION CONTAINED IN THIS REPORT

This report addresses all tasks identified in the original scope of this project. This includes a comprehensive list of UVM Best Practices that we developed with the active input, support, and endorsement of UVM industry experts in the US and Canada. These (and other) UVM experts have also graciously contributed specific recommendations they feel will address many of the current conditions that contribute to the likelihood of future tree and power line conflicts.

We believe that the attention now being focused on the critical importance of UVM could lead to increased safety and reliability for both electric transmission and distribution systems throughout North America. While we have focused our investigation and efforts into transmission UVM activities, we believe that many of the specific recommendations contained in this report have equal applicability to distribution UVM programs.

In closing, we believe that it would be a tragic mistake, leading to a lost opportunity, to simply conclude that unique errors or unusually inadequate vegetation management practices were the sole cause of these outages. Loss of transmission lines and major outages due to tree and power line conflicts have occurred in the past, and they are certain to occur in the future, unless there are significant changes in the industry's vegetation management practices and their oversight. We believe the recommendations and information contained in the report will provide a significant start in the right direction.

II. INTRODUCTION

This report covers a wide variety of issues related to the UVM industry, and the specific UVM programs and practices of the utilities involved with the August 14th Blackout. Equally important, we have tried to address some of the issues that we believe should be evaluated in order to mitigate the possibility of future large-scale, tree-related outages along transmission lines in North America.

The broad nature of these objectives requires us to provide a great deal of background and supplemental information regarding the current state of the UVM industry. This includes discussions on such items as the current UVM requirements and laws, and common obstacles to performing the work. We believe the totality of the information provided here will lead to a better understanding of how current conditions may have contributed to the August 14th Blackout, and also what steps can be taken to mitigate future tree and power line-related faults on transmission lines.

III. BACKGROUND

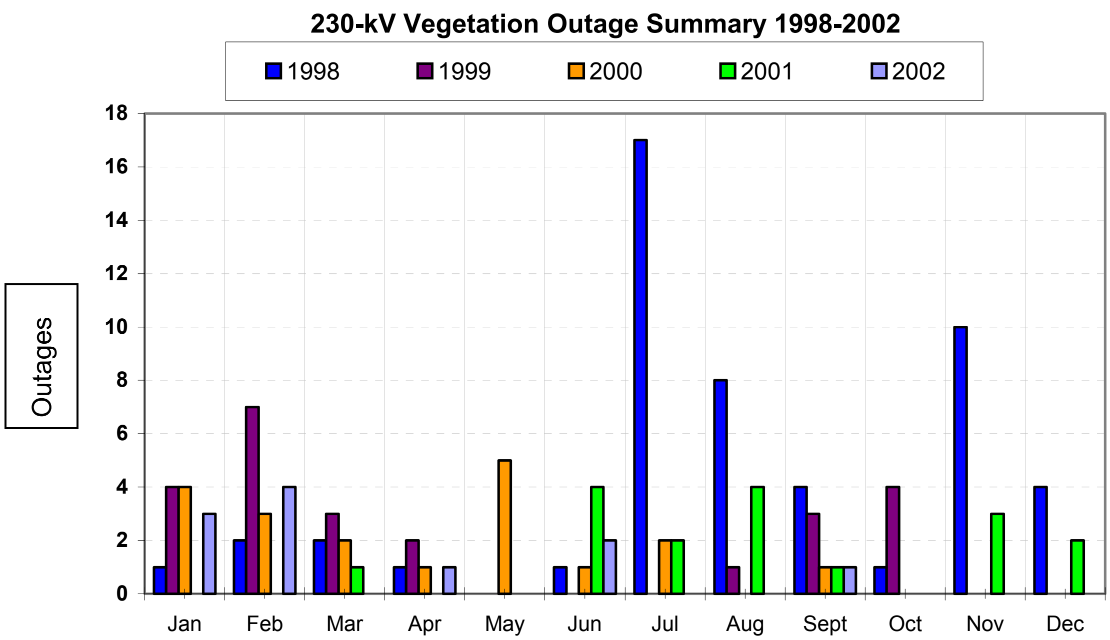
THE PURPOSE OF UVM: WHEN TREES AND POWER LINES CONFLICT

It is appropriate to begin with an explanation of why a UVM program is critical to any utility company that maintains overhead energized lines. The three most often cited reasons for having a UVM program are to prevent tree-related outages, to prevent tree/power line-related wildland fires, and for overall public safety.

Electric Service Reliability: Preventing Tree-Related Outages

Tree-related outages such as those experienced on August 14th are not anomalies. In fact, it is generally accepted that the single largest cause of electric power outages occurs when trees, or portions of trees, grow or fall into overhead power lines. The odds are that every single electric customer in the US and Canada has, at one time or another, experienced a sustained electric outage as a direct result of a tree and power line conflict.

While this is a more common problem on distribution lines, transmission tree-related outages are also experienced by utilities on a regular basis. For example, the following chart, provided by the Western Systems Coordinating Council (WSCC), illustrates the frequency of 230kV tree-related outages experienced on member utility systems in the west from 1998-2002.



A look at other large historical outages also clearly points to the influence of vegetation. For example, two significant outages in the western US in 1996 were attributed, in part, to trees. On July 2nd trees contacted a 345kV line resulting in an outage to 2.2 million customers and on August 10th trees contacted a 500kV line ultimately affecting 7.5 million customers in seven states. More recently, the outage that occurred in Italy on September 28, 2003 was "triggered by a trip of the Swiss 380kV line Mettlen-Lavorgo (also called the "Lukmanier" line) at 03:01 caused by tree flashover." This tree related outage left 57 million people without power and impacted several other countries in Europe.

While there is no shortage of these examples, it is important to keep these numbers in perspective regarding our actual exposure to tree-related outages on transmission and distribution systems. Utility companies in North America manage hundreds of millions of trees[5], and any one of them could conceivably cause an outage. To illustrate this exposure, if the total number of trees managed by utility companies in North America is 200 million, and the utilities could achieve adequate clearances on 99% of the trees, the potential[6] to experience 2 million tree-related outages in any given year still exists.

Preventing Tree-Related Fires

While not as common as tree-related outages, the issue of fires initiated from tree and power line conflicts is another reason that many utility companies have comprehensive UVM programs. Arcing between any part of a tree and a bare high-voltage conductor has the potential to occur if the physical separation between both is not maintained. Arcing distances vary based on such factors as voltage and ambient conditions. If arcing does occur between a branch and high-voltage line, there is the possibility that the branch could ignite and fall to the ground. If flammable material is present on the ground, it could cause a fire.

Unfortunately, current fire information systems at the local, state, and federal levels do not accurately record or track the historic incidents of tree and power line-caused fires. So, no one knows exactly how big the problem actually is. What we do know is that tree and power line-initiated fires are typically much more damaging and costly than typical wildland fires. For example, California fire officials have stated in the past that 1-3%[7] of the state's wildland fires can be attributed to tree and power line conflicts. However, a review of major historic fires in California illustrates that these fires typically cause significant devastation. We believe this is partially related to the fact that many of these fires occur in remote areas with a larger fuel base of flammable vegetation.

While fires are a significant problem and concern in both the US and Canada, it appears that the issue of tree and power line-caused fires is primarily an issue in the western states and provinces. Nevertheless, these types of occurrences have happened everywhere at one time or another and many fire authorities have promulgated codes to prevent them from occurring. (See section on "Current Requirements for UVM Work".)

Public Safety

Preventing outages and fires related to tree and power line conflicts is obviously in the interest of public safety. In addition to preventing these types of occurrences, the act of keeping lines clear of vegetation also makes it easier for the public to see, and avoid, the energized lines and equipment. While the most effective way to prevent accidents associated with the public climbing trees or working near power lines is through public education and avoidance of these situations[8], separation between lines and vegetation increases the likelihood that the individuals will "see" the energized facilities before an accident occurs.

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[5] Given that the majority of utility companies do not currently have an inventory of all vegetation under their management, we have extrapolated this number from the limited data available.
[6] Trees in contact with conductors do not always generate sufficient ground fault current to cause an outage.
[7] We question this number given that California's fire tracking system (CFIRS) does not have the current ability to track these causes. They are typically lumped under various causes and do not show up in any generated reports as tree- and power line-initiated fires.
[8] Current mandatory clearance requirements are not effective, or practical, in preventing accidental direct or indirect contact with energized lines by unwary tree climbers.

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INTRODUCTION TO THE UVM INDUSTRY AND PROGRAMS

UVM programs represent one of the largest recurring maintenance expenses for electric utility companies in North America. Keeping trees and vegetation from conflicting with overhead conductors is a critical and expensive responsibility of all utility companies concerned about electric service reliability and fire mitigation.

The vast majority of work in this multi-billion-dollar-a-year industry is not performed by utility personnel, but rather outsourced to specialized tree and vegetation management contractors. These contractors typically work under the direction of a utility company Arborist or Forester who is charged with overall management of the UVM program.

A typical UVM program can include all of the following activities:

1. Tree pruning and removal
2. Vegetation control around poles, substations, and other electric facilities
3. Manual, mechanical, or chemical control of vegetation along rights-of-way
4. Pre- and post inspections of required work
5. Tree planting and transplanting
6. Research and development
7. Public education
8. Tree inventories, work management systems, and sundry computerized functions

While this industry has been around in some form or another since the first tree caused an outage on overhead lines, it is still relatively immature in many respects. For example, there still remains a wide spectrum of competence between how UVM activities are handled at each utility. There are many utilities that have comprehensive, well-funded, and very effective programs. Conversely, there still remain utilities that pay little attention to this important activity. They opt instead to look at UVM as a function best handled by the contractors.

TRANSMISSION AND DISTRIBUTION (T&D) UVM ACTIVITIES

While this investigation has focused on transmission UVM activities, it is important to note the relationship with distribution UVM operations. This discussion is necessary in that most utility companies have one program that deals with both transmission and distribution UVM activities. Additionally, many lower voltage transmission poles have distribution circuits located on them. This is typically referred to as "under-build facilities." While T&D UVM operations frequently share the same administration and oversight, there are important differences in the potential risks and general differences in the type of work that is performed. The following is a brief description of the types of work associated with each of these UVM programs.

Distribution UVM

Distribution Systems are Much Larger: By far, distribution UVM activities comprise the largest part of an electric utility's efforts in managing trees and vegetation near power lines. At many utilities, the distribution part of a program may utilize 80-90% of utility funding and resources for managing vegetation. This does not however mean that distribution UVM is any more important than transmission work, but rather, it is a by-product of having significantly more miles of distribution lines (and exposure) than transmission lines.

Distribution UVM is Typically More Public, More Complex and More Expensive: Distribution programs typically prune more trees than they remove, and the costs (on a per tree basis) are higher than equivalent work on transmission lines. This is primarily due to the fact that most distribution tree pruning or removal is done in front of someone's home, and on community streets. Distribution UVM work is more visible to the public, and as such, requires more upfront notification, coordination with agencies, and a greater amount of personal and public education prior to commencing the work.

Transmission UVM

Transmission UVM has Better Defined Rights to Perform Required Work: The primary difference between transmission and distribution UVM work can be summed up as follows. The vast majority of transmission rights-of-way (ROW) have documented provisions allowing the utility to clear and maintain the vegetation in order to provide safe and reliable electric power. These ROW easements give the utility a greater amount of control over the landscape than what is experienced adjacent to distribution lines. In the latter case, little if any documentation exists giving the utility the "specific" right to perform whatever UVM work is required to maintain the distribution lines free of vegetation.

Greater Risk of Arcing at High Voltage and Less Pruning: Given the greater rights associated with transmission UVM work, and the necessity of maintaining greater clearances due to higher voltages, it is common to see less pruning and more removals related to transmission work than are typically seen in a distribution program. The unit costs are also typically lower for transmission UVM work than are experienced in distribution activities (due in part to fewer customers and landowners to negotiate with). These documented rights also result in greater use of mechanical and chemical UVM tools on transmission rights-of-way. This includes various types of mechanical mowers and the wider use of appropriate herbicides.

CURRENT REQUIREMENTS FOR UVM WORK

There are a wealth of laws and regulations that encourage and/or direct utility companies to work toward the mitigation of transmission line outages. However, this direction is typically non-specific regarding UVM efforts. It appears that rather than rely on prescriptive requirements (telling utilities exactly how to achieve electric service reliability) most applicable laws and regulations are generic in their direction to utilities. The following example illustrates this point:

> Performance Based Ratemaking generally relies on encouraging utilities to meet or exceed performance goals (e.g., reduce outages). Rather than specifically require that all trees be maintained at a specific clearance, it is assumed the utility understands that one of the biggest threats to service reliability is trees and vegetation. Therefore, the utility would presumably work toward preventing these types of outages in order to achieve the defined goals.

While most laws, regulations, and incentives requiring UVM work are non-prescriptive, there are several current guidelines and regulations that mandate this work under certain circumstances.

The National Electric Safety Code (NESC) Rule 218

The NESC Rule 218 is the most widely adopted and referenced set of guidelines for UVM programs in the United States. It currently states:

A. General

1. Trees that may interfere with ungrounded supply conductors should be trimmed or removed. Note: Normal tree growth, the combined movement of trees and conductors under adverse weather conditions, voltage, and sagging of

conductors at elevated temperatures are among the factors to be considered in determining the extent of trimming required.

2. Where trimming or removal is not practical, the conductor should be separated from the tree with suitable materials or devices to avoid conductor damage by abrasion and grounding of the circuit through the tree.

B. At Line Crossings, Railroad Crossings, and Limited-Access Highway Crossings. The crossing span and the adjoining span on each side of the crossing should be kept free from over-hanging or decayed trees or limbs that otherwise might fall into the line.

The NESC Code has been adopted by most Public/State Utility Commissions by rule, and is used to provide direction and standards for electric utility companies. In the case of Rule 218, it has generally been interpreted as a set of guidelines that the utility should use in defining their UVM activities and goals.

At first glance, Rule 218 seems clear in its intent, but it has historically generated a great deal of industry discussion regarding what it actually requires. For example, the use of the word "should" versus "shall" points to its application as a general guideline, not a mandate. More importantly, Rule 218 does not specifically state that clearances should be "maintained" between energized lines and vegetation. While some have argued that it can be interpreted as a "no-touch rule", the industry has not interpreted it to require that mandatory clearances be maintained at all times.

Note: Rule 218 of the NESC is currently being reviewed by industry organizations to update and clarify the requirements. Having reviewed various proposed drafts, we believe the upcoming changes will help in clarifying the requirements for utility companies, and in providing better direction for managing vegetation adjacent to power lines.

Mandatory Clearance Requirements

California: Based on a 2002 national review[9] of laws and regulations, the California Public Utility Commission (CPUC) is the only utility regulatory body in the United States to have adopted mandatory clearance requirements[10]. California utilities must achieve and <u>maintain</u> prescribed clearances between high-voltage lines and any parts of trees or vegetation. This requirement is in effect 24 hours a day, 7 days a week, and is applicable in all Commission regulated areas of the state. Typical clearances that must be maintained between vegetation and transmission lines are: 230kV – 31.7 inches, 345kV – 84 inches, 500kV – 120 inches. The text of this rule (General Order 95, Rule 35) can be found in Appendix 'A'.

Alberta: The Province of Alberta has also promulgated mandatory clearance requirements. They can be found in the "Electrical Protection Act, Section 3.1.7 of the Alberta Electrical and Communication Utility Code. (See Appendix 'B' for the full text.)

Fire Prevention: While mandatory clearance requirements are not typical in Commission-based regulations, they are becoming commonplace in fire prevention requirements. As previously mentioned, trees or vegetation growing close to or contacting energized lines have the potential to start wildland fires. In an effort to prevent these occurrences, many local governments have

[9] Non-published survey conducted by the authors to determine the extent and nature of UVM requirements in the United States.

[10] Oregon has a "staff policy" that has been interpreted by some as a mandatory clearance requirement.

adopted and enforce mandatory clearance requirements. Common mandatory clearance requirements can be found in the Uniform Fire Code (UFC) and the Urban Wildland Interface Code (UWIC). These are both “model” codes developed by the International Fire Code Institute (IFCI) and adopted locally (or at a state level) as the standard community fire code. The text for mandatory clearance requirements taken from the Urban Wildland Interface Code can be found in Appendix ‘C’.

The key differences between the CPUC mandatory clearance requirements and those found in fire codes are related to the timing of enforcement and the geographic areas in which they are applicable. The CPUC requirement is applicable 365 days a year and is enforced throughout the state. The fire codes, on the other hand, are only applicable at times and in locations deemed appropriate by the fire official. For example, mandatory clearances for fire protection are not typically enforced during winter when the ground is covered by snow, or in downtown locations where no flammable ground cover is present.

Mandatory Clearances as a Way to Mitigate Future Transmission Tree-Related Outages

There are compelling arguments that suggest mandatory clearance requirements will not eliminate tree-line contacts. In fact, it can be argued that their adoption can create more problems than they may resolve. The following are several issues that should be addressed before adopting these types of standards.

1. **Efficacy:** We do not know if mandatory clearance requirements would prevent all tree-related outages. We do know that they should eliminate tree outages that are caused by “growth.” However, the majority of tree-related outages in North America are caused by trees or portions of trees falling into lines from distances that are typically located outside of what would be considered normal clearing zones. In other words, the biggest threat from trees is not presented by growth into a clearance zone, but rather by trees located outside of what would normally be pruned or removed.
2. **Enforcement:** In order to enforce mandatory clearance requirements, there must be no ambiguity regarding clearances encountered in the field. For example, if the standard says, “maintain 18 inches from 12kV lines” (as in California’s Rule 35[11]), it should be a relatively easy task to identify any violations in the field. While this is possible for distribution line clearances, transmission lines present a different challenge due to greater conductor sag and sway considerations. To enforce specific mandatory clearances on transmission lines, one would need to either inspect the lines at the maximum loading, or make complex calculations during the inspection to determine the maximum sag.
3. **Cost Concerns:** The adoption of mandatory clearance requirements in California resulted in a tripling of UVM costs for utilities. If such rules spread, the current annual multi-billion dollar figure needed to keep trees away from transmission and distribution power lines could increase significantly.

We do not know if the adoption of mandatory clearance requirements, in and by itself, would have prevented the type of tree-related incidents that occurred on August 14th. We have not performed, and are not aware of, any studies that have evaluated the efficacy of mandatory clearance requirements in preventing outages. However, if the utilities that experienced outages on August 14th had maintained certain clearances, based on system conditions such as load and ambient air temperature, it is unlikely that the outages would have occurred. These outages

[11] Fines can be levied against utilities in California for each violation of clearance requirements.

were caused by tree growth as opposed to some other condition outside of the right-of-way, and may have been prevented.

It is our opinion that a change in standards as significant as adopting mandatory clearance requirements will likely be controversial, with opponents arguing that such action could significantly raise energy costs to all consumers, without guaranteeing any major improvement in electric service reliability.

There are, nonetheless, valid arguments that mandatory clearance requirements would address some of the current industry problems. For example, in our experience mandatory clearance requirements have resulted in more adequate and consistent funding of UVM activities. They have also increased focus on these important activities, because failure to comply will often result in heavy penalties for the utility company.

We do not, however, believe that mandatory clearance requirements should be adopted without a further investigation into their efficacy, enforceability, and cost effectiveness. Our preferred approach to the development new standards and oversight of UVM operations is found in Section VI of this report.

Enforcement of "Cycles"

We are aware of one state regulatory body that has chosen to motivate and track UVM efforts by insisting that the utilities comply with specific vegetation management "cycles". We do not think that this is an appropriate method to ensure that all potential problems are addressed in a timely manner. In the following sections we will provide the rational for this, in addition to presenting information specific to the day-to-day impacts of UVM operations in both the US and Canada.

In order to understand the reasons why a cycle is not an sufficient remedy, it is important to first understand what a "cycle" actually is.

A "cycle" is a loosely defined term used by utility arborists to generally describe the time it takes to complete identified pruning or removal of certain trees on their entire electric system.

The following will illustrate how the term is typically used in the UVM industry.

The majority of utility companies have a systematic approach to scheduling routine work. Some use simple geographic grid systems, and others use the actual electric circuits for developing their work schedule. For example, let us assume that they schedule their work by electric circuit and that they have a total of ten circuits on their system. On day one, they begin patrolling the first circuit to identify required UVM work. As the work is identified, it is given to the UVM contractors to complete. After the first circuit is completed, the process starts all over on the next scheduled circuit[12]. This process proceeds sequentially until all of the circuits have been patrolled and the required work has been completed. If it took seven years to identify and then complete all of the required work, the utility would be considered to be on a seven-year cycle.

The actual spread for utility cycles industry-wide is anywhere from 1 to 10+ years. This wide divergence in "cycle lengths" is due to an extensive list of influences that are often uncontrollable and unpredictable. Examples include:

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[12] In this example, only one circuit is worked at a time. In reality, much of the circuit work is done concurrently.

Available Water: Water availability is probably the single largest determinant as to how fast a tree will actually grow. Withholding water will slow growth. An increase in water (particularly after a period of drought) will dramatically increase growth. This is a particularly important issue to address in drought-plagued areas of the US and Canada. For example, in the latter part of the 1980's, California suffered an extended and severe drought period that lasted several years. The impact on the general population of trees was a slowing of growth rates. This initially had a positive effect on utilities in that, as they were patrolling on their routine cycle, a significantly fewer number of trees required pruning. Unfortunately, the drought was followed by unprecedented rainfall that resulted in explosive growth throughout the impacted area. (This issue will be discussed in depth in the Precipitation and Tree Growth section.)

<u>How this impacts cycles:</u> Drought and increased rainfall can have a significant impact on cycles, particularly if the resources to perform the work remain static. For example, during an extended drought, tree growth is slowed, requiring that fewer trees need to be pruned on any given cycle. If fewer trees are pruned, the cycle will be shorter. Conversely, if rapid re-growth is experienced throughout a service territory, significantly more trees will need to be pruned, thereby extending the length of the cycle.

Other Environmental Influences: The urban and rural forests are routinely bombarded by various environmental threats. For example, Dutch Elm disease all but decimated the elm trees across the US. Sudden Oak Death currently threatens to kill large populations of trees in the West. Pitch Canker is another pathogen threatening conifers. As a result of an extended drought in Arizona and southern California, millions of trees have died or are in various stages of decline. Large populations of dead and dying trees are a threat to electric reliability.

<u>How this impacts cycles:</u> The trees in jeopardy, more often than not, are located near power lines. If a utility company has large populations of dead and dying trees near their lines, it has a responsibility to mitigate the additional threats to electric service reliability. With a typically fixed amount of resources, the utility must, out of necessity, prioritize the work that must be completed. If the choice is between continuing on a routine cycle or removing immediate hazards, the utility will typically address the emergency conditions first. If this occurs, the cycle certainly will be extended.

Shifting Priorities: Utility companies are under continual pressure to balance available resources with ever-changing priorities. For example, a utility company cannot predict whether or not its service territory will be hit with a massive storm three years from now. It is equally impossible to predict if thousands of poles, connectors, transformers, or other equipment will be found to have manufacturer defects and require replacement next year. As in the case of drought-killed trees, utility companies continually deal with an ongoing stream of emergencies and shifting priorities. With a limited budget, every utility must routinely adjust funding based on reasonable and changing priorities. For most UVM programs, this means that some years they will get additional funding, some years they will remain flat, and some years they will see a reduction of resources in order to address other more urgent priorities.

<u>How this impacts cycles:</u> If the UVM program receives additional funding (and they are not facing additional workload due to any previously mentioned anomaly) the cycle time should be reduced. If the UVM program funding is reduced, the cycle time may be extended.

Cultural and Regulatory Influences: While few people would argue against the necessity of UVM work, this does not translate into the utility being able to do whatever it feels is appropriate regarding the trees. The utility does not own the trees. In many cases, utility companies must adjust the amount of time and resources devoted to UVM work based on new legal requirements or changing industry standards. For example, communities across the country routinely adopt new tree ordinances. Many of these ordinances contain elaborate requirements for tree pruning and removal. These can include waiting periods, public meetings, and arborist reports before the required work can proceed.

<u>How this impacts cycles:</u> If new time-consuming requirements are added, UVM work will slow down and result in an extended cycle, again without regard to actual reliability needs.

How Does a Cycle Influence When a Tree Must be Pruned?

A “cycle” has very little, if anything, to do with when an individual tree must be pruned. The only connection is that the tree will typically be <u>evaluated</u> at least once during any given cycle. More to the point, some trees are pruned several times during any given cycle, and others will not be pruned for several cycles. The determination as to when a tree needs to be pruned or removed is (or should be) based on a tree- and site-specific inspection. And to be clear, each and every tree is completely different. Two identical species of trees, planted at the same time and located a mere 10 feet apart can differ by years as to when UVM work is actually required. Here is a very short list of the actual determinants of when a tree requires pruning or removal:

a. **The location of the tree in proximity to the conductors:** A tree planted directly underneath the conductors will require pruning at different intervals than the same aged species that is planted next to the conductors.

b. **The anticipated growth rate of the species:** Some species are known to be fast growing and some slow.

c. **Available water:** As previously mentioned, growth of individual trees is largely determined by available water. A tree planted in someone’s front yard, that is never watered, will require less frequent pruning than an identical tree next door that is routinely watered as part of the landscaping.

d. **Tree structure:** Decurrent (typically rounded looking) trees are candidates for directional pruning, which can effectively direct the growth away from the conductors. If the tree is adjacent to the lines (planted to the side of the conductors) this clearance might last in excess of 15 years. However, if the same tree is located directly beneath the conductors, the clearance may only last a fraction of the time. Excurrent (typically one main trunk) trees cannot be readily directionally pruned.

e. **The perceived threat to the electric lines:** If there are two identical trees and one of them is dead and leaning toward the line, it will be worked sooner than the healthy tree.

f. **The affected utility lines and equipment:** Utilities typically prioritize work based on such items as the line voltage, number of customers who could be impacted by an outage, and the geographic areas involved. For example, protecting transmission lines would receive a higher priority than an isolated distribution line. In this example, the transmission lines have a greater likelihood of arcing (due to the higher voltage) and would likely have a larger impact on customers, should a tree related outage occur.

These six items only touch on a few of the myriad influences that actually dictate <u>when</u> UVM work should occur.

Given the countless influences, and the historical inability to track and manage them from a technological and informational standpoint, we do not believe that adherence to a “cycle” is an appropriate measure of a utility company’s efforts. While the term “cycle” is still used in the industry, we are not aware of many utility companies that can claim they have “been on a consistent cycle” for any extended period of time. A cycle is, and always has been, a moving objective. Our preferred approach to the development of new standards and oversight of UVM operations is found in Section VI of this report.

IMPEDIMENTS TO COMPLETING REQUIRED UVM WORK – COMPETING INTERESTS

When we asked more than 50 utility companies in North America to list the government entities that “influenced” their UVM activities, we received the following response:

69% Requirements by State Highway departments
58% Requirements relating to local street tree ordinances
58% Rules specifically mandated by State Public Utility Commissions
46% Requirements related to “other” local ordinances
44% USFS/BLM or other federal agency requirements
42% NESC Rule 218
38% Other State mandated laws
18% Urban Wildland Interface Code
16% Uniform Fire Code
12% Other local fire codes

While these responses were from both transmission and distribution utility arborists, they do illustrate the significant problem of “competing interests” when it comes to performing required UVM work on transmission lines.

The problem can be summarized as follows:

- Utilities have the obligation to manage vegetation near transmission lines in order to provide safe and reliable electric service.
- This objective sometimes appears to conflict with other various interests on a local, state/provincial, and federal level.

Specifically, utility arborists look at the vegetation adjacent to power lines as a threat to service reliability and public safety. This same vegetation is viewed, by various other agencies and authorities, as primarily intended for landscaping, habitat, a community resource, a timber supply, etc. For many of these groups, the necessity of keeping the lines clear is subservient to their own requirements and authority.

A subtle yet tangible example of this conflict can be seen in the following DRAFT code language that has recently been proposed by certain highway/roadway officials. The proposed language states:

> "Appropriate trees should be selected for planting underneath overhead utility lines. Where space is available, larger trees should be planted along on the outside of the utility lines clearance area, with smaller trees underneath. This provides for the best opportunity to minimize the visual intrusion of the overhead utility line."

While the intent of that language may have been noble, it provides a clear example of how imprecise language can make a bad situation worse. Rather than recognize the necessity of overhead utility lines, this language stresses the need to minimize their "visual intrusion" by planting small trees underneath the lines, and larger trees adjacent to them. Unfortunately, a small tree can mean a giant sequoia in a 5-gallon bucket, and a large tree can be any species in a large container. If this language is adopted, and the suggestions implemented along transmission corridors, it will likely result in future outages and wasted money spent trying to keep the trees away from the lines.

This of course is not to say that all code language has been bad, or that it is not effective in reducing tree and power line conflicts. Many local tree ordinances and fire codes recognize and effectively address the problem of future tree and power line conflicts. A particularly good example of positive language can be found in the Urban-Wildland Interface Fire Code. It simply states that "no trees or vegetation can be planted that will grow within 10 feet of an energized line at maturity" (primarily applied to electric distribution, not transmission facilities or ROWs). This simple language, if adopted globally, would reduce the future likelihood of countless outages and fires, save a great deal of ratepayers' dollars, and actually improve the health and longevity of trees and vegetation by eliminating unnecessary pruning and removals.

