PDHonline Course C273 (5 PDH)

Utilities and Roadside Safety

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2020

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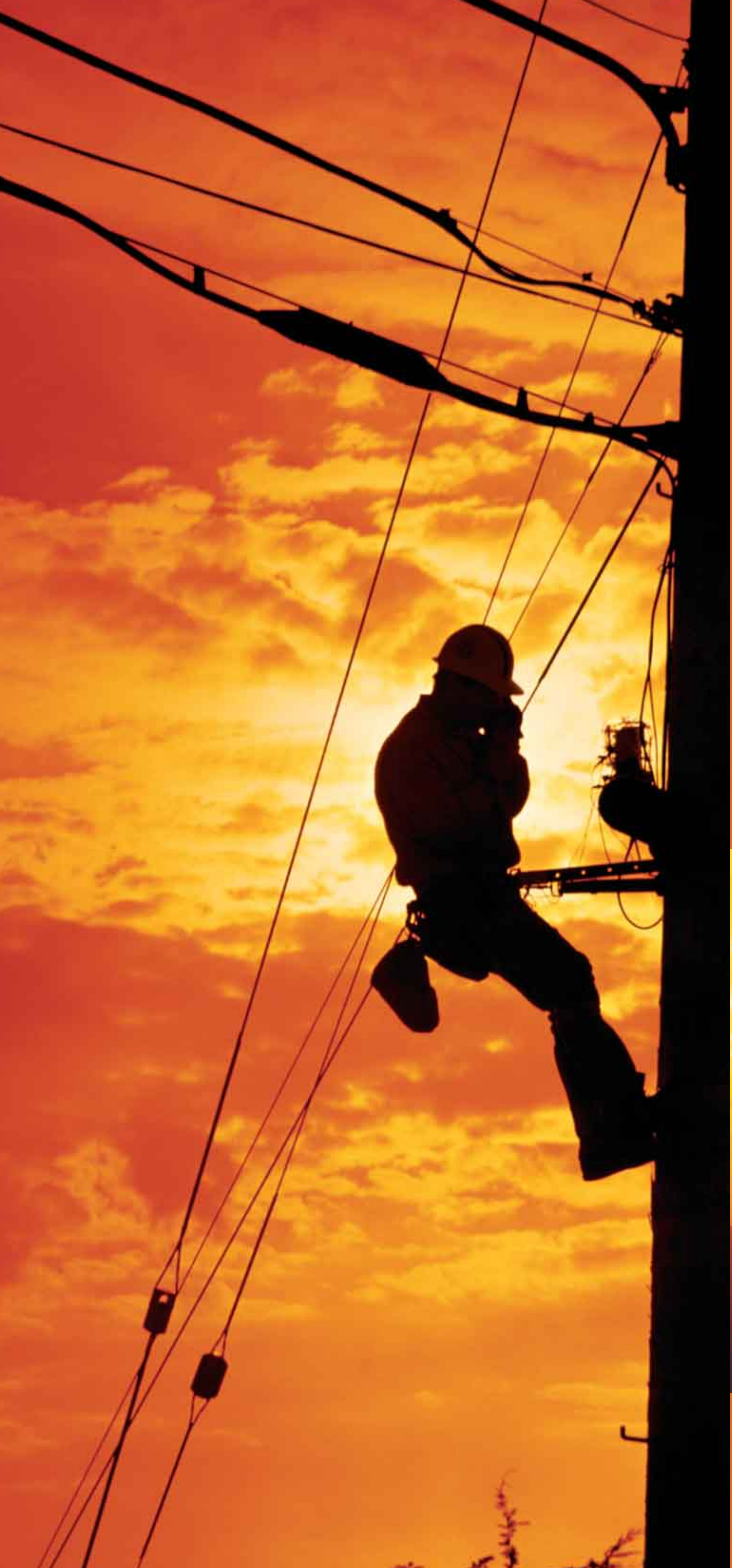
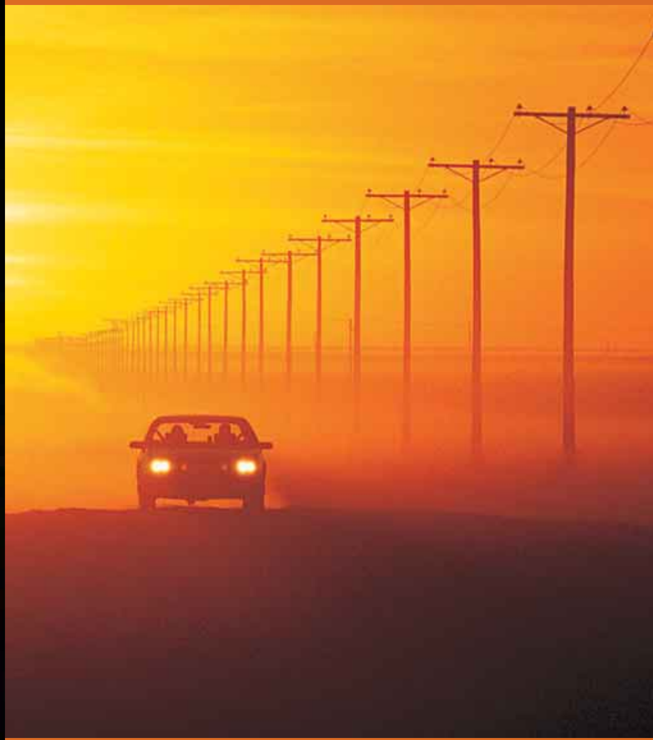


State of the Art
Report 9

UTILITIES AND ROADSIDE SAFETY



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TRANSPORTATION RESEARCH BOARD
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STATE OF THE ART REPORT 9

Utilities and Roadside Safety

Committee on Utilities

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

Transportation Research Board
Washington, D.C.
2004
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Transportation Research Board State of the Art Report 9

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Printed in the United States of America.

ISBN 0-309-09451-8

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Foreword

The purposes of this report are to compile the latest information on utility company, state department of transportation (DOT), and local highway agency roadside safety programs; to describe the current status of a combined federal and industry effort to implement roadside safety, including yielding poles; and to document recent developments in guardrail, concrete barrier, and crash cushion design to reduce utility maintenance costs, potential liability, and public health costs. Strategies are identified to deal with a relatively small number of poles on a prioritized, cost-effective basis. The report includes cost comparisons of various safety treatments for prioritized utility poles in highway rights-of-way, and a summary of the current status of litigation is given to provide an estimate of how recent precedents may affect future exposure.

The development of this report has a long history. The Transportation Research Board's Utilities Committee (AFB70, formerly A2A07), recognizing the significant influence on roadside safety of utility poles within highway rights-of-way, in 1997 formed a Utility Safety Task Group under the leadership of Don L. Ivey and C. Paul Scott. That Task Group directed its attention to ways that could make the roadside safer without the incurring of prohibitive costs by either utilities or state DOTs. The Task Group organized and guided the effort to develop a state-of-the-art report on the influence of utilities on roadside safety. To obtain the necessary information to prepare this report, task group leaders secured the participation of 22 nationally recognized professionals from utility companies, state DOTs, FHWA, universities, and private consulting firms. The names of these individuals are listed below. An additional 10 individuals consented to serve as "advisors," providing document review and comment; these individuals' names are also shown below. These 32 individuals provided invaluable assistance in compiling and reviewing this report.

Over the past 4 years, this report has been developed through a process in which authors wrote the individual chapters, which were reviewed by the task group members and advisors and then discussed in committee during semiannual meetings. In addition, all 50 state DOTs and 72 utility companies were provided the opportunity to preview the document and provide review comments that allowed for further editions to strengthen the document. It is hoped that the resulting report will make a significant contribution to the resources available on this important topic.

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1
Introduction

Don L. Ivey and C. Paul Scott

Formidable structures of steel, concrete, and wood located in critical positions are not consistent with a forgiving roadside. Many of these structures are utility poles. This report describes the tools and methods available to state departments of transportation (DOTs), local highway agencies (HAs), and utility companies (utilities) to make the roadside more forgiving.

The unforgiving nature of utility poles has been recognized since the 1960s. It is as old as the highway engineers' recognition of the need for forgiving roadsides, a concept that found wide understanding and acceptance some time before AASHO published its revolutionary 1967 Yellow Book, *Design and Operational Practices Related to Highway Safety* (*1*). Through the intervening years, the roadsides have changed dramatically. Breakaway ground-mounted sign and luminaire supports, crash cushions, traversable clear zones, collision-worthy guardrails and bridge rails, and safer drainage structures are some of the changes that have saved tens of thousands of lives in the intervening decades. Utility pole improvements have also been made. New utility poles are placed as close to the edge of the right-of-way as possible. Many utility poles that existed before 1967 have been removed, moved to safer locations, or made safer in some other manner. Many more, however, remain in place and continue to present a significant roadside hazard.

In 2000, the latest year for which data are available, there were 1,103 fatalities and about 60,000 injuries related to utility pole crashes. The fact that 1,103 fatalities are only 2.6% of all highway fatalities may be one of the reasons why state DOTs, local HAs, and utilities appear to place a low priority on the utility pole safety problem. However, collisions with utility poles are a significant part of the overall roadway safety problem, resulting in more than 9% of all "fixed object" fatalities. Utility poles are one obstruction that can be addressed in an overall effort to reduce highway fatalities and injuries.

Utility poles used to rank second on lists of fixed object fatalities. Now they are down to fourth. This appears to imply that things are getting better and may be another reason for the apparently low priority. Things are getting better, but much work remains to be done before collision-exposed poles have been eliminated.

Collisions with utility poles may appear to be a problem affecting only owners of the poles, but that is not the case. Some poles became more exposed due to highway changes. In certain cases poles were located far from the edge of pavement before the roads and

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streets were widened. Some poles existed at their present locations before roads and streets were built. Thus, the utility pole problem is a joint problem involving many stakeholders.

State DOTs and local HAs are stakeholders. In cooperation with affected utilities, they often take the lead in developing safety programs designed to identify hazardously located utility poles, prioritize them, and systematically remove, relocate, or modify them. In some cases, state DOTs also take the lead in looking for ways to fund needed improvements. Unfortunately, few state DOTs and local HAs have taken these basic steps.

Utilities are another stakeholder and may also take the lead in roadside safety programs. Today they are in a unique position to make progressive decisions that will positively influence the management, employees, stockholders, and the public for many years to come. Coming through the longest period of economic expansion in recent history, prepared to make the most of government deregulation, and presented with the opportunity to take advantage of a highly visible public relations windfall, it is hard to imagine a better environment for the utility industry to contribute to roadside safety. Even though a few utilities have taken steps toward resolving roadside safety issues, most have not.