In the following section, we will further discuss how various authorities and agencies also contribute to impeding required UVM work.

THE URGENCY OF THE WORK

The intent of any UVM program is to address the trees and vegetation <u>before they become</u> a problem. For example, when a tree is pruned for clearance, the intent on the part of the utility is to return to that tree right before it needs to be re-pruned. To prune it before it actually needs re-pruning can damage the tree and may waste money (if it really doesn't need to be pruned for another year or so, it makes sense to devote the available resources to address other, more immediate work). This balancing act often means that a utility will not re-work the tree until it is either already a threat to the lines, or will be in a few short months.

The difficulty in this situation is as follows. If the utility companies wait to schedule a pruning target until it is on the verge of becoming a problem, there is only a short period of time between identifying the required work, and completing it before it can result in a potential outage or fire.

Unfortunately, this short period of time is not often recognized as a legitimate concern by many of the groups or individuals who actually own the trees. Here are several examples of problems provided by utility arborists:

> **Location:** Maryland
> **Utility:** Large Investor Owned
> **Incident:** "One of the utility's contractors followed protocol to notify property owners about impending distribution tree pruning and selective removal activities. Door hangers were distributed in advance of the work and signed permission cards were obtained from property owners to allow for tree removals. A local (third party) resident complained about the pruning aesthetics and about the amount of tree removals in the area. Local elected officials were mobilized and interceded to have the tree work halted until an investigation by a State agency could be conducted. The agency performed the investigation as directed. The State agency alleged that the contractor trimmed in excess of the ANSI A-300 Pruning standard in many instances and violated various

aspects of another law governing trees on public rights-of-way. The utility challenged all of the allegations in their response, and continued negotiations with the State agency and the elected officials were required. The outcome was that most of the pruning issues were generally dismissed. Where trees were removed with property owner permission, the utility agreed to replant trees on the State right-of-way. In situations where the State was not willing to dismiss the pruning complaints on public rights-of-way, the State agreed to issue removal permits and the utility agreed to provide tree replacements. Total elapsed time of the work stoppage was approximately 1 year, and numerous storms occurred during the work stoppage."

Location: California
Utility: Large Investor Owned
Incident: "The local Public Works Director stopped the utility from completing identified and required UVM work on city trees in this particular community. The Public Works Director said he was getting too many phone calls complaining about the directional pruning and wanted the utility to stop for a few months till things settled down. The utility wanted to proceed but was told they could not prune any of the additional trees that had been identified as requiring work. Within two weeks, one of those trees caused a rather large outage that just happened to take out power to a good portion of this town (including City Hall). The Public Works Director immediately called the utility and told them to continue to do whatever pruning and removal was necessary to ensure they had no more outages."

Location: Arizona
Utility: Large Investor Owned
Incident: "Two examples of the Arizona utility not getting adequate clearance on the high voltage lines are as follows: The first is found on the Tonto National Forest where individuals limit the amount of clearance the utility can obtain. The utility has 176 acres of trees that could affect the reliability of the system under maximum load conditions. The utility has been working with the Forest Service at all levels from the District Forester, Forest Supervisor, Regional Forester and the Chief of the Forest Service to get a consistent vegetation management approach across all federal lands. The utility began this process in 1997 and to date has not been able to get a science-based approach on federal lands. The utility has finally gotten the Forest Supervisors in Region 3 to put together a working group to address these issues.

The next example is on the Navaho Nation which prevented the utility from removing trees over 9" in diameter at breast height (DBH) due to the Mexican Spotted Owl. The utility has 370 trees that could affect system reliability under loaded conditions. The utility has been working with the Navaho Nation to get these trees removed since 1998. The utility finally got approval from the Navaho forestry department to remove these trees on October 20, 2003. After one week of cutting, the Navaho Nation environmental department shut down our crews because they were not consulted."

It should be noted that we make no claim as to the accuracy of the facts behind any of the preceding examples. We have not been able to validate any of any of these occurrences and only include them as examples of the types of issues that are routinely encountered throughout North America.

THE INFLUENCE OF INDIVIDUAL PROPERTY OWNERS

Approximately 1-3% of all property owners who are notified of pending UVM work on their property initially refuse to allow the utility the right or access to perform the work. Fortunately, the majority of these "refusals" are resolved after further negotiations with the utility. Unfortunately, there still remain a small percentage of individuals who successfully stop the work. Such work stoppage, combined with current UVM scheduling methods by utilities, can temporarily increase the likelihood of outages or fires. The reasons for these refusals are numerous and can range from concerns over aesthetics to negative prior experiences with the utility and/or contractor.

While the percentage of refusals capable of causing problems (before being resolved) is estimated to be less than 1%, we need to recognize how that actually translates into exposure. To illustrate, if a utility manages 1 million trees adjacent to or under transmission lines, and is stopped from working on one-half percent of the trees, there could conceivably be 5,000 trees capable of causing a problem at any given moment in time. This exposure needs to be multiplied by the numerous utility companies who do indeed manage over a million trees in the US and Canada.

The issue, and exposure, of individual refusals is best illustrated by reviewing the outage that occurred on August 14th on Cinergy's Columbus – Bedford 345kV line (see Appendix 'D' for a detailed description of the incident). Had this refusal been on one of the lines that contributed to the blackout, it could have been accurately stated that an individual landowner was, from one perspective, largely responsible for triggering one of the worst outages in North American history.

Work on this span on the Columbus – Bedford 345kV line had been halted various times by the owner of the property. The owner of the property had severely limited the ability to achieve necessary clearances and to apply herbicides to control future growth. This landowner has successfully halted work from proceeding on several occasions. This included the homeowner obtaining a court-granted temporary injunction against the utility.

The required work was finally completed on October 9, 2003 as depicted in the photo below.

Another significant influence by individuals (and agencies) simply relates to planting the wrong trees in the wrong place. A very large percentage of trees that are currently managed by utilities simply do not belong there because they are too large and will, at maturity, cause conflicts. There are countless lower-growing species that can be safely planted and never require costly pruning or removal. We believe that if the public simply planted the right tree in the right place, hundreds of millions of dollars could be saved annually in unnecessary UVM maintenance costs, outages and fires would be significantly reduced, and the actual health of urban and rural forests would be dramatically improved.

TRANSMISSION RIGHT-OF-WAY (ROW) MAINTENANCE

As previously mentioned, transmission UVM work typically differs from what would be found adjacent to distribution power lines. Distribution UVM work is dominated by pruning and removing trees adjacent to distribution poles, which in most cases are in more populated areas. Conversely, transmission lines are typically located on towers and typically in more remote areas.

As a general rule of thumb, the higher the voltage, the more sensitive the line will be to tree-related faults. For example, uninsulated low voltage secondary lines (120/240 volts) can come in direct contact with vegetation and it will be highly unlikely that an electrical outage will occur. The same can be said for most typical primary voltage lines carrying 4-12kV. However, as we reach higher transmission voltages, the likelihood of an outage, due strictly to contact, is exponentially increased. As a result, utilities maintain typically larger clearances between vegetation and transmission lines than would be seen on a typical distribution line. Generally speaking, the higher the voltage, the higher the lines will be located above the ground, and away from the vegetation.

The following photos depict typical transmission and distribution facilities.

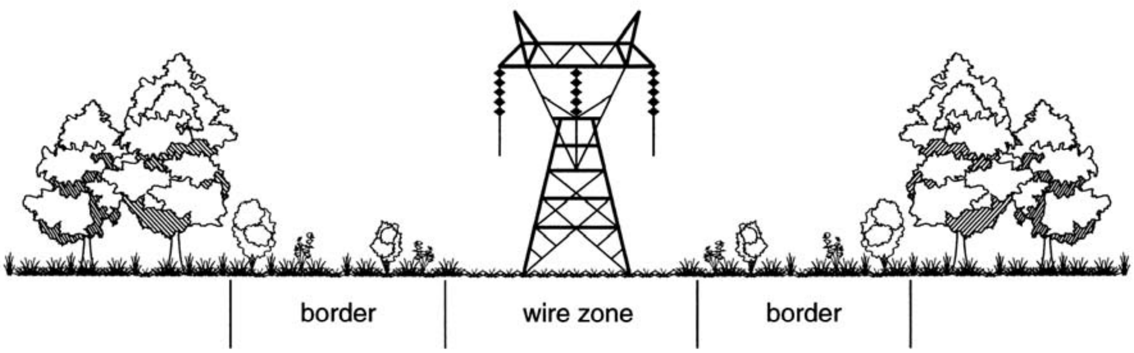
Transmission Line

Distribution Line

Ideal ROW Maintenance – Industry Consensus

There is industry consensus as to how a transmission ROW should be established and maintained. From an electric reliability standpoint, it simply requires managing vegetation so that it cannot grow into, or fall onto the energized facilities. It requires creating a predictable and low-growing environment of vegetation under and adjacent to the ROW. The following graphic illustrates this simple concept.

Bramble and Byrnes Wire Zone – Border Zone
(From Yahner, Bramble and Byrnes, 2000)



As the graphic describes, this concept is typically referred to as the Wire Zone - Border Zone model, and it has, based on years of research[13], been proven to be effective in reducing and/or eliminating outages related to vegetation on transmission ROWs. In addition, this research has proven that the Wire Zone - Border Zone model generates a great many more benefits than just reducing outages. These benefits include reduced long-term maintenance costs, improved habitat for wildlife, biodiversity, and wildland fire mitigation.

While we recommend that this model be used wherever possible, there are locations where this may not be practical. There are locations where transmission lines are not located on clearly defined and documented ROWs. These lines may also be located in more urban areas where the Wire Zone - Border Zone model may not be appropriate due to existing landscaping or property lines. With that said, we do believe that this model should be utilized whenever new lines are built, and wherever existing lines will allow. This model could and should be applied to the vast majority of transmission lines.

Reclaiming ROWs

The steps to effectively managing a transmission ROW from a UVM perspective are:

1. Design the line and obtain necessary easements and permits.
2. Build the line and establish the Wire Zone - Border Zone vegetation model utilizing appropriate Integrated Vegetation Management (IVM) techniques[14].

[13] Example: Bramble, W.C., W.R. Byrnes, R.J. Hutnick and S.A. Liscinsky. 1991. *Prediction of cover type of rights-of-way after maintenance treatments.* Journal of Arboriculture. 17:38-43.

[14] IVM is generally defined as the practice of promoting desirable, stable, low-growing plant communities that will resist invasion by tall growing tree species through the use of appropriate and environmentally sound control methods. These methods can include a combination of chemical, biological, cultural, and/or mechanical treatments.

3. On a scheduled and routine basis, return to the ROW and perform the necessary UVM work to “maintain” the vegetation consistent with the Wire Zone - Border Zone model.

Unfortunately, there are many locations throughout North America where this ideal cycle has been broken and resulted in overgrown and unmanageable transmission ROWs. It appears that this breakdown occurs when it comes to step three. While we know that routine scheduled maintenance on existing ROWs is cost-effective in the long-term[15], many utilities have allowed these Wire Zone - Border Zone areas (once established) to grow back. Once they have grown back, they require an even greater effort and expense to re-establish, or reclaim, what could have been simply maintained on a regular basis.

The reasons for this can be numerous, and occasionally out of the control of the utility. However, the utility may have also made a poor long-term decision to simply not perform the work in order to focus on more immediate issues, or to reduce short-term costs. Regardless of the reasons, the issue of not maintaining ROWs on a routine basis is relatively common in the industry.

Fortunately, many utility companies have recognized this problem and are taking active measures to “reclaim” these ROWs. Unfortunately, reclaiming ROWs is often a difficult and costly process. One example of these difficulties arises when a landowner plants landscaping within the ROW and the utility allows it to exist over an extended period of time. This problem is illustrated in the following picture taken a few spans away from the fault location that occurred on the Hanna – Juniper 345kV line.

Above, the landowner has planted a row of trees directly underneath the transmission lines. If the utility chooses to enforce the documented easement rights, it would be able to remove this

[15] Considerable research has been done that demonstrates that while initial clearing costs might be higher, they are usually reduced, and recouped, over time. It has also been demonstrated that “deferred” UVM maintenance will result in considerably higher long-term costs compared to just performing “routine” maintenance.

landscaping. Unfortunately, this would most likely cause a great deal of controversy between the utility and the landowner, and adjacent neighbors who would obviously notice the difference. This could lead to lengthy court proceedings in order to enforce those rights or create negative publicity for the utility company[16]. It is the anticipation of these types of occurrences that often complicates reclaiming transmission ROWs.

The issue of reclaiming ROWs should be important to the individual utilities, their regulators, and to the community at large, as it directly relates to the long-term cost-effective delivery of reliable power to the public. However, we need to recognize that these efforts are not a simple matter of just removing a large amount of trees and vegetation. Many influences can, and often do, limit the ability of a utility company to have 100% of their ROWs managed under an ideal model. Some examples of absolute and restrictive easement rights are contained in Appendix 'E'.

PRECIPITATION AND TREE GROWTH

As previously mentioned, available water can have a dramatic influence on the growth of trees and other vegetation. We were asked to investigate whether or not these environmental conditions that affect growth played a role in the August 14th Blackout.

The short answer to the question is that <u>we do not believe that the small increase in rainfall in 2002 was significant enough to have required the utility to increase or accelerate pruning efforts in an attempt to mitigate a potential outage</u>. The rainfall data (see Appendix 'F') show that while certain subject areas did experience above and below normal rainfall in the preceding three-year period, it was very close to normal in all years and was not significant enough to cause concern with respect to accelerated tree growth. The average rainfall, indicated as a percent of normal, for all areas reviewed is shown below:

2000 - 104%
2001 - 98%
2002 - 102%
2003 - (January through June) - 96%

This review suggests that rainfall was close to normal in the three years prior to the outage and therefore we believe it did not play an important role in contributing to the outages. While it is possible that a few particular species of trees may have shown increased growth, we do not feel this phenomenon would have manifested itself over the larger population of vegetation managed by any of these utilities.

The Industry Needs to Improve Their Understanding of How Available Water and Precipitation Can Influence UVM Programs: Our review did identify an important concern. We do not believe that the UVM industry actually considers precipitation to the extent necessary to effectively schedule work and adequately fund transmission UVM activities. As explained by Dr. David Wood in his report (see Appendix 'G'), available water can significantly alter the amount of required UVM work that a utility must perform in order to keep up with growth. Add to that the impact that drought can have on tree mortality, and we cannot escape the fact that available water and precipitation must be considered by utilities when they develop short and long-term plans for transmission UVM work.

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[16] This is a common problem for utilities. For example, recent news articles have illustrated this point with FirstEnergy in their attempts to become more aggressive in their tree pruning and removal efforts in the aftermath of the August 14th Blackout.

To illustrate the impact of available water on UVM programs, one only needs to look at southern California and Arizona during the past two to three years. As a result of extended droughts, both areas are currently facing massive tree mortality adjacent to electric T&D facilities. In southern California alone, utility companies are expected to spend several hundred million dollars over the next few years in order to remove dead trees that could fall into power lines and equipment (causing outages and/or fires). Arizona faces an equally severe problem of tree mortality in the largest contiguous pine forest in the United States.

Conversely, we are aware of at least one utility that was unprepared for explosive tree growth across a significant portion of its service territory, following an extended period of drought. In this case, the utility was required to employ extraordinary efforts to try and keep up with an onslaught of rapidly growing trees.

We do not believe that the industry currently considers available water to the extent they should in planning for, and responding to, required UVM work. There does not appear to be a good scientific model to accurately predict the influence of available water on the large populations of vegetation currently managed by utility companies. This is an important issue that needs to be addressed and recommend that the industry work toward the development of appropriate predictive models based on rainfall and available water data.

UVM FUNDING AND WORK MANAGEMENT

To develop an annual UVM budget, a utility must be able to answer the following two basic questions:

1. How much vegetation needs to be removed, pruned, or treated to prevent outages and fires?
2. How much does it cost to complete each unit of work?

If you know how much work you need to complete, and you know how much it should cost, it is simply a matter of multiplication.

Unfortunately, few utilities can answer the first question with any certainty. In fact, the vast majority of utility companies do not have an accurate inventory of the vegetation they manage, but rather rely on historic and often anecdotal work histories. For example, their forecasting ability could be limited to "the last time we did that circuit, it took us three months with four crews." This method of forecasting does not consider the myriad variables that continuously change the base workload. This status quo approach does not take into consideration such factors as precipitation, past tree removals, species growth rate variability, or new trees added to the base workload. All these influences significantly alter exactly how much work is necessary to be completed in a given timeframe. Simply put, the majority of utility companies cannot answer the fundamental question of "how much work do they actually need to perform?"

It has only been in recent years that the technology[17] has existed to develop and maintain accurate UVM inventories and systems capable of monitoring these millions of pieces of information. Of the small number of utilities that do currently have an accurate inventory and work management system, most have had to develop this technology internally. These utilities

[17] Database management tools that schedule work, track assignment and completion of work, billing, and other pertinent data.

have invested a great deal of money in the development of their systems, and have also had to invest in the costly and formidable task of accumulating the required data.

All medium and large utility companies should seriously consider the investment in inventories and work management systems. The argument for this expense is simply this: If one tree can take out power to millions of people and cost billions of dollars in lost revenue and damages to society, isn't it worth spending a few dollars per tree to document information that may very well prevent the incident from happening in the first place? We also believe that the cost for these systems will be reduced as more utilities opt for comprehensive data management systems.

The implementation of these systems will also address two frequently cited problems related to consistent and appropriate funding of UVM programs.

Perhaps the most common complaint we have heard over the last few decades has been that UVM budgets have been routinely reduced to fund other maintenance activities that are, in the opinion of the utility, more urgent in nature. It appears that whenever reductions in maintenance expenses are forthcoming at a utility company, it is often the UVM program that takes the first large hit. While it is appropriate to adjust UVM budgets based on a changing workload, UVM expenses should not be adjusted to balance budgets or fund other initiatives. <u>The utility should perform UVM work when it is appropriate</u>. Unfortunately, without an actual understanding of what UVM work needs to be performed, UVM budgets will continue to be a target for funding cuts.

The use of inventory and work management systems will address problems with many current ratemaking proceedings. Given the large expense associated with UVM in a non-Performance Based Ratemaking (PBR) proceeding, the utility should be required to justify the expenses based on facts, rather than anecdotal and historic information. The appropriate governing body should base rate recovery on the answers to the first two questions posed in this section: "How much vegetation needs to be removed, pruned, or treated in order to prevent outages and fires?" and "How much does it cost to complete each unit of work?"

While we recognize the challenges associated with developing and implementing inventories and work management systems, we believe that these systems will yield lower long-term UVM costs, and a greater ability to predict and prevent future tree and power line conflicts.

IV. FIELD INVESTIGATION

FIELD REVIEWS RELATED TO THE AUGUST 14TH OUTAGE

A review of available documentation and our field investigations at AEP and FE suggest that four of the line outages were, in fact, caused by conflicts between high voltage transmission lines and vegetation. Furthermore, had all these specific trees been pruned or removed prior to these outages, the blackout most likely would not have occurred.

The following contains an overview of our findings of AEP and FE line outages, and identifies contributing and/or mitigating factors. We will begin with a brief discussion of conductor sag, and follow this up with our investigation protocol and findings.

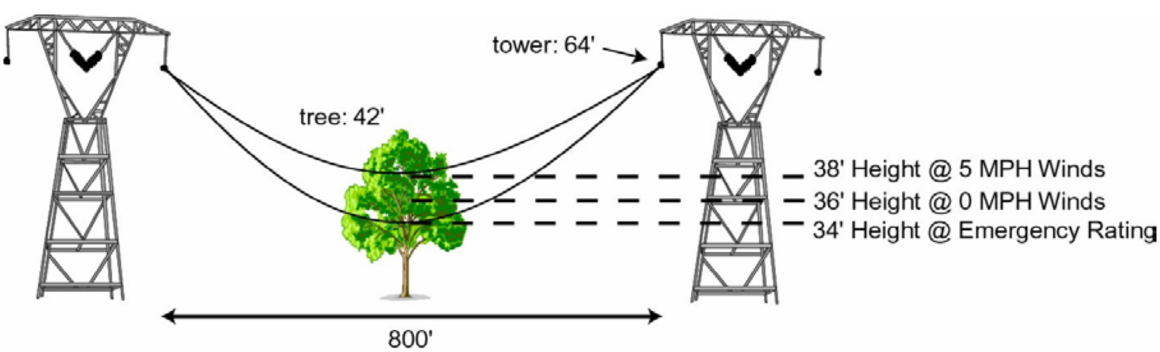
Conductor Sag

A key consideration during the design, construction, and maintenance of transmission lines is that of conductor sag. The height of transmission conductors does not remain static once they are installed, due in part to such factors as temperature and wind velocity.

Temperatures typically increase during the summer months, requiring additional power to accommodate air conditioning load. As the load increases over transmission lines, each line's temperature increases and the conductors, typically aluminum, expand. The effect of this expansion is a lengthening of the conductors, which causes them to sag closer to the ground.

The presence of wind also influences conductor sag. Wind provides a cooling effect on the conductors. This cooling of the conductors reduces the amount of sag that would be encountered in comparison to sag on a calm day.

The following graphic provides an example of how conductor height can vary depending on load and wind velocity.



Field Investigation Protocol

The vegetation management investigation team consisted of Richard Dearman (TVA), Saeed Farrokhpay (FERC), and Stephen Cieslewicz and Robert Novembri of CN Utility Consulting. The investigation consisted of a review of prepared responses and documents provided by AEP and FE, field visits to one suspect location at AEP and three suspect locations at FE, and interviews with AEP and FE contract personnel. Appropriate photographs, GPS readings, measurements and calculations were made at each location.

General Findings

Overgrown trees, as opposed to excessive conductor sag beyond design, appear to have been the cause of these faults.

Each of these lines was predisposed to fault under system sag conditions well within normal operating parameters.

- Incremental increases in amperage and temperature caused an incremental sag increase on the Stuart – Atlanta (AEP) line causing it to fault and lock out due to contact with vegetation.
- Incremental increases in amperage and temperature increased the sag on the Star – South Canton (FE) line causing it to fault and reclose due to contact with vegetation. This line tripped three additional times over a period of 1¼ hours before locking out.
- Incremental increases in amperage and temperature increased the sag on the Chamberlin – Harding (FE) line causing it to fault and lock out due to contact with vegetation.
- Again, incremental amperage and temperature increases, escalated by the loss of the Chamberlin – Harding line caused further incremental sag increases on the Hanna – Juniper (FE) and it faulted and locked out due to contact with vegetation.

We have field evidence of tree contact at three locations. At the fourth location, Hanna – Juniper, the tree was removed before we arrived, but the fault was visually (time/date) confirmed during the occurrence and pictures of the tree before it was removed support the visual observation. We also have a revised calculated fault location, provided by FE, for the Star – South Canton line that matches the location of the visually confirmed tree fault.

Thus, while conductor sag may have contributed in a small way to these events, the direct cause of these incidents was overgrown trees.

FAULT CHRONOLOGY, OBSERVATIONS AT FIELD SITES AND COMMENTS

Stuart – Atlanta (345kV) AEP[18]

14:02:00.0 Line trips and locks out.

No calculated fault location was provided by AEP for this outage.

Evidence of tree contact was observed between towers 222 and 223. Conductor height of north phase measured 39 feet at tree location and point of contact. Center phase measured 41 feet and south phase measured 47 feet.

Trees and brush were felled on or after August 14th. Debris was left on site and inspected.

Two ailanthus trees showed evidence of significant fault current damage and were de-barked. One measured 2.5" diameter at ground line, and the other measured 6" diameter at ground line..

[18] The Stuart-Beatty 345kV transmission line is jointly owned by Cinergy, Dayton Power & Light (DP&L) and AEP's Ohio operating company Columbus Southern Power. AEP is responsible for conducting patrols, vegetation management, maintenance and repair of the Stuart-Beatty 345kV transmission line. The Stuart-Atlanta 345kV circuit (a portion of the Stuart-Beatty transmission line) is under the dispatching authority of DP&L and is in DP&L's control area. On occasion, DP&L has performed emergency patrol of the circuit and has referred any problems found to AEP for correction.

Both trees were estimated to be 30 to 35 feet tall. Other trees in the area showed evidence of fault current damage as well.

The following readings were provided by AEP at the approximate time conductor height measurements were taken.

Time: 10:00 EDT
Date: 10/22/03
Temperature Reading: 55.6°
Wind Speed: N/A
Conductor Height: 39’

Loading:
Stuart – 950 amps
Atlanta – N/A

Star – South Canton (345kV) FirstEnergy

14:27:15.880	Line trips and recloses (both ends).
15:38:47.770	Line trips and recloses (both ends).
15:41:33.43	Line trips and recloses (both ends). Retrips at South Canton.
15:42:07.0	Line recloses at South Canton, retrips and locks out. Line already open at Star.

Calculated Fault Location[19] (revised): 20.5% from Star Substation, Span 40375 – 40376

Inspected conditions at structure 40404 and right-of-way toward 40401 (between 6.7% and 8%). No vegetation conflicts observed in this area. Did not review 40399 (9.1%).

Inspected tree conditions at structure 40376 (20.5%) between towers 40375 and 40376. Trees and vegetation were felled on or after August 14th. Debris and tree parts were inspected on site.

Conductor height measured 44' 9". Tree height measured at 30 feet, although we could not verify location of the stump, or missing section of tree. Obvious significant fault damage to clustered trees. Charred limbs, and de-barked by fault current.

[19] The calculated distance from a substation, based on the total distance between substations, represented as a percent.

Topsoil in the area of trunk was disturbed, discolored and broken up at site. This is indicative of a higher magnitude fault or multiple faults.

Fourteen year-old tree in the middle of the right-of-way was recently removed.

The following readings were provided by FE at the approximate time conductor height measurements were taken.

Time: 14:14 EDT
Date: 10/16/03
Temperature Reading: 47°
Wind Speed: 1 mph (Wadsworth, OH)
Conductor Height: 44' 9"

Loading:
Star – 836 amps
South Canton – N/A

Harding – Chamberlin (345kV) FirstEnergy

15:05:41.0 Line trips and locks out.

Calculated Fault Location: 11.3% from Chamberlin Substation, Tower 42852

No evidence of vegetation at calculated fault location (11.3%). See photo below.

At 17.7%, between towers 42861 and 42860 we inspected vegetation. Trees and brush were felled on or after August 14^{th}. Conductor height measured at 46' 7", tree height measured at 42'. Locust tree showed evidence of fault current damage. Tree damage indicated a lower level of fault current.

Burn marks were observed at 35' 8" up tree. Portions of the tree had been removed from the site making it difficult to determine exact height of contact, implying that the measured height is a minimum, and likely 3-4 feet higher than verifiable.

Other vegetation along the right-of-way measured between two and five inches in diameter at ground line. The following photo depicts a tree located in the right-of-way that was over six years old, as indicated by the growth rings.

The following readings were provided by FE at the approximate time conductor height measurements were taken.

Time: 11:58 EDT
Date: 10/16/03
Temperature Reading: 47°
Wind Speed: 2 mph (Wadsworth, OH)
Conductor Height: 46’ 7”

Loading:
Chamberlin – 405 amps
Harding – 400 amps

Hanna – Juniper (345kV) FirstEnergy

15:32:03.0 Line trips and locks out.

Conductor height measured 48' 9" at fault location. No evidence of tree debris at site. Walnut tree stump measured 14" diameter at ground line.

Subsequent clearing left trees and brush that, in our opinion, could have been removed as indicated by the photo below on the left. This photo was taken in the same span as the fault occurred. Other trees were pruned and left in the right-of-way as part of a landscaped area as indicated by the photo on the right. This photo was taken within one span of the fault.

The contract foreman who witnessed the event on August 14th was interviewed. He described the fault and provided a definitive time and date for the contact incident.

Per FE field personnel, the schedule for completing work on this circuit had been advanced by one year. In fact, FE's October 31, 2003 response indicated that this circuit was scheduled for regular maintenance in 2003 and work was underway in close proximity to the fault.

South phase, where contact occurred, is lower than the center phase due to construction design. Subsequently, FE provided photographs that clearly indicate that the tree was of excessive height.

The following readings were provided by FE at the approximate time conductor height measurements were taken.

Time: 09:31 EDT
Date: 10/16/03
Temperature Reading: 44°
Wind Speed: 3 mph (Wadsworth, OH)
Conductor Height: 48' 9"

Loading:
Hanna – 900 amps
Juniper – 970 amps

Columbus – Bedford (345kV) Cinergy

12:08:40.0 Line trips and locks out.
18:23:00.0 Line returned to service.

We also performed an initial review of a transmission fault experienced on the Cinergy system on August 14th in Indiana. While it does not appear that the fault was connected to the blackout, this situation does provide a very good example of the obstacles placed in front of utilities that are attempting to manage vegetation near overhead power lines.

Based on discussions with Cinergy, this transmission line fault occurred as a result of tree contact in one span of the Columbus – Bedford circuit. The photo below was taken prior to August 14th.

Apparently work on this span had been halted various times by the owner of the property. The owner of the property had severely limited the ability to achieve necessary clearances and to apply herbicides to control future growth. While Cinergy does, in fact, have documented rights to perform this work (documented easement), this landowner has successfully halted work from proceeding on several occasions. This included the homeowner obtaining a court-granted temporary injunction halting work by Cinergy. Note: the required work was finally completed on October 9, 2003 as depicted in the photo below.

We bring this up to illustrate that there are many hurdles every utility company must face when trying to maintain lines clear of vegetation. In this particular case, it was a landowner that halted work. In other cases we are aware of, it can be local, state, or even federal agencies that hinder progress. See Appendix 'D' for a detailed description of this incident.

V. UVM PROGRAM ASSESSMENTS

Introduction

This section of the report contains the results of our UVM program assessments for AEP, FE, and Cinergy. We will begin with a brief description of the methods we used to perform these assessments, followed by general commentary and recommendations regarding our assessment of all three UVM programs. This will be followed by utility-specific findings and recommendations.

Method of Assessments

This section of the report covers all items related to the following original task:

> Collect and analyze information and data regarding transmission right-of-way vegetation management practices of three electric utility companies in order to assess the strengths and weaknesses of each company's vegetation management program. The utilities included AEP, FE, and Cinergy.

In order to satisfy this objective, a review of each utility's vegetation management program was completed to assess each company's effectiveness and to provide comparisons to industry benchmarks. These assessments included performing the following key tasks:

1. Conducted field investigations (AEP and FE only)
2. Evaluated responses to prepared initial data requests
3. Conducted interviews with key personnel
4. Evaluated responses to follow-up data requests and supplemental inquiries

In addition, the following documents, manuals, and procedures were reviewed for each utility:

Tariff Process	Work Histories
Easements	Work Processes
Permits	Budgets
Ordinances	Outage Reporting
UVM Program Standards	Compatible Tree Lists
Maintenance Standards	Ohio PUC Outage Filings
Program Structure	Ground Patrols
Contracts	Aerial Patrols
Computer Systems	Commission Requirements (See Appendix 'H')

The resulting information was then compared to UVM industry practices and programs in both the US and Canada[20].

General Commentary and Recommendations

Our general findings are that all three UVM programs are consistent with what we would currently expect to see at other utility companies in this industry. There are certainly differences in the strengths and weaknesses of each program, but in general, we uncovered no evidence to suggest that any of these UVM operations could be considered sub-standard compared to the

[20] Based on our comprehensive and industry-reflective UVM benchmarking study.

rest of the industry. All three utilities have an adequate UVM program in place that reasonably satisfies the limited requirements set forth in current industry requirements and standards.

However and as illustrated in various sections of this report, we do not believe that the "current" industry requirements and standards are adequate to require utility companies to achieve the level of UVM necessary to improve reliability by reducing tree-caused transmission outages. If compared to the "best management practices" outlined in Section VII of this report, all three utilities would have sub-standard programs[21].

While all three utilities have programs consistent with what is expected of them based on the status quo, and regardless of whether new laws, regulations, or requirements are promulgated, we strongly encourage each of the three utilities (and all others) to consider the following recommendations:

1. Consider adopting the Best Management Practices as defined in this document.
2. Consider adopting the utility-specific recommendations found in the following sections.
3. Work with appropriate officials and the public to remove obstacles to completing the required work in a timely manner.
4. Consider performing routine UVM program assessments.
5. Work toward developing a Best-In-Class UVM program.

We also recommend that each of the utility companies consider direct involvement with The National Arbor Day Foundation's Tree Line USA program, and the EPA's Pesticide Environmental Stewardship Program (PESP)[22]. While these voluntary programs do not necessarily ensure any improvements in preventing outages, they both require that utility company members focus on correctly managing transmission ROWs and performing the work in a manner that is consistent with industry accepted practices. We believe that Tree Line USA and PESP participation are baseline indicators of a competent UVM program.

In the following section, we provide detailed information, analysis, and specific recommendations for each of the three utility UVM programs. While we are confident of these findings, it is important to note that there are hundreds of processes and procedures that could be evaluated for each of these UVM programs. We have tried to focus on the larger issues for each of the utilities. We have provided a comprehensive side-by-side comparison between these utilities, and the UVM industry, at the end of this section.

[21] If the same standard was applied to the rest of the industry, there would be only a handful of utilities in the industry that could suggest they were themselves above sub-standard.
[22] Detailed information regarding these programs can be found at the following links:
http://www.epa.gov/oppbppd1/PESP/about.htm
http://www.arborday.org/programs/treelineusa.html

AMERICAN ELECTRIC POWER (AEP)

Following the general information regarding AEP and its UVM activities, this section provides a brief discussion of key program elements, and then our findings and recommendations for AEP's UVM program.

Utility Description

AEP is one of the largest electric utility companies in North America and currently serves approximately 4.9 million electric customers in Arkansas, Indiana, Kentucky, Louisiana, Michigan, Ohio, Oklahoma, Tennessee, Texas, Virginia, and West Virginia.

Description of Transmission UVM Program

AEP manages vegetation along approximately 38,000 miles of transmission line within its entire service territory. This includes managing approximately 103,812 acres of vegetation, and 437,400 individual trees adjacent to transmission facilities and lines.

Involvement with the August 14th Blackout

AEP experienced a tree-related fault on the Stuart – Atlanta 345kv line on August 14th at 14:02 hours.

> ***Discussion:*** This incident occurred as a result of overgrown trees and as such, could be classified as an "avoidable" outage. (See discussion below on "service reliability")

Key Program Elements

<u>Organizational Structure</u>
AEP's UVM program is centralized with a full and part time in-house staff reporting to a System Forester. These employees oversee the work of 43 contracted transmission UVM crews.

> ***Discussion:*** AEP's organizational structure is consistent with what we would expect to see at an equivalent utility.

<u>Current System Conditions</u>
AEP reported that less than 2% of trees on their system are either potentially in contact with electric transmission lines at any given moment, or in contact with the lines at the time of pruning.

> ***Discussion:*** Industry benchmarking indicates that the average for either situation is approximately 1% or less of the total population of trees adjacent to transmission lines. AEP's claim is within the range we would consider normal for transmission lines.

<u>Service Reliability</u>
AEP reported that 25% of historic tree-related outages could be considered "avoidable[23]" whereas the remainder would be classified as "unavoidable[24]." This is consistent with industry benchmarks.

[23] Typically attributed to tree growth or hazardous trees that should have been identified as potential hazards.
[24] Typically attributed to trees, or portions thereof, outside of the normal clearing zone that fall or are blown into high voltage conductors.

Discussion: The majority of utilities track and differentiate between "avoidable" and "un-avoidable" tree-related outages. These differentiations allow a utility to track, and hopefully reduce those outages that could be prevented by routine work. Currently, approximately three fourths of tree related outages in the UVM industry are categorized as unavoidable (could not have been avoided given current requirements and standards). The remaining 25% could conceivably have been avoided had required UVM work been completed prior to the outage. (Note: the use of consistent definitions of "avoidable" and "unavoidable", and the rigor of their application, is discussed in a later section)

Contracting

AEP competitively contracts out the following UVM activities to qualified vendors: Pruning & removal, ROW clearing, Tree Growth Regulators (TGR), Herbicide application, Pre-inspection, and clerical support. AEP relies primarily on Time & Material (T&M) contracts (99%) but does also utilize a few unit price and lump sum contracts. The typical duration of the T&M contracts is five years. AEP currently has five different vendors working under these contracts.

Discussion: AEP's contracting practices are consistent with the industry.

Work Techniques

AEP reported that it complies with industry-accepted pruning standards found in ANSI A300[25], and other often-referenced publications. AEP stated that 100% of lines are managed utilizing appropriate Integrated Vegetation Management (IVM) techniques.

Discussion: AEP's stated work techniques and referenced standards are consistent with the industry

Historic Budgeting

The following are AEP's "budget" versus "actual" expenses for transmission UVM program activities:

Year	Budget	Actual	
1998	$[redacted]	$[redacted]	(REDACTED)
1999			
2000			
2001			
2002			
2003		N/A	

Discussion: While there are minor anomalies between budget and actual, they are not significant enough to cause us any concern.

[25] ANSI A300 is the industry consensus standard which describes proper pruning near power lines.

Historic Completed Work

AEP provided the following summary of completed Transmission UVM work by year:

Year	Trees Pruned	Trees Removed	Acres Mowed	Acres Treated
1999	14,014	53,611	576.5	2,478.86
2000	15,759	42,250	882.94	2,962.86
2001	9,348	30,205	821.73	3,097.72
2002	10,723	21,591	722.59	4,335.67
Projected 03	15,000	23,000	1,000	4,450

Discussion: These statistics illustrate common and expected trends in a transmission UVM program. For example, tree removals are consistently higher than trees pruned, which indicates a correct focus of resources. Also, a consistent increase in the number of acres treated typically indicates that more of the system is being managed proactively, as opposed to reactively.

Cycles

AEP states that their transmission UVM program is on a cycle that does vary upon the types of transmission facilities and locations. AEP's stated cycles for performing UVM work are as follows:

Urban/Suburban – 2-4 yrs
Rural – 6-8 yrs

Discussion: The majority of transmission UVM programs have varying cycles that are consistent with those claimed by AEP.

Patrol Methods and Frequency

AEP indicates they patrol their lines "generally, once a year" and employ an outside helicopter company to provide the service. We could not determine, based on data request responses, exactly how many ground patrols, if any, occur on a regular basis. However, it important to note that an aerial patrol was performed on the Stuart – Atlanta circuit that experienced an outage on August 14th:

Stuart – Atlanta: An aerial patrol conducted on June 25, 2003 resulted in no vegetation related problems being observed.

Discussion: There seems to be a wide gap in the industry regarding the frequency and method of patrolling transmission lines. Some utilities rely, as appears to be the case with AEP, on annual aerial patrols, while others may rely more heavily on ground patrols. In general, a combination of both methods seems to be the norm. In addition, routine inspections by the utility are complemented by a great deal of patrolling and observation during pre-inspection of routine UVM work.

Influences on Work Progress

AEP states that the following laws and regulations apply to their UVM operations:

NESC Rule 218
State Highway Requirements
Local Street Tree Ordinances
Other Local Ordinances

AEP states it does not work under mandatory clearance requirements, but that its work is influenced or hindered by local ordinances.

We reviewed easement documents for the location of the outage on the Stuart – Atlanta 345kV line and found no restrictions that would have precluded the required work from being performed prior to the outage.

Sag and Sway
A review of AEP's Goals, Procedures & Guidelines for T&D Line Clearance Operations and Contract Specification, revealed no reference to consideration for sag and sway during pruning and removal operations.

> ***Discussion:*** Unfortunately, most utilities do not provide specific direction to the UVM workers regarding how to take conductor sag and sway into consideration when deciding site-specific clearances to be achieved during routine work. This is an area that warrants attention, and improvement, by the industry.

Engineering Assumptions
A high level review of AEP's engineering assumptions regarding line ratings, line sag, and line clearances was performed (See Appendix 'I'). The following areas of concern were noted during the review.

1. The basis for the assumed ambient temperature used for line ratings is unclear.

Findings and Recommendations

AEP's UVM programs and program attributes are consistent with what we would expect to find at a similarly sized utility, working under the same requirements and conditions. It is not a best-in-class program, nor would we consider it to be substandard. There are both strengths and weaknesses worth mentioning.

AEP seems to have a competent UVM organization and strong support from upper management. AEP also maintains a visible and positive presence within the UVM industry. They have a history of active industry involvement and have contributed in many ways to the progress of this industry. In fact, several AEP UVM employees (past and present) have been recognized by the industry for their specific contributions.

While AEP has not obtained The National Arbor Day Foundation's (NADF) Tree Line USA[26] designation (see #1 below), they are the only one of the three utilities to be an active member of EPA's Pesticide Environmental Stewardship Program[27] (PESP). While this program does not ensure any improvements in preventing outages, it does require that utility company members focus on correctly managing transmission ROWs and performing the work in compliance with industry accepted practices. As with the NADF Tree Line USA designation, we believe that PESP participation is a baseline indicator of a competent UVM program.

While we did not uncover any major negative revelations during the review of AEP's transmission UVM program, we will provide the following observations and recommendations:

[26] http://www.arborday.org/programs/treelineusa.html
[27] http://www.epa.gov/oppbppd1/PESP/about.htm

1. AEP should consider working toward obtaining the NADF's Tree Line USA designation. In addition to helping the utility stay focused on important activities such as worker training, public education, and the use of proper tools and techniques, this designation acts as a baseline measurement of overall program efficacy. In other words, we would expect that any utility company that wishes to have a "Best-in-Class" UVM program would first obtain the Tree Line USA designation. This is a basic measure of general UVM competence and we encourage all utilities to achieve this designation.

2. While annual aerial patrols may be consistent with industry standards, given their obvious limitations[28], we believe that these should be validated through routine ground patrols. AEP needs to review and modify the frequency and methods of patrolling for the identification of vegetation-related problems. Based on the following, it is apparent that the current patrolling methods and frequency were not adequate to prevent the August 14th outage on the Stuart – Atlanta 345kV line.

   A patrol completed on the Stuart – Atlanta line on June 25, 2003 by a helicopter service and by using an AEP Transmission Line Mechanic, identified no vegetation related problems. Fifty days after this aerial patrol, August 14th, the outage occurred on the Stuart – Atlanta 345kV line from tree/conductor contact.

   It appears that the tree(s) that caused the August 14 outage should have been identified during the preceding aerial patrol. If they had been, this specific outage should not have occurred. While helicopter patrols are both necessary and efficient in most cases, they do have inherent problems when it comes to identifying potential vegetation clearance issues because you cannot consistently and accurately determine the distance between vegetation and conductors from the air. In cases where there is <u>any</u> question regarding clearances observed from the air, we recommend a follow-up ground patrol.

3. While the AEP Transmission Operations department does perform monthly checks of transmission outage reporting statistics, AEP should review current "tree related outage" reporting procedures. Several responses to our data requests raised concerns about AEP's focus on outage reporting. AEP reported eleven tree-related transmission outages in 2002 on transmission circuits rated 138kV and below. Nine of these outages were reported as being caused by trees "inside" of the right-of-way and two were reported as being caused by trees "outside" the right-of-way. Without additional information on the specifics of these events, we can only conclude that the majority of these outages should have been classified as "avoidable", versus "unavoidable." As previously mentioned, AEP claims that 75% of outages in 2002 were "unavoidable." It is possible however that there could be explanations for this apparent anomaly, and suggest it be looked at in more detail.

   Other reasons for suggesting a review of "tree-related" outage reporting procedures has to do with an apparent problem in the industry that is not unique to AEP. Benchmarking indicates that there may be a problem with outage reporting accuracy at many other utilities in North America. In fact, 50% of reporting utilities in our benchmarking study suggested that there needs to be improvement in this area. Statistics on tree related outages (for both transmission and distribution) may be inflated or under-stated due to inaccurate reporting procedures. We recommend that all utilities validate current procedures and protocols and the accuracy of their reporting.

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[28] Three of the four lines whose tree contact led to the cascading blackout were aerially inspected in the Spring of 2003.

4. AEP should initiate a program that identifies and prioritizes transmission ROWs that require re-claiming. Documented easement rights should be fully exercised where possible, and it should be the objective of AEP (and all utilities) to prevent ROWs from becoming unmanaged and overgrown. The common thread between the August 14th tree-related outages on AEP, FE, and Cinergy's systems was that none of these ROW locations had been fully managed in a manner consistent with the documented rights to do the work. A ROW that has been consistently managed utilizing proper IVM techniques and Wire Zone - Border Zone concepts significantly reduces the likelihood of future tree and power line conflicts.

5. Finally, given our general finding here that the status quo industry practices are not adequate, we recommend that AEP consider adopting all of the general recommendations referenced in this document. AEP should work toward incorporating all Best Management Practices into their program and work with appropriate parties, including utility regulators, to remove obstacles to completing required work.

FIRSTENERGY (FE)

Following the general information regarding FE and its UVM activities, this section provides a brief discussion of key program elements, and then our findings and recommendations for FE's UVM program.

Utility Description

FirstEnergy Corp. is a holding company made up of seven electric utility operating companies, Ohio Edison, The Illuminating Co., Toledo Edison, Penn Power, Penelec, Met-Ed, and Jersey Central Power and Light. It has a service territory of 36,100 square miles and serves 4.3 million customers. It operates in the states of Ohio, Pennsylvania and New Jersey.

Description of Transmission UVM Program

FE manages approximately 283,445 trees and 56,405 acres along its 35,796 miles of transmission line, rated at 69kV and above.

Involvement with the August 14th Blackout

As indicated in our Initial Report, there were three transmission outages on the FE system that contributed to the degradation of the system and subsequent blackout. Tree/conductor contact occurred on the Star – South Canton 345kV line, the Harding – Chamberlin 345kV line, and the Hanna – Juniper 345kV line. A more detailed discussion about these incidents is contained in the Field Investigation portion of this report.

Key Program Elements

Organizational Structure

FE's UVM program is structured as a de-centralized[29] organization with a full-time staff of 25 in-house employees and 6 contract foresters. Field staff is distributed throughout the FE service territory and report up through various operational organizations. The program is overseen by a System Forester, or equivalent, and corporate UVM staff. These employees oversee the work of 39 contract transmission crews and a larger number of distribution crews. The reporting structure is as follows for both the Corporate and Regional organizations:

Corporate Positions	Regional Positions
Vice President, Energy Delivery	Region President
Director, T&D Support	Director, Regional Operations
Supervisor, Distribution Forestry	Forestry Manager, Regional Operations
Distribution Specialist, Distribution Forestry	Distribution Specialist, Regional Operations

> ***Discussion:*** FE's organizational structure, although not typical in the industry, is consistent with what we would expect to see at a corporation with various operating companies. While we would prefer to see all UVM activities at a company to be centralized, there may be valid reasons at FE for this particular structure. Because FE is structured in this way, there may be inconsistencies in operational procedures linked to either its organizational structure, or the process of integrating acquired entities. (See FE Findings and Recommendations)
>
> .

[29] More than one department has responsibilities for the UVM program.

Current System Conditions

FE indicates that, to the company's knowledge, there are currently no trees in contact with electric transmission lines. No response was provided regarding contact with transmission lines at the time of pruning. (Note: No further inquiry was made as to the basis of the "to our knowledge" response.)

> ***Discussion:*** Industry benchmarking indicates that the average for either situation is approximately 1% or less of the total population of trees adjacent to transmission lines.

Service Reliability

The following provides historical information regarding "avoidable" versus "unavoidable" outages on the FE system.

Year	Avoidable	Unavoidable
2000	75%	25%
2001	57%	43%
2002	25%	75%

> ***Discussion:*** As previously noted, the majority of utilities track and differentiate between "avoidable" and "un-avoidable" tree-related outages. These differentiations in theory allow a utility to track, and hopefully reduce those outages that could be prevented by routine work. Currently, approximately three fourths of tree related outages in the UVM industry are categorized by the reporting utilities as unavoidable (could not have been avoided given current requirements and standards, and typically attributed to trees outside of the standard clearance zones). The remaining 25% could conceivably have been avoided had required UVM work been completed prior to the outage. The current ratio at FE is consistent with the industry average.
>
> Note: We have no definitive explanation for the significant shift from avoidable to unavoidable outages between 2000 and 2002 as reported by FE. In general, this could be consistent with a change in the accuracy of outage reporting and/or an overall improvement in program efficacy. Another possible explanation could be related to the small number of outages that are reported on transmission lines annually. A small shift in outages from avoidable to unavoidable can cause a significant swing in these percentages.

Contracting

FE competitively contracts out the following UVM activities to qualified vendors: Pruning and removal, right-of-way clearing, inventory work, pole clearing, R&D, clerical support, and herbicide and tree growth regulator applications. FE utilizes a combination of Time and Material (T&M) and Lump Sum contracts that are competitively awarded. The typical duration of these contracts is one year with some multi-year contracts being awarded. FE currently has eight different vendors working under these contracts.

> ***Discussion:*** FE's contracting practices are consistent with the industry.

Work Techniques

FE reported that it complies with industry-accepted pruning standards found in ANSI A300, and other often-referenced publications. FE stated that 100% of lines are managed utilizing appropriate Integrated Vegetation Management (IVM) techniques.

Discussion: FE's stated work techniques and referenced standards are consistent with the industry.

Historic Budget

The following provides a comparison between FE's "budget" versus "actual" expenses for transmission UVM program activities:

Year	Budget	Actual	
2000	$[redacted]	$[redacted]	(REDACTED)
2001	[redacted]	[redacted]	
2002	[redacted]	[redacted]	
2003	[redacted]	n/a	

Discussion: There are no significant deviations in expenditures that would cause us to be concerned.

Historic Completed Work

FE tracks the number of trees pruned or removed by year and they track the acres treated and mowed per year on their transmission system:

Year	Trees Pruned	Trees Removed	Acres Mowed	Acres Treated
2000	19,266	32,362	108.08	2,376
2001	20,092	36,075	564.82	2,492
2002	19,254	36,641	846.90	2,097
Projected 03	17,748	25,736	274.57	2,098

Discussion: These statistics illustrate common and expected trends in a transmission UVM program. For example, tree removals are consistently higher than trees pruned, which indicates a correct focus of resources. Also, if a company is employing IVM techniques, and has its system under control, it is appropriate to see a higher number of acres "treated" as opposed to "mowed". We have no concern related to FE's stated numbers.

Cycles

FE states that their transmission UVM program is on a five-year cycle. In addition, they noted that: "All transmission lines are on a five-year cycle, although our practice recognizes that for some locations, more frequent spot control is required, such as urban areas or where conditions limit tree to conductor clearances (i.e., through easement restrictions)."

Discussion: This response is consistent with what we would expect and do not have any concerns.

Patrol Methods and Frequency

FE reported that it uses both aerial and ground patrols. Although FE indicates they are on a five-year UVM cycle, patrols of their transmission system appear to be performed on a more frequent basis. For example, frequent aerial patrols were performed on the three circuits that experienced outages on August 14th. The dates of those patrols are as follows:

Harding – Chamberlin: June 2001, November 2001, July 2002, November 2002 and April 2003.

Hanna – Juniper: May 2001, October 2001, June 2002, October 2002 and April 2003.

South Canton – Star: July 2001, December 2001, April 2002, October 2002 and April 2003.

In a review of the most recent inspection reports from these aerial patrols, nothing significant regarding vegetation clearances was noted for the three locations where outages occurred.

> ***Discussion:*** It appears that the trees that caused the outages on August 14th should have been identified during one or more of the preceding aerial patrols. If they had been, these specific outages should not have occurred. While helicopter patrols are both necessary and efficient in most cases, they do have inherent problems when it comes to identifying potential vegetation clearance issues. In certain cases you cannot accurately determine the actual distance between vegetation and conductors from the air. In cases where there is any question regarding clearances observed from the air, we recommend a follow-up ground patrol be initiated.

Influences on Work Progress

FE did not provide a response regarding what laws and regulations apply to their UVM work. However, we reviewed easement documents for the location of the outages on the Harding – Chamberlin, Hanna – Juniper, and the South Canton – Star 345kV lines and found no restrictions that would have precluded the required work from being performed prior to the outages.

Sag and Sway

In a review of FE's Vegetation Management Specification (contract and work specifications) we were unable to find any reference to consideration for sag and sway during pruning and removal operations.

> ***Discussion:*** Unfortunately, most utilities do not provide specific direction to the UVM workers regarding how to take conductor sag and sway into consideration when deciding site-specific clearances to be achieved during routine work. This is an area that warrants attention, and improvement, by the industry and FE. We have addressed this issue in our general recommendations

Engineering Assumptions

A high level review of FE's engineering assumptions regarding line ratings, line sag, and line clearances was performed (See Appendix 'I'). The following areas of concern were noted during the review.

1. FE's assumed wind speed of 6 feet per second (fps) is significantly higher than the typical industry values of 2 fps for both normal and emergency ratings. Although the industry is starting to consider using 4 fps wind speed under certain conditions, FE's 6 fps is still significantly greater.
2. The temperature assumptions used in line ratings are unclear.

Findings and Recommendations

FE's UVM program, and program attributes are consistent with what we would expect to find at a similarly sized utility. It is not a best-in-class program, nor would we consider it to be substandard. There are both strengths and weaknesses worth mentioning.

Out of the three utilities we reviewed, only FirstEnergy has obtained the Tree Line USA[30] certification from The National Arbor Day Foundation (NADF). FE has actually received this designation for each of the last five years. While the Tree Line USA designation does nothing to indicate how effective a utility is in reducing tree related outages, it is a basic measure of the utility's commitment to various important UVM functions (public education, worker training, and quality work). Our experience has shown that utilities that have achieved this designation are typically more inclined to be working toward a best-in-class status.

However, FE does have issues it should address if it intends to ever achieve a best-in-class status. One issue that FE has been working to resolve is a by-product of trying to standardize their UVM programs across several company boundaries. FE is made up of several merged companies and each of them has a different history regarding UVM programs. Parts of FE have historically had well managed UVM programs, whereas other parts of FE did not. In other words, some areas are in good shape, while others are not. We believe that without significant efforts directed specifically to this outcome, it may take a considerable period of time before FE can state their system is relatively uniform regarding vegetation conditions along transmission ROWs. FE must work diligently and devote whatever resources are necessary to bring areas of the system, which are currently lagging, up to the highest standards as quickly as possible.

We also offer the following observations and recommendations:

1. FE should review its practices related to patrolling, pre-identification, and assignment of work. We make this recommendation based on our investigation of the outage on the Hanna – Juniper 345kV line. As mentioned in our initial report, several trees in the vicinity of the outage should have been identified and removed during the routine work that preceded this outage. When we interviewed an FE employee about these trees we were told that the sequence of pre-inspecting and assigning work is as follows: After the circuit is assigned, the contractor goes out and completes what they think is required. After the work is completed, FE UVM personnel may perform a post audit and require the contractor to return to the site to do any additionally identified work. Following that, an FE land agent may also inspect the site to determine if the work fully complies with the documented easement rights. If it does not, the contractor once again returns to the site. <u>If this is an accurate description of how FE pre-identifies and assigns work, this is an extremely ineffective process.</u> The full extent of the required work should be identified <u>before</u> being assigned to the crews. Crews should only return to the same location if they have not complied with the original prescription for the work.

2. FE should initiate a program that identifies and prioritizes transmission ROWs that require re-claiming. Documented easement rights should be fully exercised where possible, and it should be the objective of FE (and all utilities) to prevent ROWs from becoming unmanaged. <u>The common thread between the August 14th tree-related outages on AEP, FE, and Cinergy's systems was that none of these locations was managed in a manner consistent with the documented rights to do the work. Simply put, a ROW that has been consistently</u>

[30] http://www.arborday.org/programs/treelineusa.html

managed utilizing proper IVM techniques and Wire Zone - Border Zone concepts significantly reduces the likelihood of future tree and power line conflicts.

3. We recommend that FE consider participating in the EPA's Pesticide Environmental Stewardship Program[31] (PESP). While this program does not necessarily ensure any improvements in preventing outages, it does require that utility company members focus on correctly managing transmission ROWs and performing the job correctly. As with the NADF Tree Line USA designation, we believe that PESP participation is a baseline indicator of a competent UVM program.

4. Finally, we recommend that FE consider adopting all of the general recommendations referenced in this document. FE should work toward incorporating all Best Management Practices into their program, and work with appropriate parties to remove obstacles to completing required work. Based on recent press reports, we understand that FE has recently commissioned a study of their UVM program. We believe this to be a positive step forward and would encourage FE to consider commissioning this type of review every 3-5 years.

[31] http://www.epa.gov/oppbppd1/PESP/about.htm

CINERGY

Following the general information regarding Cinergy and its UVM activities, this section provides a brief discussion of key program elements, and then our findings and recommendations for Cinergy's UVM program.

Utility Description

Cinergy Corporation was created in 1994 as a result of a merger between Cincinnati Gas & Electric and PSI Energy. Cinergy currently serves approximately 1.5 million electric customers in Ohio, Indiana, and Kentucky through their regulated subsidiaries. These include Cincinnati Gas & Electric Company (Cinergy/CG&E), Union Light Heat and Power (Cinergy/ULH&P), and PSI Energy (Cinergy /PSI).

Description of Transmission UVM Program

Cinergy manages vegetation along approximately 8,340 miles of transmission lines rated at 69kV and above. Cinergy does not track the total number of trees managed, but does indicate that they manage approximately 91,000 acres of vegetation along these ROWs.

Involvement with the August 14th Blackout

A tree-related outage did occur on Cinergy's system in the hours before the blackout, which required extensive attention from Cinergy and MISO system operators. Although this outage had no electrical consequence for the subsequent Northeast Blackout, it did lead the Task Force to include Cinergy in its UVM review. The outage occurred on the Columbus – Bedford 345kV line which is located in Indiana and was attributed to trees contacting the conductors.

As we stated in our Initial Report, the Cinergy incident provides a graphic illustration of what can happen when utility companies are stopped by landowners or land use authorities from performing required UVM work. In Cinergy's case, it was an individual "refusal," as opposed to an agency, that stopped Cinergy from fully exercising their rights to perform the work. A comprehensive history of this incident can be found in Appendix 'D'.