FHWA is also a stakeholder. Federal regulations contained in 23 CFR 645.209(k) indicate that when a state DOT or local HA determines that existing utility facilities are likely to be associated with injury or accident to the highway user, as indicated by accident history or safety studies, the state DOT or local HA shall initiate or cause to be initiated, in consultation with the affected utilities, corrective measures to provide for a safer traffic environment. The regulations go on to say that the corrective measures may include changes to utility or highway facilities and should be prioritized to maximize safety benefits in the most cost-effective manner. FHWA has not enforced this regulation but has worked in recent years to encourage roadside safety programs that include movement of poles and implementation of safety structures.

This report contains tools a utility, state DOT, or local HA will find useful. These subjects include the following:

- Precedents
  - –AASHTO Strategic Highway Safety Plan (potential for saving 6,000 lives per year)
  - –Utility Safety Task Group of Committee A2A07, Transportation Research Board
  - –FHWA supporting research and developing status reports on every state
  - –State, city, and utility programs to reduce exposure to roadside poles
- Strategies
  - –Determination of where pole collisions occur by using accident and maintenance records
  - –Prioritization of safety improvements by accident experience, probability of collisions, and degree of compliance with clear zone recommendations
  - –Demonstration of the cost-effectiveness and indeed the cost savings to utility companies implementing roadside safety programs
- Engineering
  - –Illustration of the applicability of current roadside safety structures to utility sites on the roadside (includes crash cushions, steel-reinforced safety poles, guardrails, and concrete barriers)
  - –Demonstrations of performance of roadside safety structures in collisions
  - –Description of opportunities presented to utility industry for cost savings, improvement of system reliability, and improvement of public safety
- State and utility programs
  - –New York
  - –Pennsylvania
  - –Washington State
  - –Florida
  - –Georgia

  –Jacksonville Electric Authority (Florida)
  –Georgia Power Company
  –Lafayette Utilities System (Louisiana)
- Professionalism
  –History of roadside safety related to professionalism
  –Conclusion: In keeping with tenets of engineering societies, the mandates of state law, and professional engineering ethics, a licensed professional engineer's approval should be required for specific pole locations in accordance with the principle of the forgiving roadside and in accordance with the responsibility of "holding paramount the health, safety and welfare of the public"
- Legal aspects
  –Negligence as the basis for tort liability
  –Judgments and settlements
  –Lawsuits
  –Ways of successfully defending lawsuits

Also included is the experience of four utilities and eight states in implementing these life-saving and cost-saving strategies and technologies.

This document will help utilities answer the following key questions:

- Will a roadside safety program save my customers money?
- Will a roadside safety program save my company money?
- Will a roadside safety program promote public safety and the safety of the people in my maintenance department?
- Will a roadside safety program enhance the position of my company with respect to litigation?
- How can an effective roadside safety program be implemented?

This document will help state DOTs and local HAs answer the following key questions:

- How will a roadside safety program enhance the safety of motorists?
- Will a roadside safety program enhance the position of my organization with respect to litigation?
- How can an effective roadside safety program be implemented?

REFERENCE

1. *Design and Operational Practices Related to Highway Safety.* AASHO, Washington, D.C., 1967.

2
Utility Pole Collisions

C. Paul Scott and Don L. Ivey

The cover of *Traffic Safety Facts 1999* (*1*) shows what is left of a red automobile after a collision with a utility pole as emergency medical technicians and firemen struggle to remove the driver.

According to NHTSA's Fatality Analysis Reporting System (FARS), there were 1,103 recorded fatalities in 2000, the latest year for which data are available, and an estimated 60,000 injuries related to utility pole crashes. Utility pole fatalities (Figure 1) have declined from more than 1,900 in 1980 to about 1,100[1] in 2000. This is good news, but much more needs to be done.

Despite the fact that more than 1,000 motorists are killed and about 60,000 are injured each year, state departments of transportation, local highway agencies, and utility companies appear to have given the problem a low priority. This may be because 1,000 is only about 2.6% of all highway fatalities. Possibly it is because utility poles rank only fourth on lists of fixed object fatalities, as indicated in Table 1. Even so, it is important to keep in mind that no matter what the statistics show, far too many people, not numbers, are being killed and injured each year in collisions with utility poles. The tragic part is that many of these deaths and injuries could be avoided.

The preceding statistics were obtained from FARS on October 30, 2001.

What is known about utility pole crashes and roadway factors associated with high crash risk? Numerous studies have been conducted in the past two decades to better understand the factors contributing to utility pole crashes. For example, a 1980 study by Mak and Mason for FHWA (*2*) included 9,583 utility pole crashes on 2,500 miles of roadway in four states. Utility pole crashes ranged from 0 to 6.4 per mile per year on the study sections, averaging 0.57 utility pole crash per mile per year (and 16.6 utility pole crashes per 100 million vehicle-miles).

Mak and Mason's work must be considered a landmark study in terms of defining the extent of hazards imposed by poles. Pertinent objectives were "(1) identify the extent of the pole accident problem; (2) determine accident and injury severity rates associated with pole accidents; and (3) assess vehicle crashworthiness and highway design and operational characteristics for pole accidents."

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[1]Because only the first recorded event is listed by FARS, the actual toll may be significantly larger.

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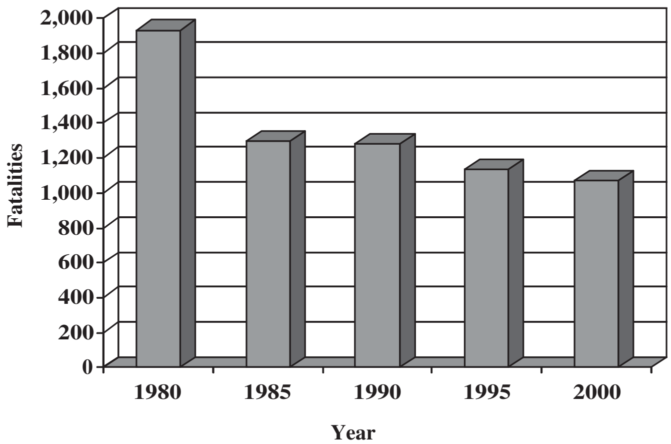

FIGURE 1 National utility pole fatalities.

Over a 4-year period, data were obtained from study sites in San Francisco, Los Angeles, Salt Lake City, San Antonio, Dallas, Kentucky, and Washington, D.C. These data included a probabilistically selected sample of 1,014 pole accidents, events (investigated in depth), and a sample inventory of poles. These data provided the base for extensive statistical analyses addressing the study objectives. Although poles in general, including signposts and luminaire supports along with timber utility poles, were studied, specific attention was given to the latter. Primary findings by Mak and Mason (*2*) are as follows:

- "Utility poles were the most frequently struck pole type accounting for 76.1 percent of all pole accidents."
- "Pole accidents are primarily an urban problem with 36.9 pole accidents per 100 miles of highway as compared to only 5.2 for rural areas."
- Mak and Mason point out, however, that "both urban and rural areas have nearly identical rates of 3.4 pole accidents per billion vehicle pole interactions." In this case, they mean by interaction simply an opportunity to strike a pole due to a vehicle passage.
- "Pole accidents in rural areas have higher impact severity than urban pole accidents as a result of higher impact speeds. A total of 10.7 percent of rural pole accidents resulted in severe to fatal injuries versus only 5.4 percent for urban pole accidents."
- "Drivers involved in pole accidents are mostly male (76.9 percent) and 25 years old or younger (55 percent) indicating the over-involvement of younger male drivers in pole accidents."
- "Collisions with timber utility poles have the highest frequency of severe to fatal injuries (7.4 percent)."
- "The incorporation of a breakaway design into luminaire and large sign supports is effective in reducing the resultant injury severity." (The authors would add the use of crash cushions and guardrails is also of proven effectiveness.)

TABLE 1 Fixed Object Fatalities (2000)

Fixed Object (F.O.)	Fatalities	% Total (41,821)	% F. O. (12,175)
Tree/Shrubbery	3,379	8.1	27.8
Embankment	1,283	3.1	10.5
Guardrail	1,171	2.8	9.6
Utility Pole	**1,103**	**2.6**	**9.1**
Ditch	944	2.3	7.8
Other F. O.	4,295	10.2	35.2
TOTAL	12,175	29.1	100.0

With those tragic facts in mind the question is whether a practical solution can be found. Clearly it cannot be recommended that 88,000,000 poles (*3*) on highway roadsides be removed. No one has ever recommended that type of overreaction. When it is considered, however, that the projected societal cost of these accidents over the next 5 years is $28 billion, it appears that something should be done. There are a number of cost-effective steps that can be taken. In the chapters on solutions (Chapter 3) and strategies (Chapter 4), those steps are defined.

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1. *Traffic Safety Facts 1999: A Compilation of Motor Vehicle Crash Data from the Fatality Analysis Reporting System and the General Estimates System.* National Highway Traffic Safety Administration, U.S. Department of Transportation, Washington, D.C., Dec. 2000.
2. Mak, K. K., and R. L. Mason. *Accident Analysis—Breakaway and Non-Breakaway Poles Including Sign and Light Standards Along Highways.* DOT-HS-805-605. FHWA, Aug. 1980.
3. Wentworth, J. A. *Motor Vehicle Accidents Involving Utility Poles—Summary of Data Availability.* Offices of R&D, FHWA, 1973.

3
Solutions

Don L. Ivey and C. Paul Scott

The documented influence of utility poles on safety makes planning for the accommodation of utilities early in the design process of critical importance. That same influence makes the inclusion of utility poles in every state's roadside safety program as well as the inclusion of an intraorganization roadside safety program in every utility's safety program of critical importance. In this chapter, the many practical solutions available for utility companies (utilities), state departments of transportation (DOTs), and local highway agencies (HAs) to accommodate these objectives are described.

The most desirable design solution, in terms of roadside safety, is to use as few poles as is practical and to locate the utility poles where they are least likely to be struck by a vehicle. The *Roadside Design Guide* (*1*) contains the following options for the location and design of utilities:

1. Increase lateral pole offset.
2. Increase pole spacing.
3. Combine pole usage with multiple utilities.
4. Bury electric and telephone lines underground.

A comprehensive group of solutions and countermeasures for extant facilities was recently proposed by Horne (*2*). These included the following:

- Keep vehicles on the roadway:
  - Use pavement markings,
  - Use delineators,
  - Improve skid resistance and drainage,
  - Widen lanes,
  - Widen and pave shoulders, and
  - Straighten curves.
- Change pole position or remove:
  - Move selected poles,
  - Decrease number of poles through joint use,
  - Decrease pole density,
  - Increase lateral offset,

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–Increase spacing, and
–Locate poles where they are less likely to be struck (includes underground).

- Use safety devices:
  –Crash cushions,
  –Steel reinforced safety poles,
  –Guardrail, and
  –Concrete barriers.
- Warn motorists of obstacles:
  –Pole delineation (reflective paint, sheeting, markers on poles),
  –Roadway lighting,
  –Warning signs, and
  –Rumble strips.

KEEP VEHICLES ON THE ROADWAY

One obvious way to reduce utility pole crashes is to assist the driver in staying on the roadway. This may be done by positive guidance—for example, by using pavement markings, roadside delineators, advance warning signs, and other visual cues to tell the driver what to expect and to provide a good visual path through a site. Physical enhancements such as improving the skid resistance of the pavement, improving drainage, widening the pavement travel lanes, widening or paving shoulders, improving the superelevation, straightening sharp curves, decreasing the speed of vehicles, and adding lighting in areas where crashes frequently occur at night may also diminish crash potential by decreasing the number of vehicles leaving the travelway. Traffic calming techniques also may be appropriate in some areas.

Improving the probability of vehicles staying on the roadway should not be neglected but can never be 100% effective. The preceding countermeasures should be considered along with decisions about the necessity of removing, relocating, or shielding utility poles. Where there are also trees, buildings, or other obstacles for errant vehicles to hit, run-off-the-road crashes caused by roadway problems may not be reduced significantly merely by removing or relocating utility poles. Keeping vehicles on the roadway is, therefore, a critical consideration when evaluating solutions to collisions with roadside obstacles.

Improvements to help keep vehicles on the roadway are clearly a state DOT or local HA function.

CHANGE POLE POSITION OR REMOVE

The most direct solution is to remove the utility pole or poles, but often this is not practical. Another solution for consideration is to relocate poles farther away from the road, preferably in a location where they are less likely to be struck (e.g., behind a ditch or existing guardrail or on the inside of a curve).

Countermeasures that reduce the number of poles may include combining utilities from separate poles (joint use) or increasing the spacing between poles. Before adopting any of these procedures, an engineering study is needed to determine whether the changes would be cost-effective and appropriate for the specific site. For example, increasing the spacing of poles requires that the remaining poles be larger and taller than the previous ones, and this is not a simple solution. In many cases, pole spacing is dictated by conductor size and characteristics and by codes and conductor spacing/clearance requirements. In all cases, pole spacing is a combination of various restrictive factors such as agency restrictions, pole loading, and customer service requirements. Ideal span lengths for power poles may be too great for communication conductors. Typically, joint use spans are shorter than power line spans.

Removing or relocating one or a few poles in areas of high hazard is often considered as a treatment when several crashes have occurred. This countermeasure may be particularly appropriate in rural areas where pole spacing is not as dependent on customer service.

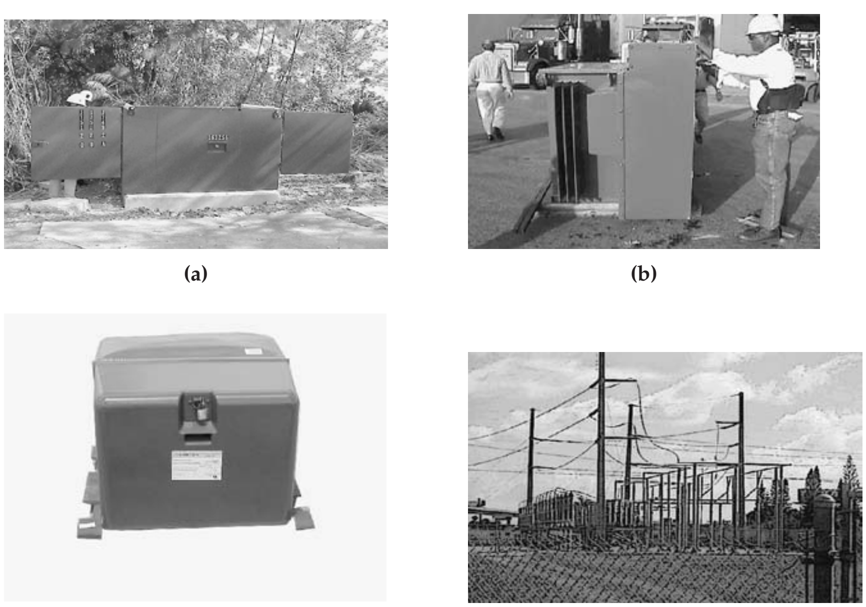
Removing or relocating utility poles is clearly a utility responsibility.

Burying utility distribution lines and removing existing poles would clearly eliminate future pole crashes, but cost is a critical consideration. Installation costs, repair costs if damaged, and routine maintenance costs will be higher. Also, undergrounding may not eliminate the potential for crashes with other roadside objects, such as trees, walls, buildings, and so forth. In some cases, collisions with the remaining obstructions may result in as severe an accident as collisions with the original pole line. When looking at the feasibility of undergrounding utilities, the complete roadside area and nearby adjacent properties should be evaluated for potential roadside obstructions or hazards. Aboveground appurtenances associated with underground utility facilities (transformers, switching cabinets, terminals, etc.) are larger than utility poles and in most cases are too large to be installed on the right-of-way (Figure 1). They may require private easements from adjacent property owners. If they are struck by a vehicle, the results may be as severe as striking a pole.

In considering undergrounding it also should be kept in mind that additional pad-mounted transformers would be required to serve the same customers because of the limitations on secondary electrical service configurations and limiting of current carrying capacity on the underground cables due to heat dissipation. Placing transmission lines underground reduces the amount of current carrying capacity and restricts the location of other utility facilities. If they are placed in conduits, the capacity of buried cable is reduced about 50%.

Specific issues for consideration when evaluating the practicality of undergrounding are as follows:

- Installation of aboveground facilities (transformers, switching cabinets, terminals),
- Easement requirements for facilities too large to be installed in the right-of-way,



(a) (b) (c) (d)

FIGURE 1 Examples of aboveground electrical equipment and mini-substation: (*a*) pad-mounted switch cabinet; (*b*) phase pad-mounted transformer; (*c*) pad-mounted transformer; (*d*) mini-substation.

- Presence of other existing underground facilities,
- Facility and customer service conversion costs (usually high and borne by the requesting agency), and
- Space requirements (right-of-way space needed for underground facilities is more than double that required for overhead installations).

In spite of the difficulties, an underground installation may be an effective design solution. In many cases, it can be justified only in new design based on aesthetic considerations. Rarely will it prove to be a cost-effective solution to existing facilities.

SAFETY DEVICES

It is clear that all safety devices do not fit every location. Often only one is applicable to a particular site. An on-site inspection, preferably attended by state DOTs, local HAs, and utility personnel, is usually required to ensure an effective choice. Appendices A and B provide practical examples for making those choices.

While many safety options are not new to the highway/utility community, some have been designed and tested specifically for use in reducing utility maintenance and guarding the public from impacts with utility poles. Others are clearly applicable to pole sites. A few of these are discussed in the following subsections.

Low-Profile Barrier

The low-profile barrier (LPB) is simply a short portable concrete barrier (20 in. tall). In total lengths of about 40 ft, it can be placed to prevent vehicle entry into an area where a pole is within the needed clear zone. The length of each concrete segment is 20 ft. The cost is about $25.00 per foot. It is qualified under *NCHRP Report 350* (*3*) Level 2 (45 mph) and is used extensively in construction zones in Texas. Currently, there are nine contractors or precasters licensed to produce LPBs in Texas. Over 100,000 ft have been cast and used on Texas highway projects (Figure 2).

FIGURE 2 LPB, construction zone.

Guardrail Extruder Terminal

ET-2000 and similar guardrail extruder terminals (Figure 3) have been broadly applied in the United States in the past 6 years. To date, over 50,000 extruders have been installed in 42 states.

Crash Cushions

Crash cushions ranging from simple effective sand-filled barrels to the most sophisticated *NCHRP Report 350* (*3*) Level 3 devices are available. At least four different designs [sand-filled barrels, EASI-cell cluster system (Figure 4); TRACC; REACT; and QuadGuard] are approved by FHWA for use on the National Highway System. Of the

FIGURE 3 Extruder terminal and guardrail (guardrail installation on pole).

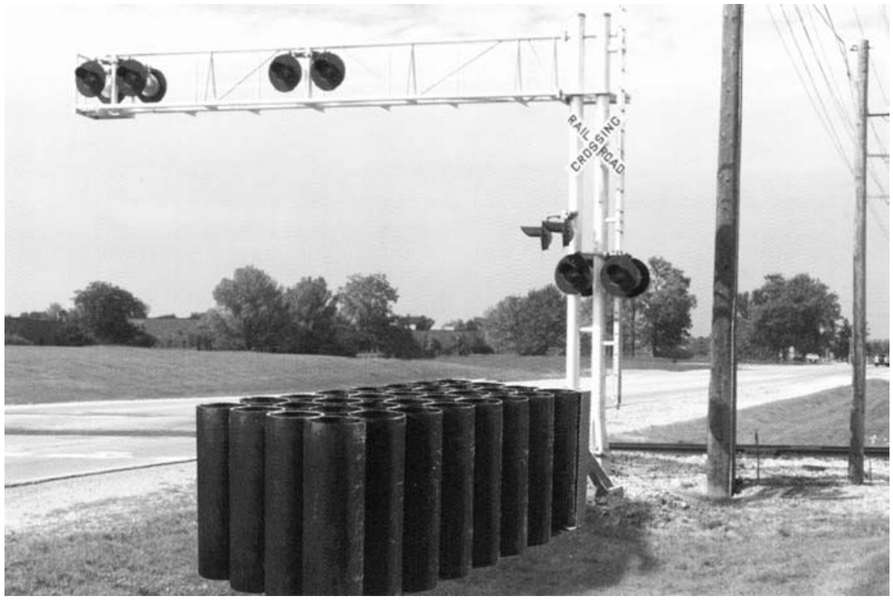


FIGURE 4 EASI-cell cluster system.

three solutions that usually render any needed changes in pole structure or placement unnecessary, QuadGuard occupies the least space but is the most costly. Where space is available, sand-filled barrels are a more cost-effective solution. Figure 5 shows a recent installation in Lafayette, Louisiana. The cost of barrels was less than $2,500. Note how chevrons have been used to better delineate the curve.

Breakaway Guy Wires

Several breakaway guy wire systems have been or are in the process of being developed. They are discussed in the following paragraphs.