Key Program Elements

<u>Organizational Structure</u>

Cinergy's UVM program is centralized with a full-time staff of 15 utility employees reporting to a System Forester. These employees oversee the work of 39 contracted transmission UVM crews working in Ohio, Indiana, and Kentucky.

> ***Discussion:*** Cinergy's organizational structure is consistent with what we would expect to see at an equivalent utility.

<u>Current System Conditions</u>

Cinergy does not track the number of trees that are potentially in contact with electric transmission lines at any given moment, or in contact with the lines at the time of pruning. While not tracked, Cinergy believes this number to be minimal.

> ***Discussion:*** Industry benchmarking indicates that the average for either situation is approximately 1% or less of the total population of trees adjacent to transmission lines.

Service Reliability

Cinergy did not provide historic information on “avoidable” versus “unavoidable” tree-related outages.

> ***Discussion:*** The majority of utilities track and differentiate between “avoidable” and “un-avoidable” tree related outages. These differentiations allow a utility to track, and hopefully reduce those outages that could be prevented by routine work. Currently, approximately three fourths of tree related outages in the UVM industry are categorized as unavoidable (could not have been avoided if the system was maintained to current requirements and standards). The remaining 25% could conceivably have been avoided had required UVM work been completed prior to the outage. Cinergy did not provide these numbers so we cannot make a comparison to the industry.

Contracting

Cinergy competitively contracts out the following UVM activities to qualified vendors: Pruning and removal, right-of-way clearing, and herbicide and tree growth regulator applications. Cinergy utilizes a combination of Time and Material (T&M) and Unit Price contracts that are competitively awarded. The typical duration of these contracts is three years, with an option to extend. Cinergy currently has five different vendors working under these contracts.

> ***Discussion:*** Cinergy’s contracting practices are consistent with the industry.

Work Techniques

Cinergy reported that it complies with industry-accepted pruning standards found in ANSI A300, and other often-referenced publications. Cinergy stated that 70% of lines are managed utilizing appropriate Integrated Vegetation Management (IVM) techniques. The remaining 30% of locations do not require extensive IVM techniques, or are unsuitable for their application.

> ***Discussion:*** Cinergy’s work techniques are consistent with the industry

Historic Budgeting

The following provides a comparison between Cinergy’s “budget” versus “actual” expenses for transmission UVM program activities:

Year	Budget	Actual	
1998	$[redacted]	$[redacted]	(REDACTED)
1999			
2000			
2001			
2002			
2003		n/a	

> ***Discussion:*** There are no anomalies in these self-reported numbers that would indicate concern on our part. In fact, they appear to suggest that Cinergy routinely increases required expenses for UVM work, regardless of projected budgets.

Historic Completed Work

Cinergy does not track the number of trees pruned or removed by year. Cinergy does however track the acres treated and mowed per year.

Discussion: The majority of utility companies comprehensively track historic completed work. This tracking typically involves statistics on trees pruned or removed, acres treated or mowed, or variations based on miles per line. We consider the development and tracking of appropriate indices to be a critical part of any UVM program. Based on Cinergy's responses, we are not convinced that they currently track historic work in a manner consistent with industry practices.

Cycles

Cinergy states that their transmission UVM program is "generally cyclic" in nature and these cycles vary upon the types of transmission facilities and locations. Cinergy's stated cycles for performing UVM work are as follows:

Urban/Suburban – As needed
Rural – As needed
Side trim – 4-5 years
Mowing – As needed
Herbicide – 4-5 years

Discussion: The majority of transmission UVM programs have varying cycles. Cinergy's response "as needed" does not provide adequate information to make comparisons with other utilities.

Patrol Methods and Frequency

Cinergy documents indicate that they patrol their transmission lines two or more times annually utilizing a combination of aerial and ground patrols.

Discussion: Cinergy obviously patrols their lines on a more frequent basis than the majority of utility companies. Given that the "key" to preventing tree related outages is being able to identify and correct problems in a timely manner, we would have to say that Cinergy is doing a good job with respect to frequency of patrols.

Influences on Work Progress

Cinergy states that the following laws and regulations apply to their UVM operations:

NESC Rule 218
USFS other Federal requirements
Public Utility Commission
State Highway Requirements
Local Street Tree Ordinances
Other Local Ordinances

Cinergy states it does not work under mandatory clearance requirements, and that there are no agency-related restrictions that hinder their Transmission UVM activities.

Discussion: As discussed in earlier sections of this report, most utility companies do indeed encounter many restrictions that impact the ability to perform required work. Cinergy apparently does not face this ubiquitous obstacle.

Sag and Sway

Cinergy provided the following general statement regarding sag and sway and how it is communicated to their contractors: "In planning trim heights and work activities (for safety) the "rule of thumb" assumption is that the conductor can sag to a height of 20'-25' above ground level at peak conditions."

> ***Discussion:*** In a review of Cinergy's contract Work Specification we found no reference or instructions to their contractors regarding sag and sway. As we have stated in various places in this report, we believe that this is an area that needs to be improved. Utility companies must develop and communicate better instructions for UVM workers regarding how sag and sway should be incorporated into clearance specifications.

Engineering Assumptions

A high level review of Cinergy's engineering assumptions regarding line ratings, line sag, and line clearances was performed (See Appendix 'I'). The following areas of concern were noted during the review.

1. The basis for the assumed ambient temperature used for line ratings at Cinergy is unclear.
2. There does not appear to be consideration of creep during conductor sagging.
3. It is unclear whether or not Cinergy checks conductor sag during routine inspections.

Findings and Recommendations

Cinergy's UVM program, and program attributes are consistent with what we would expect to find at a similarly sized utility, working under the same requirements and conditions. It is not a best-in-class program, nor would we consider it to be substandard. There are both strengths and weaknesses worth mentioning. (See general recommendations regarding our conclusion that the current industry standard is inadequate for the prevention of transmission outages due to tree contact.)

Cinergy seems to have a competent UVM organization and strong support from upper management. Based on our review of documentation, data responses, and discussions with Cinergy employees at all levels, we believe they understand the importance of this activity and are willing to continually improve their program.

While we did not uncover any major negative revelations during the review of Cinergy's transmission UVM program, we will provide the following observations and recommendations:

1. Cinergy should consider working toward obtaining The National Arbor Day Foundation's (NADF) Tree Line USA[32] designation, and becoming a member of the EPA's Pesticide Environmental Stewardship Program[33] (PESP). In addition to helping the utility stay focused on important activities such as worker training, public education, and the use of proper tools and techniques, these programs act as a baseline measurement of overall program efficacy. In other words, we would expect that any utility company that wishes to have a "Best-in-Class" UVM program, would naturally have first obtained the Tree Line USA designation and be an active participant in the PESP program. In our opinion, they are both basic measures of general UVM competence and we encourage all utilities to become involved with these programs.

[32] http://www.arborday.org/programs/treelineusa.html

[33] http://www.epa.gov/oppbppd1/PESP/about.htm

2. We found no evidence that Cinergy is fully utilizing appropriate methods for tracking and managing overall UVM operations. We believe that more emphasis should be placed on the ability to predict, monitor, and adjust, as necessary, to changing conditions. For example, Cinergy apparently does not track the total number of trees pruned or removed on an annual basis. We would suggest that this type of information is critical for various reasons ranging from the development of unit price contracts, to tracking improvements in productivity. We would suggest that Cinergy review their current measurement systems to ensure they are accurately capturing the right information to track and monitor their program efficacy.

3. We recommend that Cinergy review current tree-related outage reporting criteria and procedures. The fact that Cinergy could not provide outage data that differentiated between “avoidable” and “unavoidable” causes us to believe there may be a problem here (in addition to the more general issues discussed elsewhere regarding the use of these terms). As should be obvious, the key indicator of UVM program efficacy at any utility company is found in the company’s ability to prevent or reduce outages. Without accurate, consistent, and meaningful data, it is hard to evaluate which direction your UVM efforts are taking you.

4. Finally, we recommend that Cinergy consider adopting all of the general recommendations referenced in this document. Cinergy should work toward incorporating all Best Management Practices into their program, and work with appropriate parties to remove obstacles to completing required work.

DETAILED UVM RESPONSES[34]

#	Review Questions	FE	Cinergy	AEP	Benchmark
3.1	Total Customers	2,124,915	1,519,701	N/a	-
4.1	Transmission Circuit Miles	69kV – 2,277 138kV – 3,724 345kV – 1,197 69kV and above 7,198	69kV – 3,233 138kV – 2,170 230kV – 888 345kV – 2,049 69kV and above 8,340	23kV – 112 34.5kV – 366 40kV – 59 69kV – 2,625 138kV – 3,284 345kV – 1,793 765kV – 509 69kV and above 8,211	-
4.5	Group that manages UVM Distribution and Transmission	Regional Forestry Operations – Both T&D	Shared responsibility When T&D facilities are on the same pole trimming is performed to the T spec	AEP Forestry Both T&D	Typically, T&D are managed by the same department
5.1	Governing Agencies	PUC of Ohio Penn. PUC FERC	PUC of Ohio Indiana URC PSC of Kentucky FERC	PUC of Ohio FERC	Similar to Industry
5.2	Other Agencies	National Parks Metro Parks ODOT	USFS Ohio DNR DOT City & County Parks	USFS US Army Corp of Eng. Ohio Div of Wildlife Metro Parks	Similar to Industry
6.1	Budget – Excluding overheads (REDACTED)	2000 – [redacted] 2001 – [redacted] 2002 – [redacted] 2003 – [redacted]	1998 – [redacted] 1999 – [redacted] 2000 – [redacted] 2001 – [redacted] 2002 – [redacted] 2003 – [redacted]	1998 – [redacted] 1999 – [redacted] 2000 – [redacted] 2001 – [redacted] 2002 – [redacted] 2003 – [redacted]	-
	Actual (REDACTED)	2000 – [redacted] 2001 – [redacted] 2002 – [redacted][35] 2003 – n/a	1998 – [redacted] 1999 – [redacted] 2000 – [redacted] 2001 – [redacted] 2002 – [redacted]	1998 – [redacted] 1999 – [redacted] 2000 – [redacted] 2001 – [redacted] 2002 – [redacted] 2003 – [redacted] Sept.	-

[34] Responses reflect Ohio operations only, unless otherwise noted.
[35] Average cost per mile can vary based on a number of variables such tree density, urban and rural mix, and accessibility.

#	Review Questions	FE	Cinergy	AEP	Benchmark
6.2	Budget – Overhead costs (REDACTED)	N/a	1998 – [redacted] 1999 – 2000 – 2001 – 2002 – 2003 –	1998 – [redacted] 1999 – 2000 – 2001 – 2002 – 2003 –	-
	Actual (REDACTED)	N/a	N/a	1998 – 1999 – 2000 – 2001 – 2002 – 2003 –	-
7.1	Program Structure	De-centralized	Centralized	Centralized	Centralized
7.2	System Forester	Yes	Yes	Yes	Yes
7.3	Full-time staff	In-house – 25 Contracted - 6	In-house - 15	In-house – 4	-
7.4	Part-time staff	In-house – 1 Contracted – 1	0	In-house – 2	-
9.1	# of Transmission Crews	39	Ohio/Kentucky – 18 Indiana - 21	43	-
9.2	Crews Dedicated to Transmission	20 – T only 19 – T&D	Ohio/Kentucky – Yes Indiana – No	Yes	Yes
9.2	In-house vs. Contracted	100% Contracted	100% Contracted	100% Contracted	100% Contracted
10.1	Trees Managed	Trans. 283,445 Dist. 2,749,427	Do not track	Trans. 437,400	-
10.2	Transmission acres	56,405	91,000	103,812	-
10.3	Inventory	Yes – system wide[36]	Yes – Indiana only[37]	Yes – system wide[38]	Typically yes, though not a true inventory

[36] Based on completed work only
[37] Based on brush reports or completed work only
[38] Based on completed work only

#	Review Questions	FE	Cinergy	AEP	Benchmark
10.6	Trees per circuit mile	40	Unknown	50	-
10.14	Primary Inventory use	Work planning	Work direction	Work planning & direction	Work planning & direction
11.1.1	Units used to track cost	Trees pruned and removed Acres of brush cut	Acres of brush cut Line mile Acres of brush sprayed	Trees pruned & removed Acres of brush cut Line mile Circuit Herbicide Mowing	Trees pruned and removed Acres of brush cut
11.1.2	Cost per tree (REDACTED)	2000 – [redacted][39] 2001 – 2002 – [40]	Not tracked 2001 69kV – [redacted] mile 138kV – mile 345kV – mile 2002 Same	2000 – [redacted] prune 2000 – rem 2001 – prune 2001 – rem 2002 – prune 2002 – rem	Average $73.75 Prune $38.76 Removal
11.2	Transmission trees pruned	2000 – 19,266 2001 – 20,092 2002 – 19,254 2003 – 17,748 proj.	Not tracked	1999 – 14,014 2000 – 15,759 2001 – 9,348 2002 – 10,723 2003 – 15,000 proj.	-
11.3	Transmission trees removed	2000 – 32,364 2001 – 36,075 2002 – 36,641[41] 2003 – 25,736 proj.	Not tracked	1999 – 53,611 2000 – 42,250 2001 – 30,205 2002 – 21,591 2003 – 23,000 proj.	-
11.4	Separate hazard tree program	No	No	No	No

[39] Pruned & removed
[40] FE note: Cost per tree affected increased due to more emphasis on removals (see footnote below)
[41] No significant increase in removals noted from 2001 to 2002

#	Review Questions	FE	Cinergy	AEP	Benchmark
11.6	Acres or miles mowed	2000 – 108.08 acres 2001 – 564.82 acres 2002 – 846.9 acres 2003 – 274.57 proj.	1998 – 50 acres[42] 1999 – 220 acres 2000 – 180 acres 2001 – 340 acres 2002 – 179 acres 2002 – 100 proj.	1999 – 576.5 acres 2000 – 882.94 acres 2001 – 821.73 acres 2002 – 722.59 acres 2003 – 1,000 proj.	-
11.7	Acres or miles treated with herbicides	2000 – 2,376 acres 2001 – 2,492 acres 2002 – 2,097 acres 2003 – 2,098 proj.	1998 – 90 acres[43] 1999 – 100 acres 2000 – 120 acres 2001 – 232 acres 2002 – 356 acres 2003 – 520 proj.	1999 – 2,478.86 acres 2000 – 2,962.86 acres 2001 – 3,097.72 acres 2002 – 4,335.67 acres 2003 – 4,450 proj.	-
12.1	On cycle?	Yes	Generally cyclic	Yes	Yes
12.1.1	Does cycle vary based on location	No, all T lines are on a 5 year cycle, although our practice recognizes that for some locations, more frequent spot control is required, such as urban areas or where conditions limit tree to conductor clearances (i.e., through easement restrictions).	Yes	Yes	Yes
12.1.2	If yes, provide cycle	5 years	Urban/Sub – As needed Rural – As needed Side trim – 4-5 years Mowing – As needed Herbicide – 4-5 years	Urban/Sub – 2-4 yrs Rural – 6-8 yrs	Urban/Sub – 3.12 yrs Rural – 5.24 yrs Side trim – 9.71 yrs Mowing – 4.93 yrs Herbicide – 4.29 yrs
12.5	Work schedule is based on	Cycle based By circuit	Condition based Work is prioritized based on line inspection, past work history and current observations of the circuits	Cycle based By circuit Reliability based	Cycle based

[42] Ohio and Kentucky only
[43] Ohio and Kentucky only

#	Review Questions	FE	Cinergy	AEP	Benchmark
12.7	Tree definition	A woody plant six inches (6”) in diameter at four and one-half feet (4.5’) above the ground (dbh) will be considered for purposes of recording a tree. All growths less than this measurement will be considered brush.	Woody vegetation greater than 4 inches DBH	Greater than 4 inches DBH	4 inches DBH or larger
12.8	Brush definition	A woody plant less than six inches (6”) in diameter at four and one-half feet (4.5’) above the ground (dbh)	Woody vegetation less than or equal to 4 inches DBH	Less than 4 inches DBH	Less than 4 inches DBH
12.9	Pruning methods	Shigo A-300 Standard ISA Pruning Standard Directional Pruning	Shigo A-300 Standard Directional Pruning Local Ordinances	Shigo A-300 Standard ISA Pruning Standard Directional Pruning	Shigo A-300 Standard Directional Pruning ISA Pruning Standard
12.11	Documented removal policy	Yes	No	Yes	Yes

#	Review Questions	FE	Cinergy	AEP	Benchmark
12.11.1	Removal criteria	Dead or defective which constitute a hazard to the conductor. Trees that have fast growth rates or trees that cannot be pruned for effective conductor clearance. Immature trees, generally classified as brush. Trees that are overhanging the primary conductors and are unhealthy or structurally weak. All priority trees located adjacent to the sub-transmission and transmission clearing zone corridor that are leaning towards the conductors, are diseased, or are significantly encroaching the clearing zone corridor. All incompatible trees that are located within the clearing zone corridor.	Specifications require that all trees and brush be removed from ROW when possible	Page 11 of policies	All three utilities have removal criteria that is similar to the industry.

#	Review Questions	FE	Cinergy	AEP	Benchmark
12.14	IVM managed	100% are IVM managed. All locations are evaluated for cost-effective control, and cycle is a key driver for when an area is maintained. The FirstEnergy Vegetation Management specifications and cycle were developed with threshold controls, cost-effectiveness, safety, environmental concerns, public relations, and reliability all taken into consideration.	70% IVM 30% no action needed	100%	Average 60%[44]
12.18	Tree growth regulators used	Yes	Yes	Yes, limited	Limited use due to lack of efficacy
12.18.1	Why are they used	When necessary due to easement restrictions	Easement limitations Property owner request	In situations where the tree cannot be removed and is situated directly under our facilities TGR are used on faster growing species. Primarily this would be in an urban or street setting, and the tree would be a "cycle buster"	- Unable to obtain permission for removal - Regulatory Requirements - Urban settings
13.3	Initial clearing widths	69kV – 50' 138kV – 110' 345kV – 170'	69kV – 50-100' 115kV – 100' 230kV – 150' 345kV – 150'	69kV – 70' 115kV – 100' 345kV – 125' 500+kV – 175'	69kV – 70' 115kV – 90' 230 to 345kV – 125' 500+kV – 190'

[44] See Page 73 for discussion on Integrated Vegetation Management.

#	Review Questions	FE	Cinergy	AEP	Benchmark
13.10	Documented rights on ROW	Yes	Yes, in most ROW documents. Some documents specify only maintenance rights	Yes, easements	Yes, on most ROWs
13.12	Notification by	Contract Inspector	Contract Inspector Crew Foreman	Contract Inspector	Contract Inspector
13.15	Non-routing work (tag work)	1-15% depending on region	25%	3%	11%
13.23	Most difficult agency	Local City or County	Local City or County	Local City or County	Local City or County
13.27	Restrictions that hinder work	Where there is a delay in issuing permits, the co's VM work schedule is impacted	No	Yes, the properties should be managed with IVM techniques on all easements	Typically yes. From City, County, State and Federal Agencies.
13.28	Examples of process delays that caused problems	No formal documentation	N/a	Yes, Wayne National Forest	-
14.3	Work with engineering dept.	Yes	Yes	Yes	Yes
14.3.1	Explain interaction with engineering	Company forestry personnel participate in regularly scheduled planning meetings with engineering personnel, attend joint field visits, and participate in routing decisions for transmission projects.	Options are discussed if high volume tree impact is anticipated	We communicate our specs and input with the ROW acquisition group and the engineering design group	Interaction with Engineering varies significantly throughout the industry.
15.1	Are UVM services contracted	Yes	Yes	Yes	Yes

#	Review Questions	FE	Cinergy	AEP	Benchmark
15.2	Functions contracted	Pruning & removal ROW clearing TGR's Herbicide application Inventory work R&D Clerical support Pole clearing	Pruning & removal ROW clearing TGR's Herbicide application	Pruning & removal ROW clearing TGR's Herbicide application Pre-inspection Clerical support	All three utilities contract various functions that are similar to the industry.
15.4	Securing UVM services	Typical bidding process Negotiated prices	Typical bidding process Negotiated prices	Typical bidding process	Typical bidding process
15.6	Typical Contract term	1 year or multi-year	3 years with an option to extend	5 years	3 years
15.8	Contract structure	40% T&M 50% Lump Sum 10% Other – performance based	25% T&M 75% Unit Price	99% T&M < 1% Unit Price < 1% Lump Sum	70% T&M 16% Lump Sum 14% Unit Price
15.14	Contractors	8 vendors perform UVM work	5 vendors perform UVM work	2 Line Clearance 3 Work Planning	2 is average[45]
16.1	Laws & regulations that apply	N/a	NESC Rule 218 USFS other Fed. Req. Commission State Highway Req. Local Street Tree Ord. Other local Ord.	NESC Rule 218 State Highway Req. Local Street Tree Ord. Other local Ord.	NESC Rule 218
16.3	Must clearances be maintained	N/a	No	No	No
16.5	% in contact w/T now	None, to the companies knowledge	Not tracked but minimal	< 2%	1% or less
16.6	% in contact w/T at pruning	N/a	Not tracked but minimal	< 2%	1% or less
16.9	Right-tree Right-place	Yes	Yes	Yes	Yes

[45] Most often driven by the size of the program.

#	Review Questions	FE	Cinergy	AEP	Benchmark
17.1	Program drivers	N/a	No formal ranking but safety and reliability are held in the highest regard	1 – Service Reliability 2 – Prevent accidents 3 – Prevent fires 4 – Customer service 5 – Comply with laws	1 - Prevent Accidents 2 - Service Reliability 3 - Customer Service 4 - Comply with laws 5 - Lower costs
18.3	Avoidable vs. unavoidable	N/a N/a 2000 – 75% A, 25% U 2001 – 57% A, 43% U 2002 – 25% A, 75% U	N/a	1998 – 25% A, 75% U 1999 – 25% A, 75%U 2000 – 25% A, 75%U 2001 – 25% A, 75% U 2002 – 25% A, 75% U	1998 - 38% A, 62% U 1999 - 34% A, 66% U 2000 - 29% A, 71% U 2001 - 25% A, 75% U N/a
19.1	Fires in the last 5 years	None	Yes	None	-
20.1	Drought and rainfall data used	No	No	No	No
21.1	Ratemaking procedure	No rate case in Ohio	No rate case in Ohio	No rate case in Ohio	Yes
21.2	Requested Authorized Actual	See 6.1	See 6.1	See 6.1	-
21.4	Adequately Funded?	Yes	The program is adequate to maintain the primary objectives of safety and reliability	Yes	Yes
21.6	Expenditures tracked by voltage?	No	N/a	See 6.1 & 6.2	No

VI. RECOMMENDATIONS

GENERAL INDUSTRY RECOMMENDATIONS

Reducing the likelihood of future tree and power line conflicts will require significant changes in industry practice, and may initially cost more money to accomplish. It may also require a great deal of political leadership.

We are submitting the following general recommendations as initial steps that can be taken to mitigate and or prevent future problems related to tree and power line conflicts. This is followed by specific recommendations regarding oversight and enforcement of UVM activities by the appropriate entities.

1. DEVELOP MEASURABLE AND ENFORCEABLE STANDARDS FOR UVM PROGRAMS

The current set of industry rules, guidelines, and/or laws are not explicit enough to ensure that utilities will strive toward the elimination of future similar occurrences (See discussion on Page 68). The agencies responsible for utility oversight have not focused, to the extent necessary, their attention on this critical function.

UVM requirements and standards must be better defined and enforced. Whether it occurs at a local, state/provincial or federal level, the agencies and organizations responsible for oversight of utility operations need to ensure development and enforcement of clear and consistent performance standards regarding the prevention of tree and power line conflicts. Further, regulators and/or oversight organizations should perform routine UVM reviews at the utility companies working under their aegis

2. INSURE THAT THESE EFFORTS ARE ADEQUATELY FUNDED

UVM programs have always been prime targets for short-term budget reductions by utility companies. Unfortunately, the real cost of these reductions does not typically manifest itself for months or even years. We also know that the perceived short-term savings actually translate into exponentially higher costs in the future. Utility companies should have clear regulatory incentives for adequately funding (and disincentives for inadequately funding) this important function.

Where applicable, the agencies and/or Commissions responsible for authorizing these expenses should adequately fund these programs to the extent necessary to meet reasonable requirements and objectives.

3. PROVIDE THE RIGHT TO PERFORM THE WORK

As it stands right now, utilities are placed in the untenable position of having the obligation to keep vegetation from conflicting with power lines, but not always the explicit right to do it (See Appendix 'E' for an example of restrictive rights). We should either find effective ways to provide the right to perform this work to the utility (in both emergency and routine situations), or accept that they cannot do all the work required to prevent future outages or fires.

It is interesting to note that the government of New Zealand has, within the last few months, taken a very bold step forward in addressing the dilemma of utilities not having the explicit right to perform the work on other people's trees. New Zealand now requires that the cost and obligation of maintaining the trees away from electric lines be borne by the person who actually planted or owns the vegetation. While extremely controversial, this provides an "out-of-the box" resolution to many of the problems we currently face in North America.

4. <u>ELIMINATE UNNECESSARY OBSTACLES</u>

Local, state/provincial, and federal governments should review existing requirements that serve to unnecessarily stop or hinder the timely completion of required UVM work. Where possible, acceptable standards and requirements should be developed that can be uniformly applied to UVM operations (permitting requirements, work standards, removal criteria, etc.).

5. <u>REQUIRE PROPER PLANTING OF VEGETATION NEAR POWER LINES</u>

<u>The simple act of choosing the appropriate species of vegetation to plant near overhead lines would save hundreds of millions of dollars annually for electric ratepayers in North America</u>. It would also result in a dramatic reduction in the likelihood of future outages and fires, and a conversely dramatic improvement in the health of our urban and rural forests. Additional ancillary benefits include a tangible reduction in herbicide and chemical usage, and an equal reduction of needless biomass waste being produced and disposed of as a result of the unnecessary pruning and/or removal of trees and vegetation.

RECOMMENDATIONS FOR OVERSIGHT AND ENFORCEMENT OF UVM ACTIVITIES

Current oversight of UVM activities by appropriate agencies or organizations is overwhelmingly inadequate. While there is no shortage of concern regarding preventing tree and power line conflicts, we believe that there needs to be a more focused and educated approach to overseeing the efforts of utility companies in this critical activity. Equally important, these entities need to develop and enforce specific and measurable objectives for the utility companies working under their aegis. While utility companies have the expertise to improve UVM activities in North America, we do not believe we will see a dramatic improvement without rigorous oversight by the appropriate authorities.

The following are recommendations regarding how to improve current oversight and enforcement of UVM activities:

1. <u>OVERSIGHT AGENCIES AND ORGANIZATIONS NEED TO LEARN MORE ABOUT UVM ACTIVITIES</u>

While trees may be the single largest cause of electrical outages, few oversight agencies or organizations can claim they have the internal expertise to address and correct UVM issues and problems. This expertise is fundamentally important in that any new requirements or expectations placed on utilities can have a dramatic effect on energy costs, public safety, customer satisfaction, and the environment. We recommend that internal staff at these organizations receive, at minimum, rudimentary training on all aspects of UVM.

2. <u>DEVELOP CLEAR UVM PROGRAM EXPECTATIONS FOR UTILITY COMPANIES</u>

Oversight organizations should work with the utility companies, the UVM industry, and other stakeholders to develop measurable and achievable program objectives. The development of these expectations will require a joint effort to identify what specifically can be done to ensure the reduced likelihood of future tree and power line conflicts. Given the myriad of site-specific UVM related variables throughout North America, we would expect that these expectations may differ based on local environmental conditions and other factors. With that caveat, we offer the following three examples of items that could be included as part of these expectations:

- Adoption of specific UVM Best Practices
- Development of, and adherence to, comprehensive UVM schedules
- Achieving specific reductions in tree-related outages

3. DEVELOP INCENTIVES/PENALTIES FOR COMPLIANCE

Oversight organizations should develop, communicate, and enforce clear incentives and/or penalties related to utility-specific performance.

4. ENFORCEMENT AND OVERSIGHT SHOULD BE ROUTINE

Oversight organizations should continually monitor utility-specific UVM program activities and progress. This could be accomplished through standard utility reporting requirements, regular meetings between staff and the utility, and verification of progress through routine field audits. Specific attention should be paid to the issue of adequate inspections and scheduling of work. As we have stated in various sections of this report, the objective of UVM should be to identify and correct tree and power line conflicts "prior" to them creating problems.

5. OVERSIGHT ORGANIZATIONS NEED TO BECOME DIRECTLY INVOLVED IN UVM ACTIVITIES WHERE APPROPRIATE

There are numerous situations where responsible agencies and organizations can actually assist in reducing the likelihood of tree and power line conflicts. For example, fire officials in the west routinely assist utility companies when they encounter refusals[46]. Similar effective intervention could be provided by oversight organizations or agencies. Another common problem occurs when local governments erroneously restrict or prevent the timely completion of required UVM work[47]. We believe that in situations where the legal authority for developing and enforcing UVM requirements is held by a specific state or federal oversight organization, that authority should not be superceded by possibly competing local interests. At a minimum, utility regulators should become involved in representing the public interest in avoiding tree-related outages.