The UTD Safety Link[1] is a breakaway mechanism for utility pole guy wires. It has been crash tested and meets the requirements of *NCHRP Report 350* (*3*). It consists of a threaded steel rod inside a two-piece cylinder. When an errant vehicle strikes the link, the two-piece outer cylinder bends at the joint. This increases the tension in the threaded rod until it fails, releasing the guy wire connection to the ground. This device has been approved by FHWA for use on the National Highway System.

Another breakaway guy wire has been developed[2] under an FHWA Small Business Enterprise Research contract. It has been successfully crash tested with a pendulum. It had previously been successfully crash tested at high speed with a small car. The test report and final report are currently not available, and it has not been approved by FHWA for use on federal-aid highways.

The starting point for these newer breakaway guy wire designs was provided by an operational breakaway guy wire connection developed and successfully tested in 1986 under an FHWA-sponsored research project. A 6-ft-long frangible transition piece, made of $\frac{3}{4}$-in. galvanized pipe, was added between the guy cable and the anchor. Details of the design are presented in FHWA Report FHWA/RD-86/154, *Safer Timber Utility Poles* (*4*).

WARN MOTORISTS OF OBSTACLES

The number of crashes and the severity of crashes may sometimes be decreased by warning motorists of the presence of poles adjacent to the roadway. This may be done with warning signs, reflective paint, sheeting, object markers placed on utility poles, or road-

[1]UTD, Inc., of Manassas, Virginia.
[2]Foster-Miller, Inc.

(a) (b)

FIGURE 5 Use of crash cushion in Lafayette, Louisiana.

way lighting. It is considered a last resort in some cases where more comprehensive treatments are not practical.

State DOTs, local HAs, and utilities can work together to warn motorists of obstacles.

EMERGING SOLUTIONS

In addition to the preceding safety devices, several new devices are now or soon will be available to reduce the number and severity of utility pole crashes. An example is the energy-absorbing fiberglass-reinforced composite utility pole.[3] This composite pole meets structural performance requirements for environmental loading in accordance with the National Electrical Safety Code for Class 4 poles and safety performance criteria in compliance with *NCHRP Report 350* (*3*) Test Level 2 conditions for utility poles. Crash tests have demonstrated the ability of the composite pole to absorb vehicle impact energy by progressive crushing and fracture propagation as the vehicle is brought to a controlled stop. This design meets a critical need in an area where there is no run out room available and no room for barriers or crash cushions.

INTELLIGENT TRANSPORTATION SYSTEM APPLICATIONS

Engineers and researchers[4] are working together on methods to increase driver awareness of known, dangerous roadway conditions and roadside obstacles, including utility poles. Awareness of hazardously located utility poles has been proposed by integrating infrastructure technologies with in-vehicle technologies. This might include the following:

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[3]Developed by Shakespeare Composites and Electronics, DE Technologies, Inc., and Dynatech Engineering, Inc.
[4]Foster-Miller, Inc., and Battelle Memorial Institute.

- Enhancing night vision by equipping vehicles with ultraviolet headlamps or infrared night vision sensors and by painting utility poles with fluorescent or high-emissivity paint.
- Providing navigational or route guidance by equipping vehicles with a Global Positioning System and embedding hazardous pole locations on digital maps.
- Providing early warning by equipping vehicles with radar sensors or transponders and positioning transmitters near potentially hazardous poles.

While these suggested countermeasures may seem impractical at this time, so did providing electricity for farmers in the 1930s.

COST COMPARISONS

As mentioned previously, keeping vehicles on the roadway should be a critical consideration when evaluating solutions to collisions with utility poles. Even so, there will be times when state DOT, local HA, and utility engineers agree there are no feasible or cost-effective ways to do this and other countermeasures must be considered. In this section, comparison of the overall cost of several of these different courses of action is attempted, while fully understanding many of these costs are highly variable.

The first and admittedly rare situation is that there is a certain pole in a certain highway right-of-way that is subject to a severe hit each year. This is presented in Table 1. A severe hit is one in which serious injury or death of one driver or passenger is expected. Estimated costs are compared over a 5-year period. For these example purposes, the action/inaction year is 2002 and costs are estimated through 2006. There is no consideration of inflation or the cost of money so in economic terms the comparison is simplified.

Table 1 presents estimates of cost for five “actions” and for “no action.” They are as follows:

- No action,
- Relocation of pole,
- Installation of a steel-reinforced safety pole (AD-IV, FHWA, or Hawkins),
- Installation of concrete barrier (LPB),
- Installation of guardrail with extruder terminal, and
- Installation of a short crash cushion (Level 2).

Table 1 is divided into initial, maintenance, loss of service, and potential liability costs. In the last column, the total 5-year cost (neglecting liability) is presented. Figure 6 presents a graphic comparison of the different action costs over the 5-year period. The most costly, even neglecting potential liability costs, is clearly doing nothing. Although relocation of the pole may be the most costly in the short term, over a 5-year period it compares favorably with other alternatives. If the comparison extends beyond 5 years, relocation clearly becomes more and more cost-effective.

If 5-year costs vary between $3,000 and $15,000 for the various rail, cushion, and breakaway devices compared, why is this variety needed? In a situation in which removal is not feasible, only one of the other three alternatives may be appropriate—for example, if there were as much as 15 ft available, a crash cushion might fit. For a more detailed discussion of where each device would or would not be feasible, see Ivey and Mak (*5*).

Three other hypothetical situations are considered. They are as follows:

- Table 2 and Figure 7: One severe collision with a pole in a 5-year period;
- Table 3 and Figure 8: Five severe collisions with any of three poles in a 300-ft length of pole line in a 5-year period (taken from PennDOT) (*6*); and
- Table 4 and Figure 9: Eight severe collisions within a 3,000-ft length containing 20 poles in a 5-year period (taken from PennDOT).

TABLE 1 Summary of Costs for 5 Years: Pole Struck Once per Year

Action	Initial Cost	Maintenance Cost per yr 5yrs		Loss of Service /yr $5yrs		Potential Liability	Total 5-Year Cost*
None	0	$2,000	$10,000	$4,000	$20,000**	$ 5m	$30,000
Relocate Pole	$3,000 to $15,000 $9,000 avg.	0	0	0	0	0	$ 9,000
AD-IV Breakaway	$2,000	$1,000	$5,000	0	0	0	$ 7,000
LPB Concrete	$1,000	$ 200	$1,000	0	0	0	$ 2,000
Extruder Guardrail	$2,000	$1,000	$5,000	0	0	0	$ 7,000
Crash Cushion	$5,000	$2,000	$10,000	0	0	0	$ 15,000

* No potential liability cost included.
** Assumed $1,100/service hour lost.

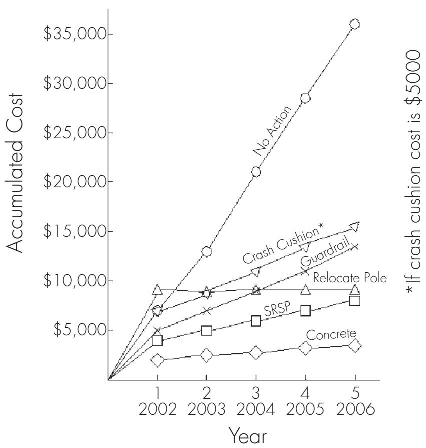

FIGURE 6 Summary of costs for 5 years (pole struck once per year, one pole affected).

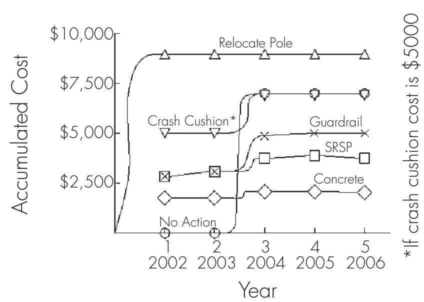

FIGURE 7 Summary of costs for 5 years (pole struck once per 5 years, one pole affected).

TABLE 2 Summary of Costs for 5 Years: Pole Struck Once per 5 Years, One Pole Affected

Action	Initial Cost	Maintenance Cost per Collision	Loss of Service	Potential Liability	Total 5-Year Cost*
None	0	$4,000	$3,000**	$200,000	$7,000
Relocate Pole	$3,000 to $15,000 $9,000 avg.	0	0	0	$9,000
AD-IV Breakaway	$3,000	$1,000	0	0	$4,000
LPB Concrete	$2,000	$ 200	0	0	$2,200
Extruder Guardrail	$3,000	$2,000	0	0	$5,000
Crash Cushion	$5,000	$2,000	0	0	$7,000

* No potential liability cost included.
** Estimated $1,100/service hour lost.

In the case indicated in Table 2 (one collision with a pole every 5 years), relocation is more costly (neglecting potential liability) than doing nothing (see Table 2 and Figure 7). In the situation presented in Table 3, five collisions in 300 ft, all actions cost less than doing nothing.

In the case indicated in Table 4, eight collisions in 3,000 ft, almost all actions with the exception of LPB are more expensive than doing nothing. Note carefully, however, this neglects the potential liability cost of eight severe pole impacts, an estimated $1 million to $6 million.

TABLE 3 Summary of Costs for 5 Years: Five Pole Hits in 300 ft of Pole Line, Three Poles Affected

Action	Initial Cost	Maintenance Cost per Hit	Maintenance Cost 5 Hits	Loss of Service /yr	Loss of Service $5 yrs	Potential Liability	Total 5-Year Cost*
None	0	$4,000	$20,000	$3,000	$15,000**	$ 1m	$35,000
Relocate Pole	$3,000 to $15,000 $9,000 (avg.) x 3 = $27,000	0	0	0	0	0	$27,000
AD-IV Breakaway	$3,000 x 3 = $9,000	$1,000	$5,000	0	0	0	$14,000
LPB Concrete	$2,000 x 3 = $6,000	$ 200	$1,000	0	0	0	$ 7,000
Extruder Guardrail	$3,000 x 3 = $9,000	$2,000	$10,000	0	0	0	$19,000
Crash Cushion	$5,000 x 3 = $15,000	$2,000	$10,000	0	0	0	$25,000

* No potential liability cost included.
** Estimated $1,100/service hour lost.

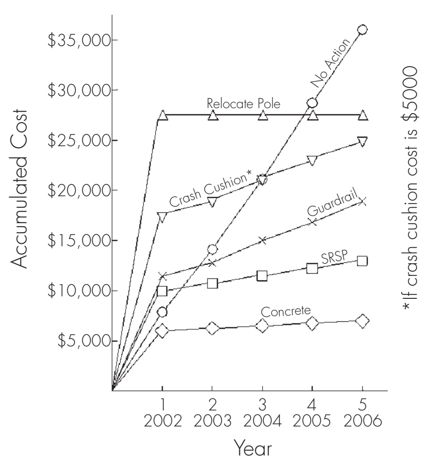

FIGURE 8 Summary of costs for 5 years (five pole hits in 300 ft of pole line, three poles affected).

TABLE 4 Summary of Costs for 5 Years: Eight Pole Hits in 3,000 ft of Pole Line, 20 Poles Affected

Action	Initial Cost	Maintenance Cost per Hit	Maintenance Cost 8 Hits	Loss of Service /yr	Loss of Service $5 yrs	Potential Liability	Total 5-Year Cost*
None	0	$4,000	$32,000	$3,000	$24,000**	$ 6m	$56,000
Relocate Pole	$3,000 to $15,000 $9,000 (avg.) x 20 = $180,000	0		0		0	$180,000
AD-IV Breakaway	$3,000 x 20 = $60,000	$1,000	$8,000	0		0	$68,000
LPB Concrete	$2,000 x 20 = $40,000	$ 200	$2,000	0		0	$42,000
Extruder Guardrail	$3,000 x 20 = $60,000	$2,000	$40,000	0		0	$100,000
Crash Cushion	$5,000 x 20 = $100,000	$2,000	$16,000	0		0	$116,000

* No potential liability cost included.
** Estimated $1,100/service hour lost.

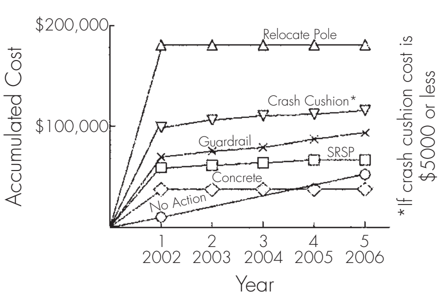

FIGURE 9 Summary of costs for 5 years (eight pole hits in 3,000 ft of pole line, 20 poles affected).

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4
Strategies

Don L. Ivey and Charles V. Zegeer

The primary objective addressed by strategy is to maximize the benefit to society for every action and expenditure taken by state departments of transportation (DOTs), local highway agencies (HAs), and utility companies (utilities) in a collision reduction program. A secondary but important objective is to institute a program that will provide state DOTs, local HAs, and utilities with the best defensive position relative to potential litigation. Strategies and analytical methods to maximize these benefits have been developed and used by some state DOTs and a few utilities and municipalities with good results (see Chapter 5). Examples of these are the approaches of Zegeer and Parker (*1*), that of Griffin et al. (*2*), and the method presented in the current AASHTO *Roadside Design Guide* (RDG) (*3*).

Each of these approaches has advantages. The Zegeer approach relies on only three factors: traffic count, lateral distance to poles, and pole density to predict accident frequency. It is statistically derived but admittedly has limited predictive power. The Griffin approach is potentially more powerful statistically but is somewhat more complicated to apply. The RDG is a benefit–cost approach, used most commonly to evaluate the potential danger of roadside objects and how that compares with the application of guardrails or crash cushions.

The authors have not been insulated from the field of litigation and have developed a clear understanding of the strategies of both the plaintiff and the defendant over the past three decades.

As part of these analyses and efforts to achieve an optimum approach, every effort has been made to find and take advantage of the strengths of various approaches while respecting the justifiable objectives and economic constraints of utility companies. In so doing, the following objectives were considered:

1. Prevent the recurrence of a fatality or injury at sites where collisions have already occurred.
2. Prevent the occurrence of a fatality or injury at sites where collisions are likely to occur.
3. Save the utility maintenance funds.
4. Put a utility in the best position to defend the clearly random collision. (This is potentially a way to save the stockholders and customers of a utility millions of dollars.)

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Perhaps the term "clearly random collision or event" is not familiar. It is this event and the ability to define it that will provide a utility, local HA, or state DOT the best legal defense against litigation. One way of defining the clearly random event is that it is everything outside the realm of the predictable. Predictive equations have been developed that are strong enough to make cost-effective site selections. If utilities, local HAs, and state DOTs act in an appropriate way in prioritizing and treating the predictable, then a strong defense can be laid not only against the clearly random but also against the lower-priority levels of the predictable. The result is the following three-path approach: best offense, best bet, and best defense (*4*).

BEST OFFENSE

This is the most obvious of the approaches and historically the most frequently used, residing firmly in the realm of common sense. It is improving safety where an atypical number of collisions have already occurred. It will work toward Objective 1, preventing the recurrence of a fatality or injury at sites where multiple collisions have already occurred. What is required is for a utility to know where collisions are occurring. There are two practical approaches. The first and most direct is to make arrangements with the appropriate law enforcement agency or agencies to secure copies of all collisions involving a part of the utility's physical plant (e.g., utility poles). Those collisions are then located to determine the facility sustaining the damage. Usually at least 3 years of accident data are necessary to begin determining the most susceptible sites, but sometimes a congregation of crosses placed by survivors or other observations in the field can be clues hard to misinterpret. The identified locations of a pole or poles atypically exposed can then be prioritized for movement or treatment. This is the most immediately visible and most obviously effective portion of the safety program. Such a program was designed by Mak (*5*) and successfully applied by Jacksonville Electric Authority in 1989. However, this approach suffers from requiring unsupportably costly collisions for definition (i.e., it is reactive instead of proactive). It is a part of the program that should take priority early and gradually be reduced in importance as these obvious exposed areas are changed. Note that this approach will also help accomplish Objectives 2, 3, and 4.

BEST BET

In this phase of the program, pole lines and roadways are prioritized by statistical algorithms that can be applied before an accident history develops. Zegeer and Parker have developed prediction equations and data useful in prioritizing pole lines of significant length. Good et al. (*6*) have also developed useful relationships. These relatively simple equations rely on traffic volume, pole offset, and pole spacing to predict where the probability of pole collisions is greatest.

They are based on a comprehensive database from 1,534 roadway sections covering 25,193 roadway miles. The sections are in Michigan, North Carolina, Washington, and Colorado. Six to 10 years of accident data were required for each section. The analysis included more than 9,600 utility pole accidents.

A major accomplishment was the development of a regression model (*7*) to predict utility pole accidents:

$$\text{Accidents/mi/yr} = 9.84 \times 10^{-5}\ (\text{ADT}) + \frac{3.54 \times 10^{-2}(\text{density})}{(\text{offset})^{0.6}} - 0.04$$

where

Accidents/mi/yr = number of predicted utility pole accidents per mile,
ADT = annual average daily traffic volume,

density = number of utility poles per mile within 30 ft (10 m) of the roadway, and
offset = average lateral offset of the utility pole from the roadway edge on the section.

Because pole collisions are generally low-probability events, the power of these algorithms to make accurate predictions is limited. Thus, this prioritization scheme should probably be only one of the controlling factors dictating change. It might be especially helpful in concert with right-of-way expansions or roadway widening (i.e., DOT improvement projects). For example, if a DOT project allowed movement of a pole line from 10 ft behind the curb to 18 ft, there is a good probability the money for utility movement would be better spent elsewhere. Thus, a utility could propose, on the basis of statistical probability, that a higher-priority section of poles be moved or treated with the funds that would have been expended on the 10-ft to 18-ft project (e.g., where poles could be moved from 2 ft to 10 ft). Further, when a given pole line shows a high priority for change, that occasionally could be used by a DOT to justify the acquisition of more right-of-way. Note that this best bet approach will apply directly to Objective 2 and will help accomplish Objectives 3 and 4.

Finally, something else should be accomplished while saving lives and limbs. Safety funds should not be dissipated on frivolous lawsuits. The final approach will be likely to prove a great frustration to plaintiff attorneys with unjustifiable lawsuits.

BEST DEFENSE

In the courthouse, a second legally damaging condition for a pole line, right behind a significant accident history, is failure to meet the recommendations of the RDG (*3*). This is already true for state DOTs, counties, and cities. It is likely to become true for utilities as the aforementioned governmental entities take the logical steps to share the responsibility for roadside safety. This has been true even in cases in which the degree to which noncompliance with the RDG recommendations is slight. In Arizona, the city of Mesa was recently held accountable for a drainage structure 15 ft from the traveled way, while the RDG recommended 17.5 ft. A way of decreasing the liability for letter-of-the-law divergences from RDG recommendations is as follows:

1. Document the areas, pole lines, and individual poles that were originally placed or came to be placed in conflict with the clear zone recommendations of the RDG.
2. Use the physical characteristics of these sites to calculate the percent compliance (PC) value with the RDG. Interpret the PC value to secure a priority number (PN). Note the relationship between PN and PC with the RDG can be derived to achieve the most productive priority listing by using lateral encroachment predictions and relative risk relationships.
3. Schedule modification of sites according to the PNs.
4. Perform safety treatment of a reasonable number of the highest-priority sites each year. (Some utilities have found a cost-beneficial investment of $100,000 per year will yield effective progress.)

In this way, if an area is in reasonable compliance with the RDG clear zone (e.g., there is a 15-ft clear zone instead of the recommended 17.5 ft), it will show up as a very low priority for treatment and thus place the state DOT, the local HA, and the utility in a good defensive position if one of these sites is subject to the rare and unpredictable random collision. Note that this third strategy pursued in concert with the first two will clearly accomplish Objective 4.

The following is a simplified approach that was recently implemented by Lafayette Utilities System (see Chapter 5 for more detailed information).

Step 1. Continue to monitor collisions with utility structures to determine whether sites are disposed to repeated collisions or are simply subject to the purely random collision that is unlikely to be repeated.

Step 2. Apply predictive analyses to heavily traveled thoroughfares to determine the relative probability of collisions in selected areas or sites.
Step 3. In the areas and sites that are prioritized by Step 2, determine the relative degree of consistency with the recommendations of the RDG.
Step 4. Make safety modifications based on Appendix A to the top 10 sites each year.

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5
Initiatives

C. Paul Scott and Don L. Ivey

In an invited address at the 1991 National Highway/Utility Conference a "critical mass package" was defined that was composed of 16 achievements taking place from 1975 through 1991. The speaker asserted that "critical mass" was compelling evidence that implementation of intrautility roadside safety programs was a positive, profitable, and responsible management decision. While this communication did not result in a great number of utility companies (utilities) striving to implement safety programs, it apparently was considered supportive of those already taking that initiative along with state departments of transportation (DOTs) and local highway agencies (HAs). Selected roadside safety programs and implementation efforts are described here.

NEW YORK

In 1982, the New York State Department of Transportation (NYSDOT) embarked on a program to identify and treat hazardous utility poles. They called it the war on utility pole accidents. It involved a systematic approach patterned after NYSDOT's Highway Safety Improvement Program.