We believe that the preceding recommendations (if adopted by oversight organizations) will result in a dramatic reduction in the future likelihood of tree and power line conflicts. While the majority of these organizations are not currently involved with UVM activities to the degree proposed here, it does appear that a few States' have begun to take important steps in this direction. Several State requirements are described in Appendix 'H' and vary from Commission to Commission. Some provide fairly detailed guidelines while others have minimum requirements for UVM maintenance and activities.

[46] See Page 18, Influence of Property Owners.
[47] See Page 15, Competing Interests.

VII. BEST MANAGEMENT PRACTICES

BACKGROUND

One of our initial tasks was to develop a list of Best Management Practices (BMP) that could be applied to all transmission UVM programs. In order to accomplish this, we felt it was appropriate to seek input from a wide audience of experts in the UVM field, in addition to drawing from our own experience and the available data.

The following section was developed with the active participation of UVM experts in the US and Canada. These individuals were asked to contribute based on their reputations, knowledge of, and active participation in our industry.

In addition to the development of the BMPs, we asked each of our experts to provide a written response to the following question:

> "As an industry expert, what would you recommend needs to be changed, improved, or fixed in order to reduce or prevent the likelihood of future tree and transmission line conflicts?"

These insightful and candid commentaries are included in Appendix 'J'.

It should be noted that their contribution and involvement in the development of the Best Practices, and/or their commentaries in Appendix 'J', were on an individual basis, and the opinions and recommendations of each participant does not necessarily reflect the endorsement of their respective companies or organizations. Additionally, these experts were not involved with the development of this report, and did not have access to any data or information related to this investigation, other than what was available to the general public.

BEST MANAGEMENT PRACTICES IN THE TRANSMISSION UVM INDUSTRY

In the following section, we have identified specific "Industry Best Management Practices" for managing vegetation adjacent to electric transmission facilities. This list was developed by Stephen Cieslewicz and Robert Novembri of CN Utility Consulting, with the active support, input, and approval of the following industry leaders and experts:

- Robert Bell, Pacific Gas & Electric Co., President of the Utility Arborist Association (California)
- Scott Deevers, Business Manager, The Davey Tree Expert Company (Ohio)
- Kevin Eckert, President and Managing Director, Arbor Global (Hawaii)
- John Goodfellow (Redmond, Washington)
- Siegfried Guggenmoos, President, Ecological Solutions (Alberta, Canada)
- Richard Johnstone, System Forester, Conectiv/IVM Industry Consultant (Delaware)
- Randall H. Miller, System Forester, PacifiCorp (Utah)
- Mike Neal, Arizona Public Service, President of the International Society of Arboriculture (Arizona)
- Jim Orr, Asplundh Tree Expert Company (Pennsylvania)
- Derek Vannice, Executive Director of the Utility Arborist Association (Illinois)

In general, BMPs are documented strategies and tactics accepted by leading industry organizations and employed by progressive companies to achieve specific objectives. For example, the acknowledged BMPs for pruning have been developed by a broad spectrum of industry experts and are outlined in the *American National Standard for Tree Care Operations A300 (Part 1)-2001, Pruning* (See Appendix 'K'). The methods defined in this document are currently the most effective way to protect the health of trees during line clearance pruning. "Best management practices" do not remain static over time. New laws, technology, products, tools, program objectives, research, and even public sentiment can influence and change what we presently understand about best practices. As such, we recommend periodic review of any set of best practices.

The best practices presented below were developed with the specific intent of describing the safest, most environmentally sound and cost-effective methods and tools to "enhance system performance and transmission reliability." This list represents "general" requirements for best-in-class UVM programs. The actual day-to-day operations and practices related to transmission UVM should be tailored to site-specific requirements and are much more detailed and technical in nature than could be described in this document. These technical best practices for UVM are typically referred to as Integrated Vegetation Management (IVM) techniques. For more technical details of what are considered best-in-class IVM practices, please consult the recommended readings listed in at the end of this section.

BEST PRACTICES FOR NEW TRANSMISSION FACILITIES

Designing New Line Routes

New transmission lines should be routed with consideration of future reliability needs and maintenance. This should include an appropriate assessment and consideration of current and expected vegetation growth and encroachment. Considerations such as defining the appropriate ROW width, and the development of long-term UVM maintenance plans, should be addressed during the design stage and include the participation of the utility's UVM experts.

> ***Discussion:*** The ideal transmission line route would be one where vegetation would not grow or fall into the facilities, given reasonable and ongoing maintenance. While this may not be realistic with many lines, it can and should be an objective for the siting of future lines. In order to meet this objective with future lines, a utility arborist should be involved to help support decisions on route selection and to develop the site-specific prescription to establish an appropriate ROW and maintain the line in the future. To be most effective, a vegetation management specialist should be included throughout the process from design through construction. This consultation can minimize environmental impacts, permitting requirements, future tree-related reliability threats and access problems, and can lower long-term financial and environmental costs.

ROW and Easement Documents

Easement documents should clearly provide the utility with rights to establish and maintain appropriate clearances under and adjacent to the proposed lines while utilizing all appropriate IVM practices. The ROW width should be determined based on the following objective: "No vegetation, or parts of vegetation, shall be allowed to grow or fall into the transmission facilities." For example, if native trees have a mature height of 100 feet, the "ideal" initial easement should be wide enough to ensure that existing and future trees (along the side of the ROW) will not, by accident or design, fall into the facilities.

The documents shall also clearly reference typical vegetation management work that can be expected in the future. For example, it should clearly permit the removal and/or pruning of any off-easement trees that are deemed by the utility to be a threat to the safe and reliable operations of the line. It should also specify the use of EPA-approved herbicides and growth regulators as necessary to manage the vegetation in a cost-effective manner. Easement contracts should also state that the primary purpose of the ROW is safe and reliable delivery of energy services.

Discussion: It appears that many utility companies rely on standard easement widths that are based on voltage, rather than the site-specific conditions. For example, many right-of-way documents state, "the utility shall have the right to adequately maintain the line." We think such language is inadequate to avoid misunderstandings over the scope of work. Rather, ROW widths should take into consideration specific factors such as conductor sag and sway, topography and the mature height of local vegetation, among others. Finally, easement contract wording should be explicit about the nature of the vegetation work required along the corridor. This would include specific references to the use of all potential IVM techniques, including herbicides.

Initial ROW Establishment

Initial clearing and ROW establishment should be extensive enough to provide safe and reliable energy services with allowance for future growth of desirable vegetation to its intended mature height. The ROW should be cleared in a manner consistent with a long-range vegetation management plan, and with the achievement of "Wire Zone, Border Zone" objectives. This involves shifting plant communities found on the current ROW away from predominately tall-growing plant species in favor of naturally low-growing plant species. These plant communities of low-growing vegetation provide a biological control of undesirable plants by inhibiting their establishment, resulting in a more environmentally and aesthetically stable ROW environment. This conversion is accomplished by selectively controlling tall-growing plant species while preserving and encouraging low-growing trees, woody shrubs, grasses, herbs, and forbs. The establishment of this new environment typically requires successive cycles of work and the selective and judicious use of herbicides to fully control the entire undesirable target plant.

Discussion: Studies have demonstrated that this practice, involving maintaining ROW corridors as distinct ecosystem zones, is cost effective, provides significant environmental and societal benefits, and will improve electric service reliability. Properly managed, these linear corridors can become an asset for forest ecology and forest management. The benefits to wildlife associated with the "edge-effect" are well documented by the 50 years of research at the Bramble and Byrnes study areas. For example, rare and endangered plants frequently find a refuge on these well-managed, open corridors. In addition, significant increases of birds and other wildlife are well documented. Finally, and equally important, such corridors have the proven potential to serve as firebreaks and/or staging areas and access points to assist in wildland fire-fighting efforts.

BEST PRACTICES FOR ONGOING TRANSMISSION UVM OPERATIONS

Understanding the Workload

Workload projections, planning, budgeting, and scheduling should be based on an accurate understanding of the existing and likely future vegetation under and adjacent to existing transmission lines.

Discussion: While there are utility companies that have an actual inventory of vegetation, most do not have a complete picture of the workload on their transmission system. We believe that in order to adequately manage a dynamic population of vegetation, the utility should have accurate baseline information that is adequate to plan and perform effective UVM activities. This should also include estimates of future natural re-growth or planted vegetation that will likely be experienced.

Funding

Consistent funding should be based on a clear understanding of the required work, and not be solely based on historic budgets. Funding should be based on an accurate understanding of workload and local knowledge of the type, cost, and frequency of required work. This should also include the ability to increase or reduce expenses (in a timely manner) in response to unpredictable events. For example, this would include the ability to adjust funding based on the unexpected impacts of drought and above normal precipitation, or widespread outbreaks of tree pathogens or pests.

Discussion: A common industry complaint is that UVM budgets are somewhat unstable. This includes annual unpredicted budget spikes (up and down) for reasons not related to actual workload. Additionally, there does not seem to be adequate funding mechanisms to address uncontrollable outbreaks of vegetation-related problems. It is critical to understand that trees and vegetation grow based on natural moisture and other climatic factors with no recognition of financial conditions.

Scheduling UVM Work

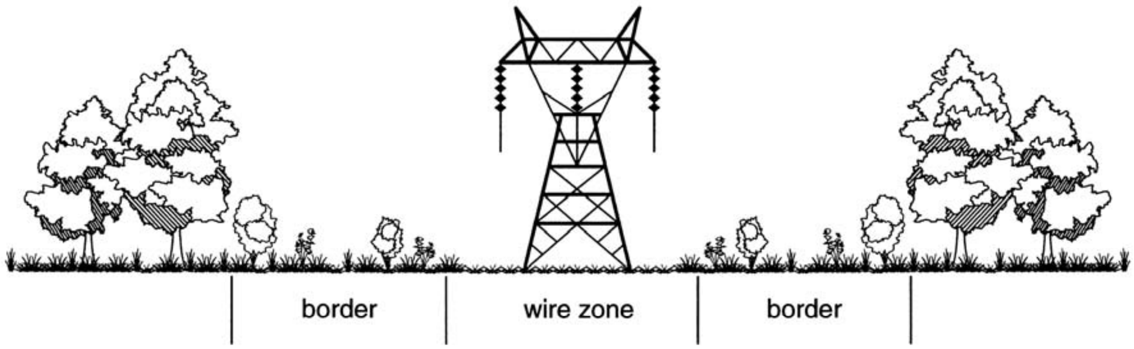
Scheduling should be based on an updated and ongoing analysis of the workload and current conditions. For example, both excessive precipitation and drought can significantly influence vegetative growth and resulting workloads. Schedules should be flexible enough to address these and other variables such as customer- and line-patrol-initiated work. The intent of scheduling is to manage the vegetation prior to it becoming a threat to service reliability.

Discussion: The key to a successful transmission UVM program is found in its ability to predict and mitigate problems. This involves the development and continuous updating of, and adherence to a long-term schedule. Vegetative growth and plant succession are dynamic processes that require prescriptive and proactive management. One cannot manage what is not known, thus a successful program requires ongoing knowledge of the changing ecosystem and the efficacy of the management inputs. It also requires the monitoring and response to unanticipated work that can be generated through customer or agency notifications, or other utility patrols and requirements. UVM schedules are not static, but, like funding requirements, are based on naturally influenced growth conditions.

Wire Zone – Border Zone Concepts and Integrated Vegetation Management (IVM)

All transmission UVM work should be identified, scheduled, completed and maintained consistent with "Wire Zone – Border Zone" objectives and industry accepted protocols. Integrated Vegetation Management (IVM) is the most commonly referred to, and used, protocol for managing transmission rights-of-way. IVM is generally defined as the practice of promoting desirable, stable, low-growing plant communities that will resist invasion by tall growing tree species through the use of appropriate and environmentally sound control methods. These methods can include a combination of chemical, biological, cultural, and/or mechanical treatments.

Bramble and Byrnes Wire Zone – Border Zone
(From Yahner, Bramble and Byrnes, 2000)



Discussion: As previously mentioned, utilities should work toward the achievement of "Wire Zone – Border Zone" objectives on new and existing ROWs. This involves shifting plant communities found on the current ROW away from predominately tall-growing plant species in favor of plant communities dominated by naturally low-growth plant species. This shift is accomplished by selectively controlling tall-growing plant species, while preserving and encouraging low-growing trees, woody shrubs, grasses, herbs, and forbs. The establishment of this new cover type typically occurs after successive cycles of work and requires a long-term commitment from the utility. In determining the site-specific requirements to achieve the Wire Zone, Border Zone ideal, a variety of vegetation management techniques is considered. These may include biological, chemical, cultural, manual, or mechanical techniques. The choice of the best technique(s) is based on effectiveness, environmental impact, site characteristics, worker and public health and safety concerns, and economics.

Transmission Line Sag and Sway

Conductor sag and sway must be considered whenever managing transmission ROWs. Utility and contract employees shall be familiar with how conductor sag and sway can influence clearances on specific ROWs under normal and short-term emergency load conditions. Such elements as training, work assignments, contract specifications, and UVM manuals should include instructions for determining potential sag and sway at specific locations.

Discussion: When clearing or maintaining transmission ROWs, it is incumbent on employees to consider the potential sag and sway of conductors as it will influence clearance between vegetation and the lines. Failure to recognize and consider the impacts can lead to unexpected or premature contact between vegetation and the conductors.

Reclaiming ROWs

Transmission UVM programs should identify all sections of line that are not currently managed to the full extent of easement rights, the Wire Zone – Border Zone method or with other compatible land use. A plan should be developed that methodically works toward the goal of putting all ROWs under this or other compatible method of routine management.

Discussion: Many utility companies may have full documented rights to perform UVM work but, due to various reasons, have allowed the vegetation to become unmanaged. Each utility should assess the condition of all ROWs and work toward achieving complete system management and fully adhering to documented easement rights. It should be noted that Wire Zone – Border Zone practices are not likely to be achieved in all locations. For example, where transmission lines are routed through heavily populated areas, such things as existing landscaping, property owner objections, a lack of documented easement rights, and other local restrictions will make it unlikely that these types of clearances can be achieved or maintained. Work should be prioritized based on the extent of potential interference, voltage of the system, and relative importance of the circuit as a radial feed versus one with built-in redundancies.

Inspections of Vegetation Conditions

Field inspections of vegetation conditions should occur on a frequent basis, and the schedule should be based on anticipated growth. Aerial patrols should be complemented and calibrated by routinely scheduled ground patrols.

Discussion: It is important to perform routine inspections of all transmission facilities for potential conflicts involving vegetation. These inspections should be performed by qualified individuals and be scheduled to ensure that all transmission lines are systematically reviewed before conflicts occur. All inspections should be adequately documented and followed up on to ensure timely completion of the identified work requiring attention. The inspection cycle and schedule should be based on the predicted growth of existing vegetation. It should supplement, not replace, other utility line inspections. While helicopter patrols are adequate for many locations, ground patrols should be utilized whenever there is the possibility of not being able to accurately identify clearances between lines and vegetation.

Organizational Structure

Transmission UVM programs should be centralized within the utility and under the authority of a qualified, experienced and knowledgeable vegetation manager.

Discussion: We recommend that management authority and control of transmission UVM programs be centralized within the utility company in order to ensure consistency in practices and the appropriate utilization of available resources. We do not believe that the integrity of the entire system can be effectively maintained if the management is de-centralized. Transmission and distribution UVM activities can, however, be combined or separated as stand-alone programs based on the workload and desires of the utility. We also recommend that the program(s) have oversight from a qualified Utility Arborist.

Management Support

Utility management throughout the organization should support and be familiar with the necessity of and practices involved with UVM activities.

Discussion: Management from the CEO down needs to understand and support the UVM program and efforts. This support should be evidenced by reasonable and consistent funding, and demonstrated support for the use of applicable UVM techniques. Another important example would be the active and timely management support in resolving individual or agency refusals. (Refusals occur when an individual or entity stops or restricts the ability to perform required UVM work.)

Note: Many of the difficult political and financial problems related to vegetation management activities result from a lack of understanding by those in a position of power at the utility company. Communication skills are necessary for Utility Arborists to educate and inform, not only those directly related to the vegetation management program, but also to those in a position where funding and support are crucial to the program's success.

Qualifications

Utility and contract employees at all levels in a UVM program should have appropriate qualifications, ongoing training, and applicable certifications to perform the required work.

Discussion: In addition to applicable pesticide training and certifications, employees can utilize the existing industry credentials of the International Society of Arboriculture, including ISA Certified Tree worker, ISA Certified Arborist and ISA Certified Arborist /Utility Specialist. An ongoing training program is needed to maintain the credentials and provide a well-trained, motivated work force.

Research and Development

Utilities should have ongoing R&D efforts to evaluate current and potential tools and practices related to UVM work. The company should continuously evaluate new technology, products and work methods that are aimed at program improvement.

Discussion: While a full blown R&D program may not be practical at many utility companies (due to size, etc.) efforts should be undertaken by all utilities to support, monitor, and/or perform UVM-related research and development.

Clearly Defined, Communicated and Measured Objectives and Milestones

Utilities should have a formal management plan outlining UVM practices, objectives, and approved procedures. The plan should also include workload-related references and projections. The utility shall have a documented schedule and appropriate measures to ensure completion of required work. The management plan will require periodic revisions

Discussion: In order to ensure UVM efficacy, it is important to document, review, and ensure completion of appropriate plans and objectives. They need to continuously monitor performance and obtain compliance with reasonable goals and objectives.

Quality Assurance Procedures

Utilities should have a quality assurance program, and a documented procedure for ensuring that work is completed per specifications and industry standards. In addition, there should be ongoing efforts and protocols to identify and correct quality problems and issues.

Discussion: Utilities should incorporate fundamental "Quality" concepts into UVM programs. At many utility companies, QA procedures are limited to the post-auditing of completed work. We suggest more effort should be focused on building comprehensive Quality processes into UVM programs. Quality Control procedures need to be incorporated into work practices in the field. Quality Assurance oversight needs to be in place to confirm that work performed conforms to appropriate quality-driven work practices. A culture of quality needs to be inculcated throughout the vegetation management organization.

External Education

Utilities should have a comprehensive public education program that provides the public, individual landowners, and other agencies and groups with accurate information regarding Transmission UVM activities and practices.

Discussion: The majority of Utility Arborists recognize that there is a substantial disconnect between the public's understanding of proper UVM techniques, and what is actually scientifically correct and necessary. This issue is particularly true when it comes to subjects such as proper pruning, how tree-related outages occur, and the safe and effective use of herbicides. We believe that one of the best ways to address these misunderstandings is through public and agency education programs.

Internal Education

Utilities and contractors should have internal training programs that provide ongoing training to UVM employees. Utilities should also provide training to other utility departments regarding UVM activities and objectives.

Discussion: Given the scope of required knowledge relating to UVM activities, it is essential that ongoing education is available to both utility and contract employees who work in UVM programs. In addition, the work of UVM is influenced by, or does influence, a myriad of utility company activities. Examples include customer service, design engineering, construction, purchasing, and the legal, public relations and regulatory departments. We believe that each of these groups should have a solid understanding of utility company UVM activities.

Work Management Measurement

Utilities should have a system(s) and procedures capable of managing work identification, assignments, and the job status for required UVM work. This should include the ability to document and track historic work at any given location.

Discussion: The utility should be able to monitor and document all UVM-related activities.

Pruning and Clearances

Pruning shall be done in accordance with ANSI A300 guidelines. Clearances, obtained at time of pruning, shall be achieved with specific consideration given to line sag and sway, expected weather conditions, and the anticipated pruning response of the specific tree.

Discussion: A300 pruning guidelines should be followed, and the clearance should be based on the tree and utility-specific circumstances. Pruning can be complemented by the use of tree growth regulators. These chemicals can reduce shoot growth and corresponding line interference. Application of bud-inhibiting chemicals to interfering branches on trees adjacent to ROW can prevent further growth and encroachment into the ROW.

RECOMMENDED READING FOR BEST-IN-CLASS IVM PRACTICES AND OTHER REFERENCE MATERIAL

1. **Transmission System Vegetation Management Program, Environmental Impact Statement (DOE/EIS-0285)** *Prepared by the Bonneville Power Administration*

   Description: This Environmental Impact Statement (EIS) was prepared by the Bonneville Power Administration (BPA) in 2000, and was subsequently adopted and approved by the US Forest Service and the US Bureau of Land Management. This comprehensive document describes how BPA will manage its vegetation adjacent to transmission lines and corridors so as to ensure its intended operation. It contains valuable information on subjects ranging from Integrated Vegetation Management (IVM) techniques and tools, to detailed discussions on the environmental impacts of transmission UVM work. While prepared specifically for BPA, the content is applicable to most UVM transmission programs in the US and Canada.

2. **The Edison Electric Institute's "Draft" Memorandum of Understanding (MOU)**

   Description: This "draft" MOU was developed by the Edison Electric Institute (EEI) Vegetation Management Task Force and has been presented to various US agencies. The intent of this document is to establish a framework for early cooperation and participation among the signatories that will enhance coordination of the processes under the National Environmental Policy Act of 1969, as amended, (NEPA) and other related statutes in connection with the authorizations that are required to maintain vegetation on the rights-of-way of electric utilities. Specifically, the intent of this MOU is to establish a process to ensure safe and reliable utility services while protecting and/or enhancing wildlife habitat on and adjacent to ROWs. It requires a focus on environmental stewardship while ensuring the timely development and completion of needed utility vegetation management projects. The MOU will also set a framework for EEI-member utilities to establish processes for the preparation of site specific vegetation management plans for agency consideration.

3. **Research of Drs. Bramble and Byrnes on the Pennsylvania Game Lands 33 Research Sites**

   Description: The research work of Dr. William Bramble and Dr. W. Richard Byrnes (Purdue University) established the foundation for proper UVM activities along transmission ROWs. Their research, which has spanned the past 50 years, has resulted in a solid understanding of the appropriate techniques and environmental benefits associated with modern UVM best practice techniques. They have produced a tome of scientifically peer-reviewed data that is useful to all Utility Arborists, for example: Bramble, W.C., W.R. Byrnes, R.J. Hutnick and S.A. Liscinsky. 1991. *Prediction of cover type of rights-of-way after maintenance treatments.* Journal of Arboriculture. 17:38-43.

4. **The ANSI A300 Standard and the "DRAFT" ANSI Standard for Integrated Vegetation Management (IVM)**

   Description: Currently, proper pruning standards for UVM can be found in the *American National Standard for Tree Care Operations A300 (Part 1)-2001 Pruning*. Recently, an ANSI subcommittee has been formed to develop a draft of an additional ANSI standard that will cover IVM Practices. The International Society of Arboriculture (ISA), in collaboration with the Utility Arborist Association (UAA), will be developing a "Best Management Practice" document that will cover A300 pruning, and ultimately the standard on IVM.

WEB SITE RESOURCES

International Society of Arboriculture: Resources for the green industry at large. http://www.isa-arbor.com/

Utility Arborist Association: Resources for utility arborists. http://www.utilityarborist.org/

Tree Care Industry Association: Tree care standards and resources for tree care companies, educational and safety programs. http://www.treecareindustry.org/

The National Arbor Day Foundation: Tree Line USA, Tree City USA, educational information on right tree, right place concepts. http://www.arborday.org/index.html

Tree Line Connection: Resources for utility arborists, links to utilities and state commissions. http://www.utilityarborist.com/

Pesticide Environmental Stewardship Program: EPA site for Integrated Pest Management. http://www.epa.gov/oppbppd1/PESP/about.htm

Project Habitat: BASF site for ROW management. http://www.vmanswers.com/default.asp?page=vmg|products|projectHabitat

Safe Tree: Public education about trees and power lines. http://www.safetree.net/

Safe Tree Kids: Educational tools for teachers and parents. http://www.safetreekids.net/

VIII. LIST OF APPENDICES

Appendix A: California Public Utilities Commission General Order 95, Rule 35

Appendix B: Electrical Protection Act Alberta Electrical & Communication Utility Code

Appendix C: Urban Wildland Interface Code

Appendix D: Cinergy Tree Related Outage

Appendix E: Examples of Absolute and Restrictive Easement Rights

Appendix F: Ohio Rainfall Data

Appendix G: Report by Dr. David Wood, Professor Emeritus, UC Berkeley

Appendix H: Sample State UVM Standards and Requirements (Submitted October 2003)

Appendix I: Engineering Assumptions

Appendix J: Industry Recommendations

Appendix K: ANSI A300, Section 5.9 – Utility Pruning

Appendix A: California Public Utilities Commission General Order 95, Rule 35

Where overhead wires pass through trees, safety and reliability of service demand that tree trimming be done in order that the wires may clear branches and foliage by a reasonable distance. The minimum clearances established in Table 1, Case 13, measured between line conductors and vegetation under normal conditions, shall be maintained. (Also see Appendix E for tree trimming guidelines.)

When a utility has actual knowledge, obtained either through normal operating practices or notification to the utility, dead, rotten and diseased trees or portions thereof, that overhang or lean toward, and may fall into a span, should be removed.

Communication and electric supply circuits, energized at 750 volts or less, including their service drops, should be kept clear of limbs and foliage, in new construction and when circuits are reconstructed or repaired, whenever practicable. When a utility has actual knowledge, obtained either through normal operating practices or notification to the utility, that any circuit energized at 750 volts or less shows strain or evidences abrasion from tree contact, the condition shall be corrected by slacking or rearranging the line, trimming the tree or placing mechanical protection on the conductor(s).

EXCEPTIONS:

1. Rule 35 requirements do not apply to conductors, or aerial cables that comply with Rule 57.4-C, energized at less than 60,000 volts, where trimming or removal is not practicable and the conductor is separated from the tree with suitable materials or devices to avoid conductor damage by abrasion and grounding of the circuit through the tree.

2. Rule 35 requirements do not apply where the utility has made a "good faith" effort to obtain permission to trim or remove vegetation but permission was refused or unobtainable. A "good faith" effort shall consist of current documentation of a minimum of an attempted personal contact and a written communication, including documentation of mailing or delivery. However, this does not preclude other action or actions from demonstrating "good faith." If permission to trim or remove vegetation is unobtainable and requirements of exception 2 are met, the utility is not compelled to comply with the requirements of exception 1.

3. The Commission recognizes that unusual circumstances beyond the control of the utility may result in nonconformance with the rules. In such cases, the utility may be directed by the Commission to take prompt remedial action to come into conformance, whether or not the nonconformance gives rise to penalties or is alleged to fall within permitted exceptions or phase-in requirements.

Mature trees whose trunks and major limbs are located more than six inches, but less than 18 inches, from primary distribution conductors are exempt from the 18-inch minimum clearance requirement under this rule. The trunks and limbs to which this exemption applies shall only be those of sufficient strength and rigidity to prevent the trunk or limb from encroaching upon the six-inch minimum clearance under reasonably foreseeable local wind and weather conditions. The utility shall bear the risk of determining whether this exemption applies, and the Commission shall have final authority to determine whether the exemption applies in any specific instance, and to order that corrective action be taken in accordance with this rule, if it determines that the exemption does not apply.

Appendix B: Electrical Protection Act Alberta Electrical & Communication Utility Code

SECTION 3.1.7 Tree Trimming

(1) Subject to subsection (2), the operator of an electrical utility system shall ensure that trees near overhead power lines are trimmed so that the following clearances are maintained at all times, including the period of time between tree trims:

(a) a vertical clearance of 2.0 m plus the minimum distance to prevent flashover, from the conductors to any portion of a tree that will support a person; and

(b) a vertical clearance of 600 mm plus the minimum distance to prevent flashover, from the conductors to any portion of a tree that will not support a person; and

(c) a horizontal clearance of 1.0 m plus the minimum distance to prevent flashover, from the conductors to any portion of a tree that will support a person; and

(d) a horizontal clearance of 300 mm plus the minimum distance to prevent flashover, from the conductors to any portion of a tree that will not support a person.

(3) For overhead power or communication lines with metal sheathed, or polyethylene covered conductors, operated at voltages below 750 V between conductors, the minimum clearance between the conductors and trees shall be up to but not touching.

(4) Where trimming is impracticable, the conductors shall be protected as necessary to prevent damage and electrical hazards.

Appendix C: Urban Wildland Interface Code

2.3 Clearance of Brush and Vegetation Growth from Electrical Transmission and Distribution Lines.

2.3.1 General. Clearance of brush and vegetative growth from electrical transmission and distribution lines shall be in accordance with Section 2.3.

Exception: Section 2.3 does not authorize persons not having legal right of entry to enter on or damage the property of others without consent of the owner.

2.3.2 Support clearance. Persons owning, controlling, operating or maintaining electrical transmission or distribution lines shall have an approved program in place that identifies poles or towers with equipment and hardware types that have a history of becoming an ignition source, and provides a combustible free space consisting of a clearing of no less than 10 feet (3048 mm) in each direction from the outer circumference of such pole or tower during such periods of time as designated by the code official.

Exception: Lines used exclusively as telephone, telegraph, messenger call, alarm transmission or other lines classed as communication circuits by a public utility.

2.3.3 Electrical distribution and transmission line clearances.

2.3.3.1 General. Clearances between vegetation and electrical lines shall be in accordance with Section 2.3.3.

2.3.3.2 Trimming clearance. At the time of trimming, clearances not less than those established by Table 2.3.3.2 should be provided. The radial clearances shown below are minimum clearances that should be established, at time of trimming, between the vegetation and the energized conductors and associated live parts.

Exception: The code official is authorized to establish minimum clearances different than those specified by Table 2.3.3.3 when evidence substantiating such other clearances is submitted to and approved by the code official.

2.3.3.4 Electrical power line emergencies. During emergencies, the utility shall perform the required work to the extent necessary to clear the hazard. An emergency can include situations such as trees falling into power lines, or trees in violation of Table 2.3.3.3.

Table 2.3.3.2 – Minimum Clearances at time of trimming

Line Voltage	Minimum Radial Clearance from Conductor (feet)
2,400 – 72,000	4
72,001 – 110,000	6
110,001 – 300,000	10
300,001 or more	15

Table 2.3.3.3 – Minimum Clearances to be maintained

Line Voltage	Minimum Radial Clearance from Conductor (inches)
750 – 35,000	6
35,001 – 60,000	12
60,001 – 115,000	19
115,001 – 230,000	30.5
230,001 – 500,000	115

Appendix D: Cinergy Tree Related Outage

The following report, provided by Cinergy, outlines the sequence of events leading up to the August 14th tree-related outage on the Bedford – Columbus 345kV Line.

The August 14, 2003 tree related outage on the Cinergy transmission system was an atypical and isolated event that occurred on the Bedford – Columbus 34517 line. This event had no impact on, nor was it a contributing factor in the Northeast Blackout that occurred later in the day. The tree contacted the line on a property with a very dense growth of trees. A variety of issues had prevented the proper vegetation maintenance for safe and reliable operation of the line.

In addition to the 34517 line, this location has two 230kv transmission lines (double circuited on one tower) that cross the property. The lines are positioned in a manner that the easements for 345kv system and the 230kv system overlap. The property owner has frequently challenged Cinergy's ability to conduct proper vegetation management arguing that the easements restrict the amount of trimming/clearing that Cinergy can do. Additionally, the property owner argued that the trimming/clearing damaged the lake on his property, negatively impacted his property value, created heath issues related to the use of chemicals, and increased security concerns from trespassers. Because of these various concerns, the property owner insisted that Cinergy schedule a time to perform any maintenance work at his convenience so that he could observe and protect his interest by limiting the amount of trimming that would be done.

Various attempts had been made in past years, including in the spring of 2003, to negotiate a long-term settlement that was mutually acceptable to both parties, however the parties have been unable to reach agreement.

On August 12, 2003, a routine aerial patrol identified the property as creating an imminent hazard. Based on this report, the property owner was contacted (as requested) to make arrangements for the crews to work.

On August 14, 2003 at 0800hrs (EDT) crews arrived to perform the needed work. Several trees were trimmed, however, the property owner refused to allow the crew to complete the necessary trimming. By 1000hrs (EDT), the property owner had requested the crew leave the premises.

At 1208hrs (EDT) the 34517 line locked out, and after investigation it was determined that the lockout was due to contact with a tree on this property. Tree crews were directed to the site to begin immediate corrective action. Work began to clear the wire zone at approximately 1530hrs (EDT), and the line was returned to service at approximately 1820hrs (EDT). Crews also returned on the following day to perform work in order to provide better clearance on the 230kv circuits.

With the 8-14-03 event on the Cinergy system and the Northeast Blackout event, there was an even greater urgency to address fully the vegetation issues on this property. Additional discussions were held with the property owner, however, it became apparent that a mutually agreeable settlement could not be achieved within a reasonable timeframe. Mindful of the concern that another tree contact could happen, Cinergy developed an Action Plan to clear vegetation on the property to permit the safe and on-going reliable operation of the three circuits~~.~~

The Action Plan was implemented on September 9, 2003, however, the property owner obtained a Temporary Restraining Order on that afternoon which prevented any further work until a court hearing could be conducted.

The hearing occurred on September 19, 2003, and the property owner was not successful in providing adequate evidence to support a permanent injunction to prevent or limit the tree trimming activities. Therefore, the case was dismissed by the court.

Cinergy contractors were able to resume work activities on September 23, 2003 and continued until the full Action Plan was completed on October 9, 2003. The property will continue to receive annual maintenance attention to ensure that vegetation within the easement does not impact the lines operation.

Appendix E: Examples of Absolute and Restrictive Easement Rights

Based on our review of various easement documents, ordinances, and mutual agreements, it appears that there is a wide variety of varying, and often conflicting, rights to perform required UVM along transmission lines and corridors. The following provides examples.

Absolute Rights

The following is language taken from an easement document that describes the rights of the utility regarding what can be pruned or removed. It is an example of absolute rights.

> "The easement and rights herein granted shall include the right to erect, inspect, operate, replace, relocate, repair, patrol and permanently maintain upon, over, under and along the above described right of way across said premises all necessary structures, wires, cables and other usual fixtures and appurtenances used for or in connection with the transmission and distribution of electric current, including telephone and telegraph, and the right to trim, cut, remove or control by any other means at any and all times such trees, limbs and underbrush within or adjacent to said right of way as may interfere with or endanger said structures, wires or appurtenances, or their operations."

These rights should be fully enforceable by the utility and should not significantly limit their work.

Restrictive Rights

The following excerpts taken from the Cleveland Metropolitan Park District easement initially appear to provide explicit rights with regard to pruning and removal but, in fact, do not:

Paragraph 6:
"The right at all times to trim or cut all or part of any trees within or without the limits of the Easement Area in order to maintain at all times a clearance of ten (10) feet between any such trees, whether standing or fallen, and the nearest wire of said transmission lines; and further, during the period of original construction and during any period thereafter when said wires are being reconstructed, repaired, renewed or removed, the right to trim, cut, and remove all trees. Branches, and wooded growth to the extent approved by Grantor in writing, except at tower sites where an area of minimum dimensions require for the construction, repair, or maintenance of the tower, but in no case an area exceeding ninety (90) feet square with its center being the coincident with the center of the base of the tower, may be cleared of trees, branches, and wooded growth…"

However, the permit goes on to read in Paragraph 6, Part D, "Specific practices will be adhered to as described in <u>Exhibit A</u> attached hereto and made part hereof."

In addition to the boilerplate language provided above, Exhibit A describes, in more detail, what can and cannot be done on this particular right-of-way.

Exhibit A:
"…Cleveland Metroparks staff was especially concerned about the impact of new lines on the mature forest. To evaluate the impact, FirstEnergy located the proposed easement in the field and Park District staff surveyed the trees within the easement….. From that information, a profile of the valley showing each tree and the sag of the new high tension lines was developed.

Based on this study, a series of discussions were held on methods to minimize the impact of the high voltage line crossing. As a result of these discussions, the following parameters for the new lines were developed and have been accepted by FirstEnergy as conditions for granting of the relocated easement:

1. The new and existing easement will be reduced in width from 150 feet to ± 130 feet resulting in a net decrease of 0.03 acres in the easement even though the distance of the crossing is ± 260 feet longer.

2. There are 81 trees over twelve inches in diameter within the new easement. Approximately 39 trees will need to be trimmed, and of those, twenty trees will be trimmed twenty feet or more. No trees will need to be removed.

In this example, an easement that started out providing relatively explicit rights has now been modified to address concerns of the Park District. On one hand, it illustrates how utility companies commonly work with other stakeholders to balance often-competing priorities. On the other hand, it illustrates the common practice of reducing the ability and rights of the utility to aggressively maintain the vegetation.

Appendix F: Ohio Rainfall Data

	1996	1997	1998	1999	2000	2001	2002	2003 (January through June)
Akron/Canton								
Rainfall	46.92	32.29	40.28	35.81	45.61	32.90	40.67	19.32
Normal	36.82	36.82	36.82	36.82	36.82	36.82	36.82	18.82
Above/Below Normal	10.10	(4.53)	3.46	(1.01)	8.79	(3.92)	3.85	0.50
Percent of Normal	127%	88%	109%	97%	124%	89%	110%	103%
Cleveland								
Rainfall	46.36	35.36	32.82	31.97	30.59	34.36	36.39	19.17
Normal	36.63	36.63	36.63	36.63	36.63	36.63	36.63	18.47
Above/Below Normal	9.73	(1.27)	(3.81)	(4.66)	(6.04)	(2.27)	(0.24)	0.70
Percent of Normal	127%	97%	90%	87%	84%	94%	99%	104%
Mansfield								
Rainfall	53.06	38.86	37.49	34.11	40.48	33.99	37.25	15.78
Normal	39.66	39.66	39.66	39.66	39.66	39.66	39.66	21.27
Above/Below Normal	13.40	(0.80)	(2.17)	(5.55)	0.82	(5.67)	(2.41)	(5.49)
Percent of Normal	134%	98%	95%	86%	102%	86%	94%	74%
Dayton								
Rainfall	54.70	31.23	39.12	29.86	34.33	42.20	37.84	18.62
Normal	38.66	38.66	38.66	38.66	38.66	38.66	38.66	19.33
Above/Below Normal	16.04	(7.43)	0.46	(8.80)	(4.33)	3.54	(0.82)	(0.71)
Percent of Normal	141%	81%	101%	77%	89%	109%	98%	96%
Cincinnati								
Rainfall	53.40	40.12	51.39	32.47	45.81	46.58	44.30	19.74
Normal	41.60	41.60	41.60	41.60	41.60	41.60	41.60	20.80
Above/Below Normal	11.80	(1.48)	9.79	(9.13)	4.21	4.98	2.70	(1.06)
Percent of Normal	128%	96%	124%	78%	110%	112%	106%	95%
Columbus								
Rainfall	45.57	37.96	37.56	27.57	42.85	36.87	39.38	20.28
Normal	37.62	37.62	37.62	37.62	37.62	37.62	37.62	18.81
Above/Below Normal	7.95	0.34	(0.06)	(10.05)	5.23	(0.75)	1.76	1.47
Percent of Normal	121%	101%	100%	73%	114%	98%	105%	108%
Averages for All Areas								
Rainfall	300.01	215.82	238.66	191.79	239.67	226.90	235.83	112.91
Normal	230.99	230.99	230.99	230.99	230.99	230.99	230.99	117.50
Above/Below Normal	69.02	(15.17)	7.67	(39.20)	8.68	(4.09)	4.84	(4.59)
Percent of Normal	**130%**	**93%**	**103%**	**83%**	**104%**	**98%**	**102%**	**96%**

Appendix G: Report by Dr. David Wood, Professor Emeritus, UC Berkeley

The following report, written by Dr. David Wood, provides technical information regarding how precipitation can influence vegetation managed by utility companies.

Precipitation and Tree Growth

It is well known that climate has an important influence on tree growth. Numerous tree ring studies conducted worldwide have shown that severe droughts are clearly associated with depressed growth rates. Twenty-five years of modeling studies have shown water availability is the essential driving force in forest productivity.

Tree ring diameter growth (wood production) is related directly to water availability and transpiration. Even when a tree has a healthy crown with high photosynthetic potential, under conditions of water stress, diameter expansion will be limited, diameter growth being the first sacrifice made by the tree. This is followed by leaf shedding and death of minor and lower branches.

Trees also respond to water stress by stomatal closure, development of the cuticle in leaves, and development of deep root systems. As drought periods continue, the lack of available water leads to significant stress to trees followed by a potential increase in pest and/or pathogen attack. These occurrences can lead directly to decreased tree health and increased tree mortality as evidenced by the beetle infestations that have occurred during droughts.

Different tree species vary in their tolerance to drought. Therefore, some species will be highly sensitive to drought effects, whereas others may not. However, all species, whether adapted to drought or not, will suffer the effects of a greatly protracted drought. It is very difficult for vegetation managers to accurately prepare for the possible effects of drought on tree health before the onset of a drought. While it is well known that a lack of available water can cause significant harm to trees, the many variables that influence tree growth and health make it almost impossible to predict which trees will actually succumb to drought-induced problems.

For example, the growth of an individual tree is greatly influenced by its relationships with other trees growing together in stands. Stated another way, trees growing in a forest setting do not grow independently from one another. Competition for light, space and moisture occurs among neighboring trees, and the severity of this competition is influenced by distances between trees, genetics, crown structure, stand history and management, root structure, and the presence of low growing vegetation.

Roots capture unoccupied space faster than crowns, so understory vegetation can be an important factor as well. As discussed above, there are several important effects of drought on trees. First, it is well established that periods of drought slow tree growth. Second, periods of prolonged or severe drought can greatly weaken trees. Third, trees experiencing stress from drought conditions become more susceptible to attack by bark beetles and their fungal associates.

Water relationships in plants are critical to their survival. Plants die when they reach their "permanent wilting point." When water loss exceeds water intake, the plant undergoes water-induced stress. In general, plants exposed to a severe water deficit are more vulnerable to insect and microbial attack than plants that receive adequate water.

The role of water stress in conifers (the predominant trees in the urban/wildland interface of California) and colonization by bark beetles has been studied for several species. Stressed trees are killed by bark beetles (and a few other families of beetles) and pathogens. Early research on water relations in ponderosa pine was studied in1961 at Grass Valley, California. It was demonstrated that the oleoresin exudation pressure (OEP) of ponderosa pines was directly related to the loss of water through transpiration in the tree canopy. This critical experiment demonstrated that watering the canopy during mid-day (when water loss is greatest from the needles) caused an increase in the OEP. Oleoresin is considered to be the tree's key defensive mechanism against attack by bark beetles.

In general, the greater the availability of water to the roots of the tree, and/or the greater the reduction of water loss through the needles, the greater the tree's capacity to withstand infestation by bark beetles and microorganisms. The relationship of OEP to tree mortality caused by the western pine beetle and mountain pine beetle was demonstrated at this time.

Periods of drought also slow tree growth. Moisture deficits cause fine rootlet mortality. Tree ring analyses are used extensively to study rainfall patterns, which have recently provided evidence in support of global warming trends. Reduced growth is also caused by high stand density, i.e., through competition for water, etc. In general, the higher the density, the slower the growth rates of the trees. The slower the growth rates, the more vulnerable they are to bark beetle infestation.

Stand hazard rating systems for bark beetles take into account moisture availability. For example, thinning is one of the recommended treatments to lower stand susceptibility to bark beetle infestation. Thus, more moisture, light and space are made available to the uncut trees.

Growth is the biological process of increase in size with time. This process involves converting sunlight energy, carbon dioxide, and water to wood and leaf mass, and interacting or adapting to temperature, moisture, and nutrient conditions and biological agents. Additionally, tree growth rates can be influenced by both tree species and age. Different species grow at different rates. Additionally, some species grow rapidly early in their lives, then later slow down, while others grow at more constant rates (e.g., eucalyptus vs. Monterey pine. Age and species are therefore key variables in the growth equation.

Just as drought has the effect of suppressing tree growth, an increase in available water typically results in increased tree growth. Precipitation can increase baseline growth by as little as 10 percent or as much as 300 percent. As previously stated, water availability has, indeed, a significant influence on tree growth. The phenomenon of increased tree growth related to increased precipitation has been witnessed by forestry professionals and scientists for over 100 years.

Water availability is the factor most referred to as having a predominant effect on forest productivity. While studies of excessive water on the susceptibility of trees to bark beetle infestation are limited, research indicates that fine root biomass is reduced under such conditions, with trees having lowered resistance to bark beetle invasion. In the first year following the drought, growth would be less than in the second year following the drought. In the first year the tree would begin to increase its photosynthetic capacity by adding more needles and by adding longer needles. Also, the fine rootlet mass would be increased, facilitating greater uptake.

Because of the extended drought stored carbohydrates would be very low and the number of needles and their size would be greatly reduced. Internode length and year ring width would be increased in the years following the end of the drought. Thus, year ring width in the first year following the drought would be less than in the second year, but greater than the year ring produced during the last year of the drought. Vegetation managers do not have the ability to predict how long a drought will last.

Appendix H: Sample State UVM Standards and Requirements (Submitted October 2003)

All of the following were answers received from the respective commissions in response to the Power System Outage Task Force information requests.

New York State Public Service Commission

"The New York State Public Service Commission (PSC) supervises the standards for tree trimming, foliage management, and ROW clearance management within transmission corridors under its Regulations at 16 NYCRR Part 84. That provision sets out the framework for the submittal and approval of ROW vegetation management plans (ROW VMP) filed by each jurisdictional utility. Specifically, PSC regulations require that every ROW VMP contain standards for tree trimming and right-of-way vegetation "management". While each utility's approved ROW VMP is different in detail, overall they reflect consistent themes for ROW management activities, techniques and specifications regarding conductor clearance zones."

New Jersey Board of Public Utilities

"The New Jersey Board of Public Utilities (NJBPU) has drafted a proposed rule and is in the process of soliciting comments from the public regarding standards for tree trimming, foliage management, or right of way clearance management within transmission corridors. Pursuant to the Electric Discount and Competition Act of 1999, the New Jersey Board of Public Utilities must adopt appropriate standards to assure the continued provision of "high quality, safe and reliable service" to electric utility customers in the restructured electric utility environment. Recognizing that trees and other vegetation are factors in causing service interruptions, part of an overall approach to providing safe and reliable electric service is to maintain trees and other vegetation so as to prevent contact with electric facilities."

Pennsylvania Public Utilities Commission

"The Pennsylvania Public Utility Commission has not established formal standards for tree trimming, foliage management or right of way clearance management within transmission corridors.

However, in August 2002, in response to a Staff Inspection and Maintenance Study, the Commission considered whether to prescribe specific inspection and maintenance standards, including tree trimming requirements, for electric distribution companies. Although the Commission declined to adopt prescriptive standards at that time, it agreed with Staff recommendations to establish specific reporting requirements aimed at gathering inspection and maintenance information. (Order adopted August 29, 2002 at Docket No. M-00021619.)

Thereafter, on June 26, 2003, the Commission adopted proposed regulations that contain provisions which would require electric distribution companies to submit information on quarterly and annual bases regarding the inspection and maintenance of transmission systems, including vegetation management, distribution and substation maintenance activity and capital improvement projects. The proposed format of this reporting requirement would allow for a comparison of the previous year's inspection and maintenance goals to the actual results achieved. For instance, this portion of the report would show the company's goal for the number of transmission line trimming and clearing projects for the year, as well as the number of such projects that were actually completed. (Order adopted June 26, 2003 at Docket No. L-00030161).

Also in the June 26, 2003 Order, the Commission directed the electric distribution companies to comply with the proposed regulatory requirements pending finalization. The companies will begin submitting quarterly reports to the Commission in November 2003 and annual reports in March 2004 that will include documentation of inspection and maintenance goals and expenses, as well as staffing levels for transmission and distribution operation and maintenance."

Michigan Public Service Commission
"The Michigan PSC has adopted Rules regarding Services Supplied by Electric Utilities. Rule 505 provides as follow:

Each utility shall adopt a program of maintaining adequate line clearance through the use of industry-recognized guidelines. A line clearance program shall recognize the national electric safety code standards that are adopted by reference I R 460.811 et seq. The program shall include tree trimming.

When it was adopted, this rule applied generally to electric transmission and distribution in Michigan. However, subsequently almost all transmission has been divested to independent transmission companies. The Detroit Edison Company transmission system has been sold to the International Transmission Company. Consumers Energy Company's system was sold to Michigan Electric Transmission Company. The various utility transmission systems in Michigan's Upper Peninsula were divested to the American Transmission Company. In addition, the Wolverine Power Supply Cooperative owns and operates 1600 miles of transmission in western and northern Michigan. Each of these transmission companies is subject to the jurisdiction of the Federal Energy Regulatory Commission rather than the Michigan PSC."

Ohio Public Utilities Commission
"The Public Utilities Commission of Ohio's (PUCO) Electric Service and Safety (ESS) Rules provide for extensive inspection and reporting requirements by electric distribution utilities in Ohio. Under the rules, each utility is required to comply with the National Electrical Safety Code, establish a maintenance plan, and regularly inspect transmission lines, distribution lines, and substations. In addition, each utility is required to annually report: whether it has met system-wide performance targets, how it plans to address its worst-performing circuits and whether it has met maintenance goals.

Under Ohio Administrative Code (OAC) rules 4901:1-10-26 and 4901:1-10-27, the PUCO requires each utility that owns transmission in Ohio to file with the PUCO a formal report on its methodology to assess the reliability of its transmission and distribution circuits and equipment. The companies filed their first reports in January 2001. PUCO staff reviewed the methodologies with each company, either accepting the methodology or recommending changes. Right-of-way vegetation control was explicitly mentioned within the scope of this requirement.

In March 2001, each company submitted a report to PUCO staff detailing its methodology used to assess the reliability of its transmission circuits for review and acceptance. OAC rules 4901:1-10-27 (C) and (D) require each utility to file a transmission system performance assessment report by March 1 of each year, beginning March 2002. OAC rule 4901:1-10-27 (C)(2) requires each company to file annually a report that identifies the performance of each transmission circuit for the previous year. OAC rule 4901:1-10-27 (D)(4) requires each company to file annually a report on its compliance with the following inspection schedule for transmission lines and substations:

- All transmission circuits and equipment shall be inspected at least once every year.

- All transmission and distribution substations and equipment shall be inspected at least once each month.

OAC rule 4901:1-10-27 (C)(2) requires at a minimum the following information be provided for each transmission circuit in the annual report:

a) Circuit identification number
b) Location of each circuit
c) Number of outages and their causes by circuit
d) Substation(s) and /or distribution circuit(s) affected by each outage
e) Remedial action taken or planned
f) Start and completion dates of any remedial action taken or planned

All the companies have marked this transmission outage data as confidential."

Massachusetts Department of Telecommunications and Energy

"The Massachusetts Department of Telecommunications and Energy (DTE), a public utility commission, has evaluated electric companies tree trimming and foliage management plans and practices on numerous occasions in the past 10 years and continues to evaluate them on an on-going basis.

Regulated companies are required to file storm preparation plans annually, which include foliage management plans as part of pre-storm preventive maintenance. In addition, the companies are required to file tree trimming schedules with the DTE on a quarterly basis as part of their service quality reporting requirements.

Additionally, as part of service quality assessments, the companies are required to file tree trimming policies, including cycles, inspection procedures, and typical minimum vegetation clearance requirements as well as budget information (including funds expended for tree trimming in the past ten years).

The participants of the New England Power Pool (NEPOOL), which include the Massachusetts electric companies, have adopted a standard for vegetation management of transmission right-of-ways. (See Attachment A, NEPOOL Vegetation Management Standard).

Based on our review of the company filings to the DTE and the NEPOOL standards, the DTE has not found reason as yet to adopt any formal universal standards beyond the current company-specific guidelines and the NEPOOL standards implemented by the companies.

Furthermore, most of the transmission systems are located in relatively large right-of-ways, which give the companies approximately 30-feet of access to the infrastructure, i.e., no tree-trimming permission from the community or property owner is typically required. This way the companies are allowed to do clear cutting, which could provides substantially more clearance than the requirements established in the above-mentioned NEPOOL standard."

Connecticut Department of Public Utility Control

"The Department does have standards and filing requirements related to distribution vegetation management; however, it has the belief that transmission vegetation management is subject to FERC jurisdiction, the Independent Systems Operator of New England (ISO-NE), and therefore state commissions are precluded by federal pre-emption from asserting jurisdiction over these matters."

Vermont Public Service Board
"Formal standards for vegetative management are specified in Vermont Public Service Board Rule 3.600. Please see http://www.state.vt.us/psb/rules/3600_ROW.pdf The following are excerpts from Rule 3.600:"

3.630. PLANS

3.631 Plan Required

Each utility, including VELCO, shall submit to the Board and the Department a long-term vegetation management plan which should include:

(A) A general statement of policy and goals;

(B) Identification of a biologically sound schedule to achieve long-term objectives, including a specified time interval between original control and subsequent scheduled control;

(C) Description and identification of the species to be eliminated or controlled, versus the species to be left, in various types of vegetative settings;

(D) List and description of techniques and conditions under which given mechanical, chemical, and other methods would normally be considered appropriate;

(E) Procedure for identifying, evaluating, reporting,and responding to right of way maintenance problems;

(F) Establishment of clearance standards sought, based on voltage of transmission line, and the part of the right of way to be controlled; i.e., central strip, side strip, high visibility, other;

(G) Establishment of standards and practices for:

(1) Wetlands;

(2) Wildlife;

(3) Erosion control;

(4) Aesthetic considerations;

(H) Establishment of right of way inspection and monitoring standards including frequency of inspection, manner of inspections, and criteria. Standards shall relate to at least the following matters: heights of road-crossing screens or ideal clearance levels, danger trees, evidence of tree-conductor contact, species identification, conditions of sensitive areas, notation of condition of specially or experimentally treated areas;

(I) Retention of records to coincide with maintenance cycle of the company including right of way inspection dates, maintenance schedules, and maintenance activities;

(J) Provisions for periodically reviewing, evaluating, and revising the long-range plan, and the time interval for such revisions;

(K) Provision to assure contractor accountability in implementing the plan.

3.632 Exemption

If a utility believes that it should not be required to have such a plan in place, or that only a brief summary is required because its lines are located solely in urban or other clear areas, it may file instead a request for exemption with the Board, with a copy to the Department of Public Service.

3.633 Filing

Plans shall be filed with the Board and the Department of Public Service.

3.634 Consistency

It shall be no objection to a plan that it includes provisions to comply with the requirements of some other state or federal agency.

3.640 ALTERNATIVES

3.641 Alternatives Provided

(A)

(1) When a landowner whose property is traversed by a utility right of way, the maintenance of which is governed by these regulations, requests of a company in writing that it refrain, from using herbicides in clearing the right of way, the company shall initially offer to perform the work using stump treatment or stem injection only. if the landowner accepts this level of herbicide use, the company shall perform the maintenance work using stump treatment or stem injection methods, free of charge to the landowner. If the landowner refuses the use of any herbicide whatsoever, the company shall be paid the rate determined in subsection (B) below if the right of way is for transmission or subtransmission line; but no payment shall be required if the right of way is for distribution line.

(2) The landowner's written request must be delivered to the company not less than 14 days before any scheduled use of herbicides.

(3) The terms "stump treatment or stem injection methods" shall, respectively, have the meanings defined in the regulations of the Vermont Department of Agriculture, that is, the placement of herbicide on the cut surface of a stump or inside a wound made with a cutting tool.

(4) Payment required under this subsection shall be made to the company not less than 7 days before the scheduled use of herbicides.

(B) A landowner who elects not to permit any herbicides under subsection (A) above shall pay a charge of $30 toward the company's administrative costs. A separate charge shall apply for each non-contiguous property with respect to which the election is made; however, a farm or a non-corporate landowner which is not a governmental entity shall not be required to pay more then $120 to any one utility in any one year.

(C) The utility company shall perform maintenance in the manner required under (A) or (B) above, provided, however, that the company may require each landowner requesting an alternative method to indicate the location and boundaries of the portion of the right of way concerned. The company may require the landowner or the landowner's agent to mark the property in a distinctive fashion or to attend an on-site meeting with designated maintenance personnel.

(D) For purposes of this Section 3.641, "landowner" shall include the owner of land which abuts a distribution right of way located along a public highway.

(E) Each utility shall prepare and send to the Board and the Department by June 15 of each year a statement showing the number of persons who have made an initial request under subsection (A) above, the number who have agreed to stump treatment or stem injection methods, and the number who have refused all use of herbicides. The listing need only cover those rights of way which are chemically treated during the year of submission.

Appendix I: Engineering Assumptions

As explained in various parts of this report, the initial tree contacts (and subsequent outages) were more an issue of tree growth, as opposed to line sag. To supplement this finding, we performed a review of the specific practices at AEP, FE, and Cinergy in order to assess their procedures, practices, and assumptions related to this important engineering consideration. The following represents the findings of this effort.

ANALYSIS OF ASSUMPTIONS USED FOR LINE RATINGS, LINE SAG, AND LINE CLEARANCE

The following table is a comparison of the assumptions used by FirstEnergy (FE), Cinergy, American Electric Power (AEP), and by the industry at large for line ratings, line sag, and line clearances[48].

In general, the three utilities analyzed employed transmission line rating, sag, and clearance procedures that are in line with the electric utility industry at large. The assumptions that they use in these procedures are also generally in line with the industry at large.

Specific areas of concern are included in the appropriate sections of the UVM Program Assessments.

[48] Review prepared by William S. Gray Jr., P.E.