The process is as follows:

1. Safety problems and accident analyses are quantified, leading to a prioritized listing of accident-prone sites.
2. The identified locations are then investigated in the field by NYSDOT and utilities engineers and subjected to a comprehensive engineering study.
3. Alternative solutions (countermeasures) are developed and analyzed to determine cost-effectiveness. Countermeasures, in descending order of desirability, are (*a*) removing poles and placing lines underground, (*b*) moving poles away from the road (the most common method), (*c*) increasing pole spacing, (*d*) encouraging multiple use of poles, (*e*) relocating poles from the outside to the inside of curves, (*f*) using breakaway poles, (*g*) shielding poles, and (*h*) if all else fails, marking and delineating poles with appropriate *Manual on Uniform Traffic Control Devices* warning devices. Research indicates that about 50% of utility pole crashes involve poles within 4 ft of the road edge, while about 75% of all pole hits are within 10 ft.

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4. Specific countermeasures best suited to reducing accidents in the most cost-effective manner are recommended for implementation.
5. The implemented accident countermeasures are later evaluated to determine actual performance, using appropriate measures of effectiveness.

Two customized outputs identifying utility pole accidents are available with data files from the State Accident Surveillance System. The first is a directory of all such accidents on the state highway system listed by reference marker for each route in each county. Seven years of data are included in the directory. To systematically identify the most severe utility pole accident sites, a second output was developed. Known as the "bad actor" listing, it pinpoints the worst locations. Sites are prioritized within regions by a measure of accident frequency (at least five accidents at the reference marker in a consecutive 7-year time period) or severity (at least one fatal accident at the reference marker plus at least one other utility pole accident in a consecutive 7-year time period).

In 1984, there were 567 locations on NYSDOT's bad actor list. The latest version of the list (released in October 1994) had only 262 locations, a 54% reduction of bad actors in the 10-year period.

PENNSYLVANIA

The Pennsylvania Department of Transportation (PennDOT) has embarked on a systematic approach to reduce run-off-the-road fatalities by concentrating improvements on those sections that have the highest frequency of tree, utility pole, and guide rail crashes. The distribution of utility pole crashes shows that over 36% of crashes occur on less than 4% of the roadway mileage. PennDOT has begun a substantial effort to address the problem relating to utility poles statewide. Its program involves several treatments and is implemented through the District Safety Initiative for low-cost improvements.

In addition to an internal engineering initiative, PennDOT has taken a historic step to partner with utility pole owners in an effort to reduce utility pole–related fatalities. On June 20, 2000, the Secretary met with the chief executive officers of all major utilities to discuss this effort. To date, there has been cooperation from both sides in developing resource-sharing options that will allow PennDOT to share in the costs.

PennDOT has also initiated a long-term low-cost improvement program composed of various specific initiatives. The Bureau of Highway Safety and Traffic Engineering has provided the District Safety Units with crash information and locations where utility pole crashes are frequent (i.e., locations where three or more fatalities have occurred on a ½-mi section in the past 5 years). Guidance has been issued to the districts for use in identifying treatments at these specific utility pole locations. The combination of these efforts is expected to reduce fatalities related to utility poles significantly. The effort will be implemented on a broader basis after effectiveness is evaluated as a part of the PennDOT goal to reduce highway fatalities in Pennsylvania by 10% by 2005.

Specific PennDOT initiatives include the following:

1. Utility pole co-op: PennDOT has joined with utility pole owners to proactively address utility pole crashes in Pennsylvania. PennDOT has agreed to assist the pole owners with the high costs associated with relocations. PennDOT is exploring (*a*) acquiring right-of-way or reimbursing pole owners for some of the costs of acquiring right-of-way for utility pole relocations in rural areas; (*b*) contributing to the cost of placing utilities underground in suburban and urban areas; and (*c*) participating in the costs of consolidating utility poles on one side of the roadway and removing them from the other when they currently exist on both sides.
2. Rumble strips: PennDOT is actively pursuing ways to keep motorists on the road. One way of doing this is with the use of rumble strips directly on the edge lines of narrow roadways.

3. Delineation: PennDOT proposes placing reflective tape around poles where undergrounding or relocation is not a feasible option. Recent evaluation of reflective tape around poles and trees in Pennsylvania indicates a significant reduction in crashes. PennDOT is currently working with utility pole owners to compile specifications that serve the purpose and that are acceptable to both parties.

JACKSONVILLE ELECTRIC AUTHORITY

In 1989, what was then believed to be the first intrautility roadside safety program was announced by the Jacksonville Electric Authority (JEA) in Jacksonville, Florida. With a service area of some 2,000 mi^2 in northeastern Florida, JEA had engaged in a cooperative study of the roadside safety problem with the Texas Transportation Institute (*1*). A program was installed under that study by King K. Mak to record and periodically analyze all police accident reports in the service area. A document titled "Recommended Guidelines for New Installations" was prepared for JEA. Later it was modified for general use and presented at a TRB session in 1989 (*2*). All areas subject to an atypical accident experience were to be prioritized for analysis and/or specific treatment of the 10 highest priorities each year. A level of expenditure not to exceed $100,000 per year was established for the treatment of as many of the prioritized sites as could be accomplished. A policy commitment was made to the overall goal of improved roadside safety and documented by Procedure Number MD 920, "Roadway Safety as Relates to JEA Facilities" (Feb. 27, 1992).

The following parts of MD 920 are of special interest:

1. Clear recovery area: New aboveground facilities should be located as far from the traveled way (or face of the curb, if a curb exists) as practical.
2. Number of poles: Reduce number of poles by emphasizing joint pole use and longest practical span length.
3. Accident experience: Safety measures will be used to improve traffic safety for locations with significant previous accident experience.
4. Susceptible locations: Medians, traffic islands, lane terminations, and right-of-way narrowing are locations to be studiously avoided.

Perhaps one unique aspect of the program included a reliance on new devices, or devices new to the utility industry, which are included in the following:

> The Distribution Engineering Division will evaluate the use of breakaway devices, guardrails, crash cushions or other devices or design changes in order to improve roadway safety.

WASHINGTON STATE

In 1986 FHWA encouraged all states to develop a program for utilities to better conform to clear roadside policies. Washington State DOT (WSDOT) responded positively. In cooperation with the utilities in the state, WSDOT developed a program for systematically alleviating hazards associated with utility poles and other utility objects. This program provides direction as to when and how the utilities may use public highway right-of-way and helps provide a safer roadside.

The WSDOT utility object program is essentially a rural program. This is because cities and counties generally are responsible for the streets and highways in urban areas, except possibly for the pavement structure. The program covers about 6,000 mi of highway containing utility objects within a control zone.

WSDOT and the utilities work together to classify existing utility objects. They prefer to use the broader term "objects" instead of "poles" to address utility facilities other than poles that might exist in a control zone.

Utility objects are classified as Location I, Location II, or Location III objects.

Location I objects include utility objects located within the control zone in the following areas:

- Outside of horizontal curves where advisory signed speeds for the curve are 15 mph or more below the posted speed limit of that section of highway;
- Within the turn radius area of public grade intersections;
- Where a barrier, embankment, rock outcropping, ditch, or other roadside feature is likely to direct a vehicle into a utility object; and
- Closer than 5 ft horizontally beyond the edge of the usable shoulder.

About 20% of the utility objects in Washington State are Location I objects.

Location II objects include all utility objects located within the control zone that are not classified as Location I or III objects. About 32% of the utility objects in Washington State are Location II objects.

Location III objects include the following:

- Utility objects located outside the control zone,
- Utility objects within the control zone that are mitigated by an alternative countermeasure (located in inaccessible areas, shielded, or breakaway), and
- Location II objects that have been classified as Location III by the AASHTO cost-effectiveness methodology contained in the *Roadside Design Guide* (*3*).

About 48% of the utility objects in Washington State are Location III objects.

The WSDOT utility object program generally requires that

- New utility objects must be placed outside the control zone,
- Existing utility objects must be moved or mitigated in conjunction with highway construction/reconstruction projects, and
- Other existing utility objects must be moved or mitigated in a systematic manner in accordance with an annual mitigation target.

If it is determined, through an engineering analysis, that a Location I object cannot be moved to Location III or mitigated, a variance may be considered. Through an engineering analysis and AASHTO's cost-effective procedure, it will be determined whether a Location II object will be moved to Location III, mitigated, or reclassified.

WSDOT recognizes that conditions may arise that make it impractical to comply with the control zone policy. Examples of conditions rendering compliance impractical include the following:

- WSDOT right-of-way is inadequate to accommodate utility objects outside the control zone.
- Segments of utility facilities, because of terrain or other features, do not warrant being located in full compliance with the control zone policy.

A variance may be considered by WSDOT to allow utility objects to remain or to be installed within the control zone.

As initially set up in 1987, the correction of existing utility objects on highways, where no other construction or reconstruction was anticipated, was triggered by the renewal of a state/utilities franchise agreement. Utilities were required to relocate or mitigate utility objects within 1 year after renewal of a franchise agreement. This was troublesome to the utilities because it created excessively large expenses for them within short periods of time. In response to this concern, WSDOT asked the utilities to suggest a number of utility objects that might feasibly be relocated or mitigated each year. The utilities in turn recommended that the franchise trigger be replaced with an annual mitigation target (AMT) based on the number of objects in need of correction, size of the utility, resources available to the utility, and other criteria. This appears to be a more workable solution.

The number of a utility's existing control zone objects to be relocated or mitigated in a given year is established by WSDOT and the utility on the basis of the following AMT formula:

$$\text{AMT} = \frac{[(M \times 5,280)/N] \times (Z)}{Y}$$

where

M = number of miles of utility-owned aboveground facilities located within highway right-of-way (multiply by 5,280 to convert to feet of facilities),
N = utility's average line span length (ft),
Z = percent of objects owned by the utility that are estimated to be in Location I or II, and
Y = number of years for compliance (50 maximum).

If a utility does not achieve its AMT in a particular year, the number of objects that are to be relocated or mitigated in the following year shall be increased so that the average number of objects that are relocated or mitigated over time equals its AMT. Conversely, if a utility exceeds its ATM in a particular year, the number of objects that are to be relocated or mitigated in the following year may be reduced.

Utility objects must be physically relocated or mitigated to be counted toward the AMT.

Utility objects required to be relocated or mitigated in conjunction with highway construction or reconstruction projects may be counted toward the AMT. The amount of utility object correction on highway improvement projects is correlated to the amount of other safety improvements planned for the highway project.

WSDOT now reports a 35% reduction in pole accidents (*4*).