DETAILED ENGINEERING RESPONSES

#	Review Questions	FE	Cinergy	AEP	Benchmark
	LINE RATINGS				
1.	Are there State codes or regulations that govern transmission line ampacity ratings?	Yes, The Ohio Administrative Code (4901:1-10-06) mandates compliance with NESC	NESC	Yes, Ohio mandates compliance with NESC	Yes, State Public Utility Commission General Orders
2.	Do you have Company standards that specify transmission line ampacity?	Yes	Yes, *“Conductor and Equipment Rating Guide”* attached	Yes, *“A Guide for Maximum Temperature And Ampacity of Bare Overhead Conductors”*	Yes
3.	Do your Company standards regarding line ratings comply with the State codes or regs?	Yes	Yes	Yes	Yes
4.	Have you done any benchmarking to determine the best practices with regard to assigning ampacity ratings to overhead transmission lines?	No	Informal comparisons with other utilities	No	No
5.	Do you participate in industry organizations such as IEEE, EEI, ANSI, or CIGRE?	Yes, IEEE, ASTM, AEIC, and Ohio Electric Utility Institute	IEEE Insulated Conductors Committee, ASCE Structure Loading Committee	ANSI, ASCE, EEI, IEE, and EPRI	Yes, IEEE Conductor Rating Working Committee, ANSI Standards Groups

#	Review Questions	FE	Cinergy	AEP	Benchmark
6.	Do you follow industry organization working committees' recommendations regarding transmission line ratings?	Yes, ECAR, NERC, and MISO	Yes, IEEE 738-1993	Yes, industry codes, standards, guidelines, and operating experience	Yes, IEEE 738-1993
7.	Do your Company standards regarding line ratings conform to IEEE 738-1993?	Yes, ECAR Guide 68-TAP-28 is the same as IEEE 738	Yes	Yes	Yes
8.	Do your Company standards regarding line ratings conform to manufacturers' recommendations?	Yes, manufacturers' ratings are not exceeded	Yes	Yes	Yes, Southwire and Alcoa for example
9.	Are your transmission line ratings adjusted for:	See footnote [49]			
9a	Seasonal variations in temperature	Yes	Yes, summer and winter ratings are applied	Yes, summer and winter normal and emergency ratings are applied	Yes, Summer- April through October; Winter-November through March
9b	Wind velocity	Yes	No, 2 mph used everywhere.	No, 2 mph used everywhere.	Yes[50]

[49] Wind velocity and ambient temperature play a dominant role in determining transmission line loadability. Reasonably conservative values (35°C summer, 0°C winter, 2.1 mph summer and 1.3 mph winter) have been chosen to determine loadabilities for planning studies, however loadability levels are available for specific ambient conditions being experienced in actual operation of the transmission system. In addition, the wind direction azimuth is assumed to be perpendicular to the conductor. Solar radiation effect is also used, the sun chosen for summer ratings is July 3 (1400 hours) and no sun for winter.

[50] On a case-by-case basis, following detailed inspection of the line. With approval of Transmission Department Manager lines may be rated based on 4 fps wind speed rather than the standard 2 fps.

#	Review Questions	FE	Cinergy	AEP	Benchmark
9c	Elevation?	No, rather than adjust for the elevation for each line section a 1000 ft. elevation is assumed for use in the ECAR Guide 68-TAP-28 and IEEE 738-1993.	No, an elevation of 500 feet is used for all ratings	No	No, used maximum elevation for entire service territory.
10.	Are emergency, or short-time overload, ratings assigned?	Yes, using parameters that correlate to a 5% risk	No	Yes, emergency ratings are a long-term continuous load rating based upon loss of life of the facility. Under certain contingencies 115% of emergency ratings may be used depending on real time conditions.	Yes, up to 100 hours/yr, 10-25% depending on season and ambient temperature duration curve
11.	Do you employ any sort of dynamic thermal rating?	No, piloting device from the Valley Group	No	No	Yes, 20 installations of the CAT-1 system
12.	If dynamic ratings are assigned:				
12a	What are the ratings	Not assigning during pilot	N/A	N/A	Standard normal ratings. Increased emergency ratings based on CAT-1
12b	What variables are monitored	Tension, wind speed, and ambient temperature	N/A	N/A	Structure: Tension, wind speed, ambient temp and net radiation Station: Amps

#	Review Questions	FE	Cinergy	AEP	Benchmark
12c	How are they monitored and recorded?	Processed in a local device and transmitted to the control center	N/A	N/A	Structure: CAT recording instruments Station: switchboard recording digital ammeters.
13.	Are transmission line ampacities de-rated to account for conductor age, possible annealing, or the number, age, or condition of splices?	Occasional temporary de-rating until abnormal conditions are corrected	Clearances, annealing, and line equipment are considered in line rating. Age is not.	Ratings are based on an anticipated 50-year annealing	Yes, conductors are de-rated for annealing, number of splices, fault current history, known clearance issues
14.	May we have copies of all documents your Company uses pertaining to the ampacity rating of overhead transmission lines?[51]	Yes, attached[52]	Yes, attached[53]	Yes, attached[54]	Yes[55]

[51] Each utility was also asked, "For each 138kV and 345kV line, please provide the line length; conductor type; size and number of conductors per phase; in service date; and line design parameters, including tower/pole type, average span, and design tension and sag. Also indicate the date the line was last inspected for sag and tension and what he findings were." They were also asked, "Please explain the basis for ambient temperature and wind speed assumptions used in rating your transmission lines."

[52] Line length, conductor size, conductor type, conductors per phase, tower/pole type, and average span are attached. Insufficient time to gather data on tension, sag, in-service dates, and inspection data. Wind and temperature were based on 27-year data from the National Weather Service. Temperature chosen is exceeded twice a year on average, and wind speed 1% of the time.

[53] Data from FERC Form 1 attached. Insufficient time to gather the additional requested data. FERC data also supplied for 230kV. No specific inspections for sag and tension, just routine inspections. Ambient temperatures based on review of typical hot summer temperatures and compared with other utilities. Wind speed assumptions not verified but compared with other utilities.

[54] GIS data is attached, however the accuracy of the conductor information has not been verified. Temperatures and wind speed chosen represent the reasonable summer and winter assumptions.

[55] N/A for 138kV and 345kV lines. Ambient temperatures are based on thirty-year data from the National Weather Service.

#	Review Questions	FE	Cinergy	AEP	Benchmark
	LINE SAG				
1.	Do you have Company standards that specify transmission line sag?	No, NESC is applied	No, NESC is applied	Yes, attached	Yes
2.	What is the design basis for sagging your transmission lines:				
2a	Company standards	No	Yes	Yes	Yes
2b	Manufacturers' recommendations	No	Yes	ALCOA Sag and Tension Program, Stress/strain relationships are obtained from other manufacturers	Yes
2c	NESC	Yes	Yes	Yes	Yes
2d	Utility best practices	No	Yes	No	No
2e	Industry standards	Yes, IEEE P-524	Yes	No	Yes, IEEE P-524
2f	Other?	None	None	None	None
3.	Do your Company standards regarding transmission line sag conform to IEEE P-524 — "Guide to the Installation of OH Transmission Line Conductors?"	Yes	Generally, yes	Generally in line with the general procedures	Yes
4.	Do your Company standards regarding transmission line sag conform to the National Electric Safety Code?	Yes	Yes	Yes	Yes

#	Review Questions	FE	Cinergy	AEP	Benchmark
5.	Are transmission line sags checked during stringing?	Yes	Yes	Yes	Yes, stringing targets and/or transit
6.	Do you ever re-use a previously installed conductor? If so, are tensions adjusted during stringing?	Yes, existing conductors are transferred to new structures. Tensions are readjusted.	No	Rarely If done consideration is given to adjusting final sags	No
7.	Is the weighted average span length used for calculations, or some approximation?	Weighted average, except very old lines used simple average.	Ruling span calculations with sag charts	Not in current design, but may have been used in the past	Weighted Average
8.	How are ruling spans calculated?	Depending on the age of the line: • Simple average • Average span + 2/3(longest span – shortest span) • Weighted average	Computer program using weighted average	Weighted average	Weighted Average[56]
9.	Are transmission line sags adjusted for temperature districts and loading districts?	No temperature districts. Entire system designed for NESC Heavy LD	NESC loading criteria	NESC loading criteria are met or exceeded	Yes
10.	How do your conductor stringing procedures account for initial and final temperatures?	Sag tables	Initial: typically normal ambient Final: worst case sag with ice or at maximum operating temperature.	Initially sagged so as to meet final clearance sag and temperature	Initial: actual measured ambient Final: 130°F and 32°F with ½" ice

[56] Ruling span is determined using the weighted average span length: Ruling Span = $[(S_1^3 + S_2^3 + +S_3^3 \ldots\ldots +S_n^3)/(S_1 = S_2 + S_3 \ldots\ldots S_n]^{1/2}$

#	Review Questions	FE	Cinergy	AEP	Benchmark
11.	How do your conductor stringing procedures account for conductor creep?	Computer sag tension program	Creep is typically neglected. If it is determined to be a factor, manufacturer's installation guide is used to modify the sag charts.	High temperature creep is incorporated in the sag and tension computer program.	Safety factor in initial design
12.	May we have copies of all documents your Company uses pertaining to the sagging of overhead transmission lines?	Sample documents attached	Work practice for sagging conductors is attached	General Specifications for T&D Construction and the ALCOA (modified) Sag and Tension Program are attached	Yes

#	Review Questions	FE	Cinergy	AEP	Benchmark
	LINE CLEARANCES				
1.	Are there State codes or regulations that govern transmission line electrical clearances?	Yes, The Ohio Administrative Code (4901:1-10-06) mandates compliance with NESC	NESC	NESC	Yes, Public Utility Commission General Orders
2.	Do you have Company standards that specify transmission line electrical clearances?	NESC, OSHA, FAA, Army Corps of Engineers, Railroads	Clearance drawings based on NESC are attached	Yes[57]	Yes
3.	Do your Company standards regarding line clearances comply with the State codes or regulations?	Yes	Yes	Yes	Yes
4.	Have you done any benchmarking to determine the best practices of other utilities with regard to assigning electrical clearances to overhead transmission lines?	No	No	No	No
5.	Do you participate in industry organizations such as IEEE, EEI, ANSI, or CIGRE?	EEI, ASTM, AEIC, and Ohio Electric Utility Institute	IEEE Insulated Conductor Committee, ASCE Structure Loading Committee	ANSI, ASCE, EEI, IEE, and EPRI	Yes, IEEE ESMOE Working Committees

[57] "System Standards – Transmission and Substransmission Lines, Clearances, Mechanical Loadings and Overload Factors Applicable to Structures, Foundations, Hardware, Insulators, Conductors, Groundwires and Line Design" and "Guidelines for Review of Certain Transmission and Substransmission Lines, Designed Prior to June l, 1978 or the 1977 edition of the NESC for Operation at Conductor Temperatures above 120° Fahrenheit" are attached.

#	Review Questions	FE	Cinergy	AEP	Benchmark
6.	Do you follow industry organization working committees' recommendations regarding transmission line electrical clearances?	No, NESC, OSHA, FAA, Army Corps of Engineers, Railroads	NESC	No, but company standards are based on NESC	Yes
7.	If emergency, or short-time overload, ampacity ratings are used, are less-than-minimum clearances accepted for these short duration periods?	No	No, electrical clearances are not reduced during contingency operation.	No	Yes, 10% reduced ground clearance for emergencies
8.	What swing buffers are specified in your clearance standards?	Horizontal clearances meet or exceed NESC and OSHA	NESC Calculations included in the clearance standard	NESC and company standards	10-15 ft through 230kV 15-25 ft for 500kV
9.	How frequently are your overhead transmission lines inspected for adequate clearances?	6-months	4-months	Aerial patrols annually and foot patrols as needed	Aerial patrols every 12-36 months **AND** Ground patrols every 12-36 months depending on age of line, design of line, criticality of line, outage history, etc.

#	Review Questions	FE	Cinergy	AEP	Benchmark
10.	How are temperature variations accounted for during transmission line inspections?	Inspectors are given a work aid illustrating required clearance adjustments for ambient conditions	Ambient temperature and anticipated load are factored in when inspecting	Wind speed, ambient temperature and other relevant weather conditions as well as the relative conductor position are used in an engineering evaluation of the line	Inspector experience and judgment
11.	May we have copies of all documents your Company uses pertaining to the electrical clearances of overhead transmission lines?	Refer to codes and regulations listed above. Tables from Company Standards are attached.	Clearance Drawings attached	Yes	-

Appendix J: Industry Recommendations

In this appendix, we are providing the written responses of our expert panel to the posed question:

> "As an industry expert, what would you recommend needs to be changed, improved, or fixed in order to reduce or prevent the likelihood of future tree and transmission line conflicts?"

Once again, these commentaries do not necessarily reflect the opinions of the companies or organizations that these individuals work for. They are simply the thoughts of the individual experts.

MR. ROBERT W. BELL, Pacific Gas & Electric Company, President of the Utility Arborist Association (California)

"The Rule of Law." In over a decade of troubled times, that phrase has moved to the forefront of political speech. The media reports on legal issues of all types with great fervor. Government entities, corporations and individuals all take the law very seriously; as well we should. While individuals may disagree over one law or another, no reasonable person would suggest that anarchy is preferable to a lawful society… or would they?

If social anarchy is when a society decides to ignore the laws of government, what is it when a government, corporation or individual decides to ignore the laws of science? I don't know if there is a name for it, but the results are well documented. In terms of the electric utility industry, those results have included several catastrophic wildfires, three electrical grid failures since 1996, numerous smaller wild land and structure fires, and millions of cases of interrupted electrical service to individual customers and businesses.

Electricity seeks the ground. This is a law of physics. It can't be vetoed or legislated away. Trees grow up. This is a law of nature. You can't negotiate with nature. The only time a tree stops growing is when it is dead… and there is usually another tree waiting to take its place. Fortunately, from an electric reliability standpoint, trees are pretty easy to kill. Unfortunately, the vegetation manager at a typical utility company faces many man-made obstacles between the teeth of the chainsaw and the trunk of the tree.

In my opinion the single most inhibiting obstacle is government bureaucracy and regulations that conflict with the laws of science. It is also the obstacle that could most easily be cast aside if the governments with the power to do so have the will to do so.

It is inconceivable to me that a municipal parks department, a state transportation department, the US Forest Service or any other similar entity should have the final authority over a utility company managing vegetation in proximity to high-voltage transmission lines, but they do. In fact, any of these and many other local, state and federal government agents have the power to stop a utility crew in its tracks. Although more often than not, the utility is stopped before it can even start by a never-ending gauntlet of burdensome, inconsistent, often conflicting rules, regulations and bureaucracy. While people finger-point and litigate, the trees keep growing.

There are many utility facilities that cross public and private lands. At the very least, we need to begin looking at those corridors critical to the integrity of the electrical grid in a different way. In the interest of national security, public safety and the North American economy, I propose that the U.S. and Canadian governments consolidate the authority over transmission line corridors in their respective territory and give that authority to the U.S. Department of Energy and its Canadian equivalent. The amount of land in question is miniscule compared to the total holdings of agencies such as the U.S. Departments of Agriculture and Interior. But the implications of mismanagement are enormous to the integrity of the electrical grid.

As a corollary to this proposal, we must recognize that it only takes one tree to trigger a catastrophic grid failure. That tree might be on private property. Utility companies must have the authority to do whatever they deem necessary, based on the laws of science, to protect critical electric transmission facilities on private as well as public lands.

> **Mr. Bell** is a Sr. Vegetation Program Manager for the Pacific Gas and Electric Company. He has a B.S. degree in forest science from The Pennsylvania State University and an M.B.A. from the University of New Mexico. He is a Certified Arborist and a Certified Utility Specialist through the International Society of Arboriculture. In his career, Mr. Bell has worked for municipal and investor owned utility companies throughout the United States and Canada.
>
> Mr. Bell is the President of the Utility Arborist Association. He is past president of the Missouri Community Forestry Council; a past director of the Midwest Chapter of the International Society of Arboriculture; and past president of Think Trees New Mexico.

MR. RICHARD E. DEARMAN, Manager of System Applied Maintenance, TVA (Alabama)

(Note: Mr. Dearman did not participate in the development of the BMPs but was asked to provide his expert commentary for this section.)

We in the transmission industry must provide better information to the general public, local, state and federal entities, and property owners about the fundamental differences between vegetation management for grid lines and non-grid lines. The transmission industry's current vegetation management practices on grid lines must change significantly based on these fundamental differences.

Definitions:
Grid lines - those lines that connect transmission buses thereby providing network load flows or directly connect generation to the transmission grid.

Non-Grid lines - All radial lines that feed loads only, including any radially tapped sections of grid lines capable of automatic separation from that grid line without opening the grid flow path.

Critical differences in interruptions on Grid and Non-Grid lines:
When non-grid lines experience interruptions, the load requirement on the grid is reduced. In fact the strength of the grid is increased after the short term surge passes. In this scenario the available generation and grid capacity is the same with reduced load requirements. The chance of a widespread blackout is less than before the load interruption.

When grid lines experience interruptions, the load requirement on the grid is not reduced. All loads are still connected, and the currents shift to supply the loads through the remaining wires.

The wires and other grid components will now have more current through them. These increased currents result in increased conductor sags, lower voltages, increased generation needs for reactive and real power, and lower grid reliability. The cascading blackout event begins with such a scenario!

What the transmission industry must do:
We must communicate the above differences internally and externally.

Internally we must change our programs, culture and practices that relate to vegetation management to fully reflect the higher standard of care required for grid lines. Currently programs for tree pruning, tree trimming, low growing species, buffer zones, border zones, etc. are embedded within the total vegetation management approach. While such programs are appropriate on non-grid lines they should be avoided on grid lines.

Grid line easements should be maintained with no woody species allowed anywhere on the right of way. Time for identification of desirable versus undesirable species, rates of growth, effective herbicide usage, etc., would be drastically reduced if these approaches were taken, and no undergrowth tree would place a grid line at risk because of "special" conditions or agreements.

Externally, after informing other stakeholders of this higher standard of care, we must work with them to gain their support for implementation of this approach. Numerous ordinances, regulations, and laws related to beautification, environmental and special interests will need to be addressed. Our duty in the operation and maintenance of the transmission grid is to ensure that the interest in a reliable be grid not be reduced by interests of lesser value to society.

Disclaimer: The views are those of this author and his opinion as to a desirable ideal. They do not reflect the status of any program currently in use at TVA.

> **Mr. Dearman** is the Manager of System Applied Maintenance in TVA's Transmission Operations and Maintenance Department of the Transmission Power Supply Group. In that capacity he is responsible for TVA's vegetation maintenance activities. Mr. Dearman has over 32 years experience in electric utility operations, engineering, and management. His experience includes responsibilities for vegetation management at the distribution and transmission level for 21 years. Mr. Dearman is a registered P.E. in the state of Mississippi.
>
> Mr. Dearman also provided invaluable assistance during the field investigation phase of this UVM project.

MR. SCOTT DEEVERS, Business Manager, The Davey Tree Expert Company (Ohio)

Management Keys to a Best Practices Vegetation Management Program

More than ever, the public and state and federal governments are demanding better reliability in the transmission of electrical service. As a result, increased attention is being directed toward tree and vegetation management programs as being a major part of the solution. At the same time, industry reports and independent research have indicated that most utilities have systematically reduced their maintenance budgets in this critical area as pressures from deregulation and the investment community mount.

Understanding and addressing three critical areas within a program will determine the probability of a utility's success in this area.

Stability

The first component of successful vegetation management programs relates to the stability of the program itself. The most stable programs in the industry are normally those that have reduced problems with electric transmission. In general, programs with stable internal management, consistent spending patterns and stability in those performing the work are successful. Rapid and frequent changes in any of the three areas noted above will cause confusion and reductions in work being completed properly. Industry-wide, the more stable the program, the less likely a utility is to have tree-line conflicts that impact customers.

Buying Practices

The actual role of contractor evaluation and contract award has traditionally fallen to the internal program managers. However, recent years have seen more involvement by purchasing or "supply-chain management" departments. The assumption made by most purchasing departments is that the lowest price is the correct one for the utility. Scores of utilities have been negatively impacted by this selection process when the low-price bidder is incapable of delivering the service required or, in a number of instances, simply goes out of business before completing the contract. This leaves large gaps in work completion at scheduled intervals creating more potential power interruption.

Program Integrity

Unfortunately, even the most stable programs that have carefully evaluated their buying practices can experience vegetation problems if integrity within the program does not exist. Integrity gaps can kill well-conceived programs by providing incomplete or incorrect data on which key decisions are made and can occur from both internal and external sources. Maintaining integrity in specification adherence becomes more difficult the larger a program gets. Each local manager of a forestry department may have a different interpretation of what the specification is which may lead to shortfalls in work efficacy. Depending on who is approving the work (and in some situations it is the contractor themselves), this lowering of the specification can have a substantial negative impact. The most successful programs consistently apply the specifications set forth and audit the work for appropriate completion.

> **Mr. Deevers** has been an active participant in the utility vegetation management industry for seven years. He has been responsible for the evaluation of dozens of vegetation management programs for the Davey Tree Expert Company during that time.
>
> Davey Tree is a world-leader in utility vegetation management and has been working with utilities since the 1920's. Currently, Davey Tree works with over 100 of North America's leading utility companies to maintain vegetation, assess program performance and improve reliability through responsible tree pruning.
>
> Mr. Deevers is currently the Business Manager for Davey Tree's utility services division and is responsible for monitoring performance of utility operations in the Eastern United States.

MR. KEVIN K. ECKERT, President and Managing Director, Arbor Global (Hawaii)

How to Reasonably Avoid Electric Transmission Line-Tree Conflicts

How do utilities manage trees and vegetation to reasonably eliminate significant conflicts with the overhead electric system? Extensive experience and observations of utilities across the US and throughout the Pacific Rim have unequivocally demonstrated that the primary factors that impact a utility's ability to provide a reasonable level of electric system reliability, safety and cost containment performance relative to tree and vegetation conflicts are the following:

- Utilization of qualified, experienced, responsive arborists to design and administer the program;
- Utilization of state-of-the-art, best management practices;
- Comprehensive, accurate, up-to-date and accessible workload database;
- Adequate management support and funding of the program; and
- Public education of the need and importance of the tree and vegetation management program.

The single most important component of an effective, efficient program is the utilization of qualified, experienced, responsive arborists with the authority and resources to design and administer the program. To be effective, these arborists must be either utility employees or third party contractors not associated with a contractor providing tree and vegetation clearing services. Tree and vegetation management is a highly technical specialty that requires an appropriate level of education, training and experience to effectively understand and control trees and vegetation. Utilization of a qualified, experienced arborist as the responsible manager ensures an understanding of how trees grow and respond to various management techniques and knowledge of the operational characteristics and requirements of best management practices. Many utilities use non-arborist staff as tree and vegetation managers (engineers, line supervisors, etc.). These professionals may be very competent within their area of education and experience, but have little or no formal education, professional training or experience in arboriculture or vegetation management. The use of non-arborists as the responsible manager has been demonstrated to frustrate the effective design and administration of programs often resulting in unreasonably high levels of tree-related outages, safety hazards, excessive costs and customer complaints.

Decisions, practices and methods utilized for tree pruning, removal and vegetation management must be based on state-of-the-art, best management practices consistent with those prescribed by the International Society of Arboriculture, Utility Arborist Association and appropriate ANSI standards. The use of these work practices must be contractually required and consistently enforced. Programs that do not require or enforce the use of proper, technically proven best management practices, regularly encounter unnecessary reliability, safety hazards, cost expenditure and customer complaint challenges.

In order to effectively and efficiently plan, schedule and administer any program, it is critical that the responsible manager possess a comprehensive, accurate, up-to-date and accessible database describing workload size, location and condition. Many utilities rely primarily on historical experience, staff knowledge/memory, and/or inadequate records and systems to develop and execute their work plans. Programs without an accurate, current workload database within an accessible work management system cannot be reasonably expected to cost-effectively identify, monitor and schedule work that will reasonably prevent tree and vegetation conflicts.

Adequate management support for programs and funding is critical to ensure that the utility's tree and vegetation management professionals have the financial resources and internal and external political support to conduct the program required to accomplish its service reliability, safety, cost-containment and customer satisfaction goals. Without adequate resources and executive support, no program will succeed.

Finally, a well designed and positioned, public education program that regularly and effectively reaches the key constituency and stakeholders is crucial to ensure understanding, acceptance and support for the program. The need and value of utility tree and vegetation management programs are very often misunderstood by other professionals and the public. This misunderstanding often results in resistance, and sometimes adverse legislative and legal actions, that prevent implementation of the program. It is critical to develop and execute a technically based, professionally managed program first, but then get the word out so that all those who are involved and affected by the program have the information and understanding required to accept and appreciate required pruning and removal work as appropriate and ultimately avoid tree conflicts when designing for and planting trees.

Mr. Eckert is President and Managing Director of Arbor Global LLC providing arboriculture and vegetation management consulting services to clients within Hawaii, the mainland United States, the Pacific Rim, and Asia.

Kevin has been a practicing utility arborist for over 20 years developing and administering demonstrably successful tree and vegetation management programs in temperate and tropical regions. During this period he has also provided expert consulting assistance to government agencies, environmental organizations, private businesses, and individuals on multiple aspects of arboriculture and vegetation management. Kevin is an active educator in the field of arboriculture regularly preparing and presenting informational and educational programs for professional and civic organizations, corporate executives, and managers on numerous arboricultural and integrated vegetation management topics. Kevin has published numerous articles in popular and industry publications, including the International Society of Arboriculture (ISA) Journal of Arboriculture.

Kevin is a graduate of West Virginia University with a BS in Forestry and a BS in Park Management. He is past President of the Utility Arborist Association, former Chair of the EEI Vegetation Management Task Force, Chair of the Hawaii Urban and Community Forestry Program, Chair of the Western Chapter ISA Arborist Certification Committee, and an active member of the Aloha Arborists Association. In Birmingham, England, he was awarded the Utility Arborist Award by the ISA Utility Arborist Association for contributions to the field of utility arboriculture.

MR. BRIAN FISHER, Strategic Coordinator, BC Hydro and Power Authority (British Columbia, Canada)

(Note: Mr. Fisher did not participate in the development of the BMPs but was asked to provide his expert commentary for this section.)

There are, in my opinion, four factors or avoidances that lead to catastrophic tree and power line conflicts.

1. The failure to recognize and fund best practices for Vegetation Management within the Utility industry. Twenty years ago, there were very few vegetation experts working for Utilities. Vegetation was treated as an item to use to balance the maintenance budget. There was little understanding of how trees grow and what practices were necessary to mitigate the problematic interface of trees and power lines. Today, there are many vegetation experts employed by Utilities and there is a strong Utility Arborist Association as an arm of the International Society of Arboriculture; which can offer a huge level of support to the industry. Nonetheless, most Utilities are directed by accountants and by engineers who are focused on one-time solutions and cost reductions. There is little understanding of the diverse nature of vegetation and the need for ongoing professional programs to deal with a myriad of terrains, growth rates, species and climatic conditions. Ongoing, consistent and adequate funding utilized in an integrated fashion by professional vegetation managers is still the greatest need in the world of Utility Vegetation Management. Interestingly, those utilities that follow this route generally end up with more efficacious programs at lower costs.

2. Edge trees: Most tree /power line contacts occur when trees fall onto lines from outside the Rights of Ways or corridors. Many utilities are slow to act to address this issue due to the perception of increased costs and the pressure from landowners etc. to leave trees standing.

   We have laws that forbid people from maintaining unsafe conditions on their property. We need legislation that makes it unlawful to maintain or cultivate any tree that is hazardous or which may come in contact with a power line within 1.5 tree lengths of a power line and authority for utilities to remove unsafe trees without fear of lawsuits or reprisals. I think it reasonable to oblige the Utility to locate, identify and prioritize the trees for removal and to cover the cost of the removal. We need authority, however, to remove these hazards without additional costs or undue delays.

3. We (Utilities) tend to capitulate in the face of public or agency or municipal pressures. This is not good risk management. Vegetation / Power line contact creates a severe public safety hazard and a high fire potential. The mandates of other agencies cannot be ignored, but, they should also not override utility responsibilities and needs. Utilities have the "duty of Utmost Care" to protect the public from contact with power (dangerous thing). If agencies and municipalities are to be permitted to refuse consent to or seek compensation from utilities for the removal of hazardous vegetation, they should be obliged to assume the liability associated with that risk. Whoever bears the responsibility should have the unfettered right to mitigate the situation.

4. As the need for delivery of electricity increases, transmission lines are being utilized at levels, which are within engineering tolerances, but far beyond anything intended or

anticipated when the lines were built. Transmission lines under heavy load on hot days can bring the line sag down to a point where electricity could arc to very low vegetation and certainly to a height where work within the area would be unsafe. Every utility should be obliged to identify all areas with "Unusual Terrain features" or "Inadequate Engineered Line Height". With mitigative action to ensure that at maximum line sag, there was still a minimum of 25 feet (7.5 meters) conductor to ground; Vegetation management best practices would be able to avoid many hazardous situations. Line Sag is a major factor and Vegetation managers need to know what clearances (conductor to ground) will be available with maximum line sag. Two tree incidents in the California blackouts were a result of lines sagging into trees rather than trees growing into lines.

Mr. Fisher (B.A.) is Strategic Coordinator of Vegetation Management for BC Hydro and Power Authority. He is responsible for Vegetation Management programs within the corporation. Brian has nearly 30 years experience in the Arboricultural Industry -12 in Utility Arboriculture. He has been a Certified Arborist for 18 years. Brian has served as a member of both the Certified Arborist and Utility Specialist Test Committees of the International Society of Arboriculture. He was instrumental in the development of BC Hydro's current vegetation maintenance program that benchmarks very well in comparison to other utilities. He also developed BC Hydro's Hazard Tree Program designed to target hazardous trees outside of the Utility Corridors.

He is a frequent presenter at training conferences and seminars particularly with respect to Utility Arboriculture. Recent presentations include International Society of Arboriculture Annual Conference and National Arbor Day Foundation Trees and Utilities Conference.

Brian is currently the Vice President of the Utility Arborist Association.

MR. JOHN W. GOODFELLOW (Redmond, Washington)

1. The risk profiles of all lines within the transmission network are not equal.

A one-size-fits-all approach to vegetation maintenance produces sub-optimal results. To optimize effectiveness and cost-efficiency, maintenance intensity needs to be based on a clear understanding of the criticality of individual lines to the over-all grid.

Clearing right of way (ROW) to widths sufficient that no tree failure will result in conductor contact is not practical in many cases.

Edge trees and off ROW trees are legitimately recognized as a discrete population of trees requiring specific management. Knowledge of tree failures and mortality should be included in developing optimal maintenance practices to mitigate the risk to reliability posed by such “hazard” or “danger” trees.

2. On-condition, reliability-driven, site-specific vegetation maintenance prescriptions need to be used in completing the work.

It must be recognized that, unlike an assessment of the structural and electrical elements of infrastructure, vegetation management is focused on a *biological system.* As such, contemporary vegetation management practices are carried out in a dynamic environment. Biological systems respond to “disturbance” (such as maintenance work) in unique but often predictable ways. Maintenance work based on an assessment of site-specific conditions and on an understanding of the response of vegetation to such work will yield the best results. An engineering-based assessment of vegetation and subsequent vegetation “clearing” work based on the assumption that trees are simply a problem to be *controlled* will be less effective and has the potential to create future reliability problems.

3. Clear and complete rights to perform vegetation maintenance work need to be established and exercised.

Too often a utility’s rights to perform vegetation maintenance work are unclear. Easements may be vague or incomplete. Past practices may have been ineffective and inconsistent in establishing a precedent for vegetation maintenance and tree removal on private property. These rights need to be established, re-established, and enforced on critical transmission lines.

4. Organizational commitment to reliability-driven vegetation maintenance.

Responsibility and authority for maintenance of vegetation in transmission corridors need to be clearly established and sufficient resources provided. The utility must adequately fund the program and enforce its standards and rights. This is particularly true for the most critical lines. Tree removal can be an unpopular maintenance activity with property owners, the public, and some governmental jurisdictions. Too often, necessary work is delayed or deferred by utility management because of customer and political pressures and local regulation. The decision to not complete necessary vegetation maintenance, either deliberately or by default, places the network and all customers at risk. Utilities need to demonstrate commitment to their responsibility for reliability and the greater public good. Regulators need to support these efforts.

> **Mr. Goodfellow** has 25 years experience in the electric utility industry; having held positions of responsibility for vegetation management, T&D operations, maintenance, and engineering at three large investor owned electric & gas utilities. John Goodfellow is recognized as a leading authority on utility vegetation management and reliability. He has conducted extensive research on tree-initiated electrical faults, and how they cause interruptions. He has direct experience with the practical application of Reliability Centered Maintenance (RCM) techniques in assessing electric transmission & distributions (T&D) systems including failure analysis & modeling and forensic engineering.
>
> John Goodfellow is currently on the Board of the Tree Research, Education, and Endowment (TREE) Fund, and is a past president of the Utility Arborist Association. He worked directly with the National Arbor Day Foundation in creating that organization’s “Tree Line USA” award program recognizing utilities for excellence in vegetation management. He has served on an industry standards committee, writing pruning standards for utility line clearance work. He also is a contributor to Dr. Alex Shigo’s pocket field guide “Pruning Trees Near Electric Utility Lines.”
>
> Mr. Goodfellow received a Bachelor of Science in Environmental Resources Management from SUNY College of Environmental Science & Forestry, and a Bachelor of Science in Forestry from Syracuse University.

MR. SIEGFRIED GUGGENMOOS, President, Ecological Solutions (Alberta, Canada)

These recommendations are based on the premise that all trees with the potential to interfere with conductors are a liability. To reduce or prevent the likelihood of future tree and transmission line conflicts, utilities need: 1) to fully quantify the tree liability by systematic accounting, 2) to assess the impact of design and operating decisions on the value of the tree liability, 3) a responsive dedication of resources to manage the tree liability, and 4) authority to undertake work required to sustain or improve the safe, reliable operation of the system.

1. The utility forest, which is comprised of all trees that have the potential now or in the future to interfere with the safe, reliable operation of the electric system, includes an enormous population of trees located outside the right of way. 'Best in class' utilities have assessments of tree work originating within the right of way and a cyclical program for the identification and removal of hazard trees located outside the right of way. The inadequacy in this approach is that it fails to comprehensively assess the risk of potential tree-conductor conflicts arising from healthy trees within the utility forest. As even healthy trees fail via lightening strikes and under wind or ice loading, all trees with the potential to interfere with conductors are a liability. While viewing trees as a liability puts utilities in conflict with community perceptions of trees as assets, the conflict does not change the fact that trees hold only the capacity to impair the safe, reliable operation of the electric system, not to augment it in any way. Recognizing and quantifying the utility forest as a liability provides a measure of the potential for, or risk of, tree-conductor conflicts. Furthermore, it connects and clarifies the influence of design and operating decisions on maintenance costs and reliability risks.

2. A current barrier to reducing the likelihood of future tree and transmission line conflicts is easement terms. The clear width (distance between conductor and treed edge) set by the right of way width provided for under easement is based on protecting against tree-conductor conflicts arising from conductor sway but fails to consider the extent of exposure to residual tree risk. This situation serves to illustrate the utility of the tree liability concept as it provides a measure of the consequence for the chosen right of way width. Narrower rights of way have lower capital costs but yield a higher tree liability. Accepting the greater tree liability involves both committing to higher annual maintenance costs and a higher risk of tree-conductor conflicts, a risk that is realized with each severe weather event. The use of tree liability accounting will also serve to highlight the need for very specific language in easements regarding vegetation management practices as the current written rights allow stakeholders to obstruct actions specifically designed to effectively manage the tree liability.

3. On established transmission lines the key drivers increasing the tree liability are in-growth, tree growth and tree mortality. As these and other biological processes follow geometric progressions, there is a window of opportunity to monitor and respond to utility forest changes. Responsive dedication of resources limits the negative effects of the compounding tree liability and maintains the equilibrium around the selected acceptable tree risk.

4. The primary use of a transmission line right of way should be the safe, reliable transmission of electricity. The use of tree liability accounting connects regulation to the maintenance costs and tree-related outage risks and brings clarity to the impact of regulation on the utilities' ability to manage the tree liability. This will serve to guide regulators to authorize utility actions to reduce tree risks.

Mr. Guggenmoos (B.Sc.(Agr.), P.Ag., CPC) has a degree in horticulture from the University of Guelph, Ontario, is a Professional Agrologist and Certified Professional Consultant. His career in vegetation management began in 1970. He has been involved in research on growth regulators and herbicides. Mr. Guggenmoos served as Executive Vice President and General Manager of Ace Vegetation Control Service Limited, a national Canadian vegetation management contractor serving oil and gas companies, pipelines, power companies, railroads, National Defence and municipal authorities. In 1985 Mr. Guggenmoos joined TransAlta Utilities, where he was a chief architect of the Distribution Line Clearance program which: reduced tree related outages 80%; saved 48 million dollars over two maintenance cycles; had a 98% customer satisfaction rating; showed a 21% increase in crew productivity. He was responsible for an extensive herbicide program, associated research and communication. In addition, he brought a financial focus to the program and was intimately involved in the design and assessment of contracting methods. In 1995 Mr. Guggenmoos formed Ecological Solutions Inc. (Ecosync) to provide consulting services in vegetation management and biotic greenhouse gas mitigation strategies including biomass derived energy.

Mr. Guggenmoos has authored over thirty articles appearing in technical journals, magazines and industry newsletters. He has presented at numerous conferences including chapter and international levels of the International Society of Arboriculture, International Right of Way Association, Edison Electric Institute and regional Vegetation Management Associations. He has served as president and several terms on the board of the Industrial Vegetation Management Association of Alberta; has been a summariser for the Expert Committee on Weeds; is a member of the Alberta Institute of Agrologists, the International Society of Arboriculture, the Utility Arborist Association and the American Consultants League.

MR. RICHARD JOHNSTONE, System Forester, Conectiv / IVM Industry Consultant (Delaware)

The primary purpose of the utility corridors must be safe and reliable delivery of energy services. Vegetation growing within or near utility corridors must be compatible with this purpose. Other needs, such as landscape aesthetics, wildlife or endangered specie habitat, or other concerns can also be addressed, but they must be secondary in nature to prevent large-scale power outages. Laws and ordinances should prevent the introduction of incompatible vegetation, and the rights and methods to perform necessary vegetation management work must be granted to the utilities and supported by the federal, state, tribal or local governments, so long as the work is performed under professional best management practices.

One of the key difficulties for utility companies in accomplishing this task has been the acceptance and coordination of vegetation management with all applicable agencies and public groups. Safe and reliable electric service is a community responsibility and electric utilities cannot provide the needed level of quality service operating alone. Blackouts and natural disasters affect the safety and security of all our citizens, thus all governmental agencies, transportation and utility services should work in harmony for the greater public good. In order to address this ubiquitous problem, all parties should support research into the establishment and subsequent management of compatible plants, and the removal and prevention of tree species found to be inherently hazardous to utility services.

A utility-compatible plant nursery should be established at the National Arboretum in Washington, DC and in various climate zones throughout North America to research and provide appropriate planting stock for use in or near utility corridors. Likewise, research is necessary to establish the best management practices for unique areas of special concern within the various climate and plant regions throughout North America. To specifically deal with this issue, I created a non-profit organization whose objectives are applicable as general recommendations to the industry, as follows:

- Develop, educate the public with respect to, and apply integrated vegetation management and conservation practices to provide safe, reliable, and accessible utility and highway rights-of-way that transport vital services for public necessity and homeland security;

- Improve wildlife and endangered-species habitats, control exotic weeds, and lower risk of wildfire;

- Inform and educate land managers and public officials so that best practices are used to resolve vegetation management problems in a safe, economical, and environmentally responsible manner;

- Develop partnerships between industry and government so that best management practices are used to resolve vegetation problems in military installations, communities, forests, parks, and wildlife refuges;

- With cooperation from land grant universities, industry, government, and conservation organizations, conduct research and disseminate information with respect to regional geophysiological differences in vegetation management practices.

> **Mr. Johnstone** has been in the utility vegetation management industry for 27 years and is the System Forester for Conectiv Power Delivery serving 1.1 million customers in the states of Delaware, Maryland, Virginia and New Jersey. He is President of the non-profit corporation; *Integrated Vegetation Management Partners, Inc.* which specializes in researching and applying best vegetation management practices for industry, government agencies and conservation organizations. Mr. Johnstone also owns the consulting company; *Vegetation Management with Environmental Stewardship, LLC* that provides training and management plans in professional vegetation management. He directed the production of a training video by Virginia Tech Pesticide Programs titled; "Integrated Vegetation Management: Principles and Practices for Rights-of-Way". He earned his BS degree in Forest Resources Management from West Virginia University in 1976.
>
> A Registered Professional Forester, he has served as President of the Utility Arborist Association and received their 2003 Education Award for adding to the knowledge and practices of utility arboriculture. He co-authored the "Environmental Stewardship Strategy for Electric Utility Rights-of-Way" for the Edison Electric Institute Vegetation Management Task Force, and is part of their negotiating team to develop memoranda of understanding between the electric

industry and federal agencies. He has served as an advisor for the Chesapeake Bay Program and presently advises Rutgers University Forestry Advisory Council. He conducts training for the U.S. Fish & Wildlife Service, the National Park Service, Department of Defense, Federal Highway Administration and Invasive Weed Councils and several universities. He also provides professional expertise for the production of a federal refuge manager vegetation management training video for the Department of Interior's National Training Center.

Mr. Johnstone has published three papers in the Journal of Arboriculture and in three International Symposia on Environmental Concerns and his work is referenced in several magazines and professional journals. Under his direction, Conectiv is a charter partner with EPA's Pesticide Environmental Stewardship Program; they received the National Arbor Day Foundation "Tree Line USA Award" for the last 4 years; and earned the "2002 Project Habitat Award" for rights-of-way wildlife habitat improvements.

MR. RANDALL H. MILLER, System Forester, PacifiCorp (Utah)

I think North Americans have a deep attachment to trees, and consider it acceptable or even desirable to have tall-growing trees in transmission corridors. While, as a professional arborist, I share the public's fond sentiment for trees, acceptance of them in rights-of-way is misguided, and often results in emotional, political, governmental, media and legal opposition to tree removal associated with effective vegetation management. While persistent utilities can still complete their work, it's difficult and time consuming, regularly involving corporate legal, regulatory, communications, community relations and other staff in addition to utility arborists.

While many utilities have long-standing educational "right tree in the right place" campaigns, I think these programs have been largely ineffective. I suspect one reason for this failure is a public misconception that transmission right-of-way work (and distribution work for that matter) is motivated by corporate greed or arrogance, rather than public interest. Consequently, I think neutral parties, such as regulatory agencies, should mount aggressive public education campaigns to augment existing utility programs. Currently, I think regulators provide only passive support for utility vegetation management activities, responding to complaints by explaining that utilities have the "right" to clear the lines, and then only after investigating that we can justify our plans. By moving to a proactive educational model, regulators can leverage their status as trusted public servants to help steer North American attitude in a more responsible direction. We must develop a collective attitude that considers it irresponsible to plant or cultivate tall-growing trees in transmission corridors, and not only accepts, but demands thorough, scientifically-based, utility vegetation management.

Mr. Miller is Chair of the Edison Electric Institute's Vegetation Management Task Force. He holds a BS in Horticulture from the University of Wisconsin-Madison, and an MS in Urban Forestry from the University of Wisconsin – Stevens Point. He is an International Society of Arboriculture Certified Arborist and Certified Utility Specialist. He has served a six-year term on the International Society of Arboriculture's Certification Test Committee, is past President of the Oregon Urban and Community Forest Council, and currently serves on the Editorial Board of the Journal of Arboriculture.

He has a broad background in urban forestry and arboriculture, having worked since 1976 in the commercial, institutional and governmental sectors before becoming involved in utility arboriculture. He joined PacifiCorp in 1993, and has been System Forester with them since March 1999. He has over 35 arboriculturally-related writing credits, including contributions to *the Journal of Arboriculture,* the *Utility Arborist Association Quarterly, Arborist News, Tree Care Industry,* the *Journal of Forestry,* and *Golf Course Management.* He speaks widely on arboricultural, urban forestry, and utility forestry related topics.

MR. MIKE NEAL, Arizona Public Service, President of the International Society of Arboriculture (Arizona)

Potential Solution

The reliability of power lines is critical to national security, public safety, and quality of life in this current electronic age. Unfortunately, there are many hurdles to overcome if we expect utilities to effectively manage vegetation near transmission (and distribution) power lines. Much of these hurdles occur as a result of varying constituencies and agendas that do in fact conflict. These conflicts result in the significant increase in the likelihood of similar outages as experienced on August 14th.

Short-Term Line-Clearance Practice: Attempting to control the rapid growth of tall-growing tree species found growing in the vicinity of power lines through repeated pruning is clearly a lose-lose proposition. A tree that is genetically predisposed to grow to a natural height of sixty feet will always strive to be a sixty-foot tree regardless of how much and how often it is pruned. Over time, these repeated prunings frequently lead to unsightly, unnatural, and unhealthy trees.

Long-Term Resolution: Key to a long-range utility vegetation management plan is getting the right types of trees into the right place. Implementation of the plan begins with the pruning back or removing all weak, dead, dying, or leaning trees along the sides of the right-of-way. Trees that must be removed also include all tall-growing tree species and fire-prone species located directly beneath a power line and those growing in such a position that the tree will require extensive and repeated pruning.

In urban and residential areas, low-growing trees, that is, those species that naturally have short mature heights, can be grown safely beneath power lines. Over time, these trees will grow tall-enough and wide enough to help obscure the power line and establish themselves as an attractive feature in the landscape.

Transmission corridors should be provided with clearance distances such that no falling tree could possibly pass any closer than ten feet from an energized conductor. In many locations such a practice will clearly change the appearance of the landscape. This is not to say that the change will necessarily be for the worse, as that is a matter of perspective:

- Developing the landscapes of rights-of-way into communities of low-growing plants including natural grasses, herbs, forbs, wild flowers and shrubs provides a sustainable supply of forage as well as escape and nesting cover for wildlife. A correctly managed utility corridor serves to link distant ecosystems together into a much larger and more biologically diverse natural area by serving as a passageway for wildlife movement.

- Open rights-of-way are not an eyesore. They provide attractive views into the forest, the colorful understory vegetation is aesthetically pleasing, and the corridors present tremendous wildlife viewing opportunities.

- Wide corridors can serve also as an effective firebreak. The edge-effect provides an air gap in the forest that can stop, or at least slow the spread of a crown fire. As devastating forest fires in the western states have demonstrated, excessive fuel loads in the nation's forested areas are a serious problem that cannot be corrected quickly. Wide, linear breaks in the forest can be a tremendous benefit in preventing the spread of a wildfire.

My final recommendation is to encourage the development, adoption, and implementation of national vegetation maintenance standards that will apply to all electric installations. The standard should be based on universally accepted science, and developed with the active participation of all appropriate stakeholders. Once promulgated, all agencies, state, and local governments should accept these standards as the appropriate and required method for managing trees and vegetation near power lines. This effort will dramatically decrease the likelihood of future tree and power line conflicts.

> **Mr. Neal,** Arizona Public Service's Systems Forester, graduated from West Virginia University with a degree in Forest Resource Management. Mike is an ISA Certified Arborist, an ISA Utility Specialist and a qualified party with the Arizona Structural Pest Control Commission. He is currently the President of the International Society of Arboriculture. The International Society of Arboriculture (ISA) has served the tree care industry for over seventy years as a scientific and educational organization. The ISA has 14,000 members in 20 countries.
>
> In addition, he serves on the Board for the Western Chapter ISA. Mike is a past-president of the Utility Arborist Association, an affiliate of the ISA. He serves as past-president of the Arizona Community Tree Council.
>
> His background includes 5-years experience in urban and classical forestry with the Florida Division of Forestry. He has been involved in utility arboriculture for the past 16 years.

MR. JIM ORR, Asplundh Tree Expert Company (Pennsylvania)

Trees are a natural variable controlled by the forces of nature. Vegetation is dynamic and can be controlled but never eliminated. Everyone involved must understand this basic premise. For more than 100 years, the electric utility industry has unsuccessfully searched for a quick fix to the complex problems that arise when trees and power lines compete to occupy the same space. Operating a reliable transmission grid depends on stable funding of the vegetation management program, experienced and informed managers, strong executive support, a commitment to research, and regulations and laws that balance the need for reliable electricity with the importance of trees to our society.

<u>Stable Funding</u>
Consistent and adequate funding for vegetation management activities is critical for a reliable program. Stable budgets promote a consistent and dependable workforce. Interruptions in planned work due to budget cuts create windows of risk because vegetation does not stop growing when funding is postponed. Research has shown that the cost of delaying vegetation

management is significant. The Blackout showed that the increased risk to millions of customers is real.

Informed Managers
A background in one of the natural sciences is important to the understanding of the dynamics of vegetation management on transmission corridors. Knowledgeable vegetation managers work with the natural forces of nature to encourage and develop vegetation on rights-of-way that is compatible with the need to transmit power. Such methods are both highly effective and cost efficient. Rights-of-way managers must stay current with developing new methods and techniques.

Executive Support
Support from Executive management is vital to the success of a vegetation management program. From the budgeting process to protecting easement rights, management decisions have a great impact on system reliability. Fluctuating budgets may create high risk situations when scheduled work is postponed due to lack of funds. Equally critical are individual customer challenges to easement rights that allow unsafe vegetation conditions to develop at the expense of all customers.

Support Vegetation Management Research
Funding of new and ongoing vegetation management research projects will result in the development of improved methods and practices for the huge variety of sites found across the grid.

Regulatory balance
Perhaps the most difficult challenge is working with lawmakers and regulators to find a regulatory scheme that effectively balances the importance of reliable electricity with property rights and aesthetically pleasing landscapes. State and local regulations regarding allowable vegetation management practices often vary considerably. Since electric transmission lines cross international, state and local jurisdictions, the creation of a reasonably uniform set of rules and regulations should be an objective.

> **Mr. Orr** has served in the utility vegetation management industry for 34 years. He earned a BS in Forestry and Wildlife Management from West Virginia University and is a Registered Professional Forester and Certified Arborist. In 1999, he was the recipient of the Utility Arborist Association (UAA) Lifetime Achievement Award and the Northeastern Weed Science Society named him Innovator of the Year in 1996. He has been the Editor, Executive Secretary and Secretary-Treasurer of the UAA. A past president of the West Virginia Vegetation Management Association, Mr. Orr also served on the West Virginia State Pesticide Advisory Board from 1975 to 1977. He has worked closely with Dr. W. R. Byrnes and the late Dr. W. C. Bramble on the Pennsylvania State Game Lands 33 Research Project for more than 25 years. Mr. Orr has made more than 65 presentations at major conferences across the US and Canada and published more than a dozen articles in various utility and arboricultural publications.
>
> Mr. Orr is currently the General Manager of Technical Services for the Asplundh Tree Expert Co. and is responsible for coordinating technical information on line clearance, trees and vegetation management for Asplundh field personnel and utility customers. Asplundh is the largest line clearance and vegetation

management company in the world with operations in the US, Canada, Australia and New Zealand.

MR. DEREK VANNICE, Executive Director of the Utility Arborist Association (Illinois)

The Importance of The Right Tree In The Right Place

One of the key issues that have emerged as a result of the August 14th outage was a renewed focus on vegetation management and the importance of keeping trees out of power lines. Comments have been made putting the blame on utilities for not properly funding their vegetation management programs. This may or may not be the case. Even well funded utility vegetation management programs have tree-related outages. The simple fact is that trees and power lines do not mix.

Trees are not like broken insulators or other hardware that can be fixed by replacement, trees are living organisms that when pruned will actually accelerate growth to make up for what was lost. Trees currently also have a much stronger meaning with the public than do poles and towers. To many people, trees are spiritual in nature and stir many emotions. When utilities work to obtain appropriate clearances, conflicts develop between the landowner and the utility. The utility is now placed in a no-win position. There is no short-term solution. However, there is something we can and should do.

The federal government should assist in the development of a national effort that promotes planting the right tree in the right place. This should include comprehensive public educational efforts and possibly the promulgation of new laws that would prohibit the unnecessary planting of the wrong tree in the wrong place.

This investment and commitment needs to be long term. If the regulators will work with the utilities to educate the public on appropriate tree placement based on species growth characteristics and proximity to conductors, the issues relating to improper line clearance will be minimized over time. In the urban environment, the life cycle of a tree is much shorter due to factors that include cyclical pruning by the utility. If the appropriate species is planted, pruning will not be necessary and the quality and condition of our urban forest will improve.

This initiative does not only benefit utilities. The right tree in the right place benefits everyone. Cities will need to spend less money to maintain trees. Major storms will be less catastrophic in terms of initial damages as well as clean up costs. Even the insurance industry will benefit when the appropriate tree species are planted next to homes, streets and power lines.

The key to long-term improvement in our communities and the urban forests which shade them is education about the right tree in the right place. The message has to get to every homeowner, city planner, landscape architect, utility, and government agency. Utilities, regulators and non-profit associations must work together to make this happen.

The Utility Arborist Association, a non-profit educational association, has always carried the right tree in the right place message and we will continue to do so in the future. However, we cannot do it alone. Educating the public on planting the right tree in the right place will have benefits that will last for generations.

Mr. Vannice is the Executive Director for the Utility Arborist Association and the Director of Certification for the International Society of Arboriculture. He started with ISA and UAA in 1992. In his positions at ISA and UAA, Vannice has had been involved in numerous new program start-ups where he served as the primary facilitator for team building, program development and implementation. Derek has also conducted numerous group and individual training exercises for employees and volunteers. Vannice serves as the primary spokesman for the utility arboriculture industry including expert testimony in regulatory hearings. Derek has given numerous presentations regarding utility pruning, liability, certification, licensure and customer service issues. Vannice also held various management positions in the utility industry before coming to ISA. Vannice holds a Bachelor of Science in Forest Management from Purdue University and a Masters Degree in Business Administration from Ball State University.

Appendix K: ANSI A300 PRUNING STANDARD (UTILITY PRUNING SECTION)

ANSI A300 (Part 1)-2001 *Pruning* standard, sub-clause 5.9 is reprinted with permission of the Tree Care Industry Association (TCIA). Reproduction without authorized consent of TCIA is prohibited.

ANSI A300 (Part 1)-2001 *Pruning* sub-clause 5.9 is used in conjunction with the entire ANSI A300 Pruning standard. ANSI A300 standards are revised every five years on average. The next revision of ANSI A300 *Pruning* should be available by the end of 2006. Hard copies can be purchased by calling 1-800-733-2622 or visit www.treecareindustry.org/default.asp?main=content/laws/a-300.htm for more information.

Full citation is provided as follows: ANSI A300 (Part 1)-2001 For Tree Care Operations, Tree, Shrub, and Other Woody Plant Maintenance - Standard Practices *(Pruning).*

5.9 Utility pruning

5.9.1 General

5.9.1.1 The purpose of utility pruning is to prevent the loss of service, comply with mandated clearance laws, prevent damage to equipment, avoid access impairment, and uphold the intended usage of the facility/utility space.

5.9.1.2 Only a qualified line clearance arborist or line clearance arborist trainee shall be assigned to line clearance work in accordance with ANSI Z133.1, 29 CFR 1910.331 – 335, 29 CFR 1910.268 or 29 CFR 1910.269.

5.9.1.3 Utility pruning operations are exempt from requirements in 5.1 Tree Inspection:

5.1.1 An arborist or arborist trainee shall visually inspect each tree before beginning work.

5.1.2 If a condition is observed requiring attention beyond the original scope of the work, the condition should be reported to an immediate supervisor, the owner, or the person responsible for authorizing the work.

5.9.1.4 Safety inspections of the work area are required as outlined in ANSI Z133.1 4.1.3, *job briefing.*

5.9.2 Utility crown reduction pruning

5.9.2.1 Urban/residential environment

5.9.2.1.1 Pruning cuts should be made in accordance with 5.3, Pruning cuts. The following requirements and recommendations of 5.9.2.1.1 are repeated from 5.3 Pruning cuts.

5.9.2.1.1.1 A pruning cut that removes a branch at its point of origin shall be made close to the trunk or parent limb, without cutting into the branch bark ridge or collar, or leaving a stub (see Figure 5.3.2).

5.9.2.1.1.2 A pruning cut that reduces the length of a branch or parent stem should bisect the angle between its branch bark ridge and an imaginary line perpendicular to the branch or stem (see Figure 5.3.3).

5.9.2.1.1.3 The final cut shall result in a flat surface with adjacent bark firmly attached.

5.9.2.1.1.4 When removing a dead branch, the final cut shall be made just outside the collar of living tissue.

5.9.2.1.1.5 Tree branches shall be removed in such a manner so as not to cause damage to other parts of the tree or to other plants or property. Branches too large to support with one hand shall be precut to avoid splitting of the wood or tearing of the bark (see Figure 5.3.2). Where necessary, ropes or other equipment shall be used to lower large branches or portions of branches to the ground.

5.9.2.1.1.6 A final cut that removes a branch with a narrow angle of attachment should be made from the bottom of the branch to prevent damage to the parent limb (see Figure 5.3.7).

5.9.2.1.2 A minimum number of pruning cuts should be made to accomplish the purpose of facility/utility pruning. The natural structure of the tree should be considered.

5.9.2.1.3 Trees directly under and growing into facility/utility spaces should be removed or pruned. Such pruning should be done by removing entire branches or by removing branches that have laterals growing into (or once pruned, will grow into) the facility/utility space.

5.9.2.1.4 Trees growing next to, and into or toward facility/utility spaces should be pruned by reducing branches to laterals (5.3.3) to direct growth away from the utility space or by removing entire branches. Branches that, when cut, will produce watersprouts that would grow into facilities and/or utility space should be removed.

5.9.2.1.5 Branches should be cut to laterals or the parent branch and not at a pre-established clearing limit. If clearance limits are established, pruning cuts should be made at laterals or parent branches outside the specified clearance zone.

5.9.2.2 Rural/remote locations – mechanical pruning

Cuts should be made close to the main stem, outside of the branch bark ridge and branch collar. Precautions should be taken to avoid stripping or tearing of bark or excessive wounding.

5.9.3 Emergency service restoration

During a utility-declared emergency, service must be restored as quickly as possible in accordance with ANSI Z133.1, 29 CFR 1910.331 – 335, 29 CFR 1910.268, or 29 CFR 1910.269. At such times it may be necessary, because of safety and the urgency of service restoration, to deviate from the use of proper pruning techniques as defined in this standard. Following the emergency, corrective pruning should be done as necessary.