GEORGIA

Georgia has an active utilities coordination program. The impetus for this program is the Georgia Utilities Coordinating Council (GUCC). GUCC, through its more than 35 chapters in seven regions of the state, provides an overall cooperative process to exchange information and resolve conflicts in the utility and public sector. It also has standing and ad hoc committees to address mutual issues, one of which is the Clear Roadside Committee (CRC). The CRC is composed of members from the Georgia Department of Transportation (GDOT) and from the electrical, telecommunications, and cable television industries.

Recognizing that a disproportionate number of utility pole accidents were occurring in Georgia and other southeastern states, the CRC initiated efforts to improve policies for placing utility poles along public rights-of-way in Georgia. This involved developing a plan to relocate all potentially hazardous utility facilities within the clear zone on U.S. and state routes within a 30-year period. This was to be done by identifying critical areas based on prior crash history and prioritizing these areas for mitigation. This innovative effort was recognized by FHWA in 1998 with its presentation to the GUCC of the Best Overall Operational Improvement Biennial Safety Award.

CRC recommendations for the placement of poles in conjunction with new or major rehabilitated facilities vary from a minimum of 6 ft in certain urban low-speed facilities to as much as 30 ft in certain rural areas (*4*).

By consensus the group recognized U.S. and state routes as the most critical. GDOT's Traffic Operations Section prepared a report documenting crashes involving utility poles during a 3-year time frame and based on 3-mi stretches of road. These routes were prioritized by total number of crashes, not just fatal crashes. Total crashes and total injuries were considered, along with feasibility, to prioritize the relocation efforts.

Not surprisingly, most of the locations identified in this manner were in metropolitan areas. The top 10 sites ranked in this way were all located in Fulton County, the heart of the metropolitan Atlanta area.

The CRC policy is based on a give-and-take premise. The utilities voluntarily move a certain number of poles each year to a safer location, and GDOT allows variances to its policy of not allowing pole attachments to any pole deemed to be within the clear zone.

The number of poles to be moved is estimated based on the number of existing poles that need to be mitigated over a 30-year period. The more crash-susceptible areas are to be treated first. Poles relocated on a GDOT project to safer locations are included in the yearly totals. This situation is advantageous for the utilities, GDOT, and the traveling public.

CRC recognizes that mistakes of the past cannot be changed overnight but, with a plan and a goal in mind, believes there will be an immense positive effect over time.

FLORIDA

In 1997 the Florida Department of Transportation (FDOT) and the Florida Utilities Coordinating Committee (FUCC) began looking at the manner in which utilities were occupying highway rights-of-way and their impact on related injuries and fatalities.

FDOT had been successful in making many positive changes in roadway elements (pavement surface, cross slope, culvert extensions and end sections, and terminal ends to guardrails) but had not been so successful with poles (signal, power, telephone, and lighting). Poles were the second most hit fixed objects in the rights-of-way. FDOT, in coordination with FUCC, began taking steps to minimize the number of fatalities and injuries and the amount of property damage caused by utility pole crashes. They also began doing the same for trees, the most hit fixed objects. Tree-related activities are occurring at a much slower rate because of environmental concerns and public opinion.

Past attempts at dealing with the pole issue had driven a wedge between FDOT and utility representatives because the utilities could foresee only more restrictions and a one-sided approach. FDOT decided that whatever was developed must be applied evenly and must be beneficial to all affected parties.

The first FDOT/FUCC activity involved an analysis of 10 years of accident statistics (national and Florida). This resulted in a determination that the frequency of crash involvement and associated injuries/fatalities was directly proportional to the frequency of conflict points. The greater the number of conflicts in an area, the greater the number of crashes. Also, the greater the number of decisions that had to be made at a conflict point, the greater the frequency of crashes. Examples of conflict points are any type of intersection or place where a vehicle maneuver involves a significant change in direction. This may include a ramp merge, a curved alignment with a radius of less than 3,000 ft and an operating speed of greater than 35 mph, and an intersection, whether signalized or not. These areas of conflict were to become known as control zones after being fully defined. At this point of the process, only their longitudinal limits were known and not their lateral limits.

The number of conflict points and their associated length of influence were determined on the FDOT roadway system by using available data and applying some engineering judgment. For example, signal and lighting poles of FDOT were predominantly in intersections, whereas utility poles were most likely to be uniformly spaced along the rights-of-way. A model utility pole setup was adopted as the typical spacing for comparative analysis. It became clear where most fatalities and injuries were occurring. Many areas where utility poles were located had a zero or insignificant frequency of crashes even when they did not meet new construction clear zone requirements. In other locations, there were a high number of crashes for both utility and FDOT fixtures. Thus, defining the nature of the area became the key to establishing a workable and cost-effective safety improvement plan.

Not all recurring crashes could be tied to conflict points, so another mechanism had to be incorporated into the model to address this situation. It was decided by consensus with the utilities that if (*a*) more than two crashes had occurred in any particular area, (*b*) within 3 consecutive years, and (*c*) in the most recent 5 years being evaluated, then this area would constitute a control zone by virtue of crash history and not geometry. It was understood that the intent was to identify high crash areas. If the cause of the crashes could be eliminated independently of any utility relocation, this would be the thrust. In some cases, the cause might be bad pavement, rutting, or superelevation that could be remedied by FDOT and would eliminate the need to relocate any poles.

To ensure the proposed model was applied cost-effectively from a safety perspective, the AASHTO Roadside Design Guide Program (RDG-6) was adopted to facilitate a determination of the cost based on risk of an obstacle being in one location as opposed to another. In essence, the program incorporates an algorithm that predicts the frequency and cost of crashes (property and personal damage) based on varying offsets from the travel lane for varied cross sections and conditions (*3*).

A review of the program data showed the relative risk of crashes outside the new construction clear zone was acceptable, and therefore FDOT needed to concern itself only with objects placed or allowed in compliance with resurfacing, restoration, or rehabilitation (RRR) criteria. Having now narrowed the problem area down to conflict points within the clear zone, lateral limits for control zones were established. Thus, it was possible to establish a program that emphasized proper analysis and placement under RRR criteria. With those controls in place, control zones became areas where FDOT wanted to add emphasis by controlling what would be installed in these areas and thereby reducing the crash risk, even though they may meet RRR criteria.

FDOT established its own cost factors for personal and property damage based on Florida accident data and modeled it after that contained in the RDG-6 Program. A benefit–cost factor level of 2:1 was adopted as the level where FDOT would require existing utility infrastructure to relocate on RRR projects. For new construction, only a 1:1 ratio needed to be shown to be cause for relocation. FDOT also established other conditional criteria and standards that are contained in its Utility Accommodation Manual to ensure relocation is cost-effective and even-handed.

Analyses conducted in the development of the pole safety program model indicated that the utilities were spending up to 74% of their relocation funds where only 44% of the crashes were occurring. This indicated that money was being spent to relocate poles that were not in high-risk crash areas. The ultimate result was development of a program that identifies high-risk areas and concentrates effort and funds only in those areas in support of a cost-effective solution.

FDOT and the utilities have clearly received a benefit through revisions in the process of evaluating crashes along the roadway. The new process applies to FDOT and utility pole installations whether new or existing, whether on an FDOT construction project or where no project is planned. Use of the model allows a utility to leave poles in place that meet RRR criteria but not new construction criteria in areas where analysis and crash history support such decisions. This in turn reduces utility relocation expenditures along much of the roadway and allows those funds to be used in more critical high-risk control zones. This approach is logical and acceptable to the utility industry. The end result is that the roadway user reaps the benefits of a safer highway through a more cost-effective allocation of available funds.

LAFAYETTE UTILITIES SYSTEM

The Lafayette Utilities System (LUS), located in Lafayette, Louisiana, has implemented a utility structure crash reduction program to achieve greater public safety and reduce LUS's costs of vehicle collisions with utility structures.

LUS begins by categorizing utility structures as follows:

Category 1. Sites where poles are subject to repeated collisions,
Category 2. Sites where poles are subject to purely random collisions that are unlikely to be repeated, and
Category 3. Sites where poles do not seem to fit either Category 1 or 2.

LUS's general approach is as follows:

Step 1. Continue to monitor collisions with utility structures to determine which of the preceding categories they best fit.
Step 2. Apply predictive analyses to heavily traveled thoroughfares to determine the relative probability of collisions in selected areas or sites.
Step 3. In the areas and sites that are prioritized by Step 2, determine the relative degree of consistency with the recommendations in the *Roadside Design Guide.*

Each year a number of utility structure locations will be selected for treatment by using an appropriate combination of Steps 1, 2, and 3.

The gradual development of priorities for 2002 through 2005 using the preceding three steps should result in a program where about 10 high-priority sites can be improved each year.

When it becomes difficult to find sites where treatment would result in safety improvements, the primary goals of the LUS program will have been accomplished. Note, however, that new roadside development through the years, changing traffic patterns, volume or speed, roadway geometry (especially roadway widening), or wet pavement friction can result in new zones of questionable safety.

LUS will sustain a long-term awareness to the need for site modifications relative to maintaining roadside safety.

The expected benefits to LUS resulting from the implementation of this program are as follows:

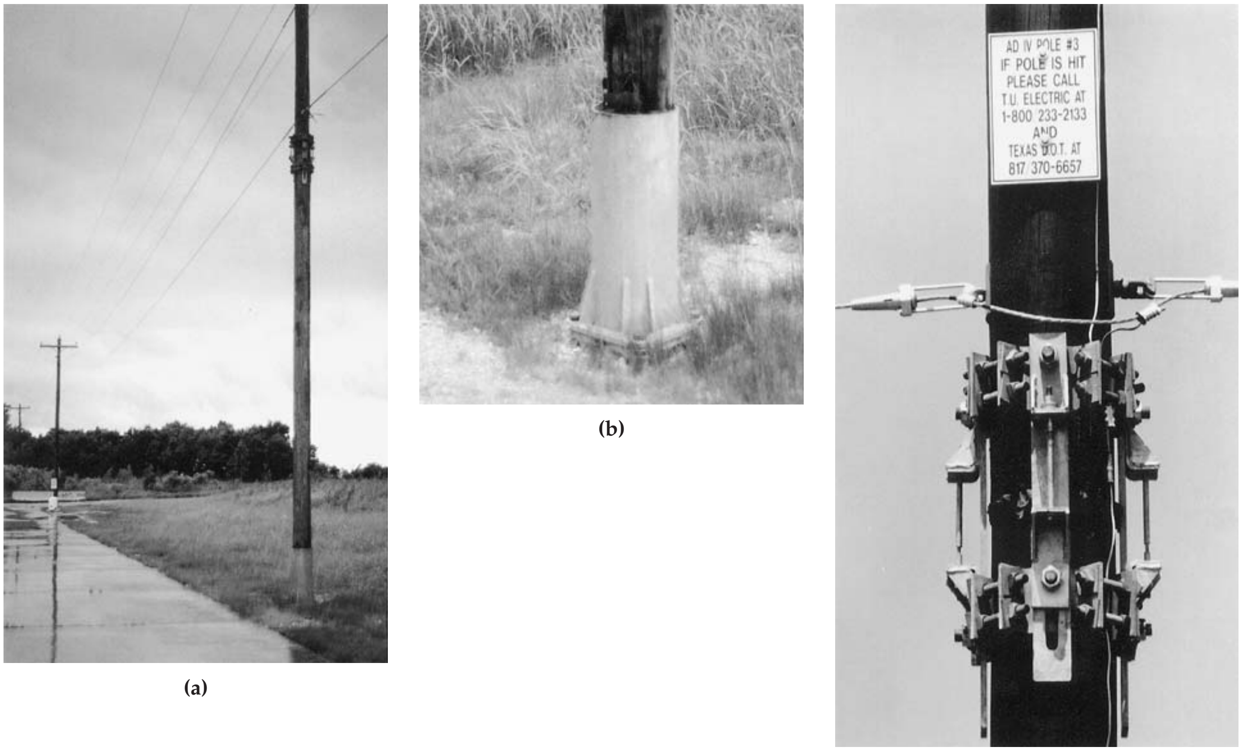
1. Increased safety for the citizens of Lafayette,
2. Increased safety for the customers of LUS,
3. Savings in maintenance costs,
4. Savings in lost service and time,
5. Increased safety for LUS maintenance staff,
6. Positive local and national public relations (considered especially important in the age of deregulation),
7. Identification as one of the most progressive utilities in the nation relative to utility pole safety, and
8. Savings in legal costs.

ONGOING DEMONSTRATIONS

Of the highway safety structures available to protect vehicle occupants during utility pole collisions, only one has been designed specifically for utility poles. It is the steel-reinforced safety pole presented in Figure 1.

FHWA sponsored research in the early 1980s to develop an economical "yielding" timber utility pole that would increase the safety of passengers in impacting vehicles and satisfy design criteria of the utility industry. The resulting design, called the Hawkins Breakaway System (HBS), was successfully crash tested at the Texas Transportation Institute. By 1986, HBS was deemed ready for selective implementation (*5*). HBS was subsequently improved during field tests in Massachusetts. This modified design was called the FHWA design or Massachusetts design. The original designers subsequently modified the Massachusetts design again. The latest design is called the AD-IV (*6*). Earlier installations were commonly referred to as breakaway timber utility poles, but a more descriptive term, steel-reinforced safety poles, is now used to describe the devices.

FHWA provided technology application funds in 1989 for experimental installations of the FHWA design in Kentucky and Massachusetts and again in 1995 for installations of the AD-IV in Texas and the FHWA design in Virginia.



(a) (b) (c)

FIGURE 1 AD-IV steel-reinforced safety pole: (*a*) full AD-IV pole; (*b*) steel base; (*c*) steel upper connection.

On January 27, 1993, FHWA upgraded the HBS and FHWA (Massachusetts) designs from experimental to operational. This meant FHWA was satisfied the yielding device had performed satisfactorily in full-scale crash tests and had demonstrated satisfactory in-service performance and deemed it appropriate for the devices to be used routinely on federal-aid highway projects. On June 17, 1993, FHWA approved the AD-IV design for use on federal-aid highway projects. The HBS, FHWA (Massachusetts), and AD-IV designs have all been found crashworthy in accordance with criteria set forth in *NCHRP Report 230* (*7*) and with more current criteria set forth in *NCHRP Report 350* (*8*).

Approval of the use of the HBS, FHWA (Massachusetts), and AD-IV designs for routine use on federal-aid highway projects does not mean steel-reinforced utility poles are mandated by the FHWA. Instead, they are considered to be one of several countermeasures available to a state as it considers what action to take in addressing utility pole safety.

An overview of the installations is presented in the following sections.

KENTUCKY

The Kentucky Utilities Company retrofitted 10 existing No. 3 utility poles in 1989 in Lexington with the FHWA yielding device. These poles were retrofitted in the field without encountering any serious problems. Experience has been positive in the way the poles perform in high winds (up to 80 mph). Maintenance costs in the first 2 years of use consisted of those necessary to straighten the upper segments of the poles. This maintenance was not necessary after that because wood shrinkage becomes minimal after a year or two of exposure. Poles were evaluated for 2 years, but because they were not selected in areas known for collisions none has ever been hit. Because of changes in facility size and relocations, six of the poles remain.

MASSACHUSETTS

The Massachusetts Electric Cooperative and the New England Telephone Company installed 19 new utility poles near Boston. These poles were prefabricated and contained the safety hardware when delivered to the site. The HBS design was substantially modified for these installations. The modified design is called the FHWA or the Massachusetts design.

As with the Kentucky poles, the steel-reinforced safety poles in Massachusetts were evaluated for 2 years. During that time, although they were exposed to wind, ice, and snow, no pole failures from these natural forces occurred. An incident in Massachusetts in 1991 (Hurricane Bob) displayed the ability of the poles to resist wind loadings that toppled conventional poles. Poles in Massachusetts were hit five times during the evaluation period by errant vehicles (there have probably been several more collisions since then). There were no serious injuries, no loss of utility service, no safety problems relative to linemen, and an average repair time of 90 min. In all these crashes, the poles were found by utility personnel to be quicker and easier to repair than standard poles, primarily because the need to transfer service lines was eliminated.

An in-depth report documenting the performance of the Massachusetts poles was prepared in 1992 (*9*). Since that time, the poles have been observed at periodic intervals. Some have been replaced with conventional poles, but those that remain are in excellent condition, including both galvanized steel elements and the wooden pole segments. An early concern was that cutting the poles at the base and upper hinge point would provide avenues for wood deterioration. This has not been a problem.

TEXAS

Six AD-IV design poles were installed in 1994 on an urban arterial between Fort Worth and Dallas by Texas Electric Company. To date only one collision has occurred at this site. It occurred on March 13, 1995, and involved the one pole of the group that had been improperly installed. It was placed on a 1½:1 slope about 10 ft off the paved shoulder. The bottom of the slip base was installed too high, almost 12 in. above the ground line at the part of the base farthest from the traveled lane. An effort was made to regrade the slope to the proper level but heavy rains immediately before the collision eroded the newly placed soil.

In spite of that, the pole functioned during the collision and serious injuries did not occur. Snagging of the car frame on the slip base lower plate clearly increased the deceleration levels on the vehicle and the delay in slip base activation resulted in fracture of the middle length of the pole and tilting of the part of the pole in the ground. The result was that the pole had to be completely replaced. The new installation met appropriate geometric criteria (*10*).

In the 3 years the AD-IV poles have been in place, there have been several instances of high winds, including a hail storm that destroyed virtually every roof and west wall of every building that was not sheltered by trees or other buildings. Texas Electric Company engineers note that some wind gusts were as high as 80 mph and that some conventional poles were downed. The AD-IVs sustained no damage.

VIRGINIA

In 1995, Delmarva Power installed five poles on the eastern shore of Virginia. The design used was that of FHWA.

The results from Virginia are as follows:

- No maintenance costs or problems,
- Several instances of high winds without pole damage or even modest deformation, and
- No collisions.

The field experience with steel-reinforced safety poles has been overwhelmingly positive. William Quirk of Massachusetts Electric, who was intimately involved in the Massachusetts work where at least five impacts have been recorded, has stated emphatically, "The breakaway poles have saved us money."

MARYLAND

FHWA and the Maryland State Highway Administration initiated a pilot study in 1999 to delineate utility poles and other man-made fixed objects within the highway right-of-way. The purpose of the study was to enhance roadside safety in a cost-effective manner when removal, relocation, and shielding of man-made fixed objects were not feasible.

Recognizing that about 5% of Maryland's fatalities result from collisions with utility poles, FHWA and the Maryland State Highway Administration met with representatives from Allegheny Power, Bell Atlantic, PEPCO, and BT&E to coordinate the delineation of a sampling of poles. Pilot roadway sections totaling 70 mi were selected on crash data and geometrics. All man-made fixed objects were delineated within the pilot roadway sections with a 12- × 6-in. yellow reflective sheeting material.

It is considered probable that delineation has a positive effect, although this has not yet been statistically validated. Because many crashes are random, the study will be continued for several years before delineation effectiveness can be assessed.

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6

Legal Issues

C. Paul Scott

Transportation departments and utility companies have two major reasons to be concerned about utility pole collisions:

- Improved safety for motorists, and
- The threat of litigation.

The threat of liability is significant, and it is increasing.

NEGLIGENCE AS THE BASIS FOR TORT LIABILITY

Negligence is the leading basis for suits in highway liability cases. The plaintiff usually alleges that the transportation department or utility company failed to act in a reasonable manner and thus caused or contributed to a traffic accident. To win a negligence suit, the plaintiff must demonstrate the following conditions:

- The defendant had a duty.
- The defendant breached that duty.
- The plaintiff suffered damage.
- The defendant's breach was the proximate cause of the damage.

In some states, the plaintiff is barred from recovery if found guilty of contributory negligence. In other states, recovery may be reduced if the plaintiff is found guilty of comparative negligence.

In laymen's terms, negligence is the failure to use reasonable care in the treatment of others. The key issue in a negligence trial is demonstrating what action would have been reasonable in the circumstances of the case. The defendant's actions are measured against the standard of care to determine whether they were reasonable. The standard of care may be a written set of instructions, a policy, a guideline, or the accepted normal practice. As an example, for obstacles located in the clear zone, the standard of care might be the AASHTO *Roadside Design Guide* (*1*).

In a typical case, the defendant (transportation department or utility company) has a duty to provide a reasonably safe roadway. Breach of this duty could be installing or

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allowing a utility pole to be installed too close to the road. A vehicle striking this pole could be severely damaged and a motorist severely injured. The motorist in such a case may have the elements of a winning negligence case, especially if installation of the pole was in violation of the standard of care (i.e., the accepted clear recovery area guidelines that were in effect at the time the pole was permitted).

NUISANCE AS THE BASIS FOR TORT LIABILITY

The legal grounds for nuisance suits are simpler than those for negligence issues. A nuisance is a public hazard simply because of how and where it exists. To prove nuisance, the plaintiff must merely show that the utility structure posed a threat of injury to public travelers. *The Law and Roadside Hazards* (*2*), published by the Insurance Institute for Highway Safety, summarizes the nuisance issue as follows:

> Governments as well as private parties are liable for public nuisances which endanger travelers. First, they may be liable for failing to order private parties to remove privately owned public nuisances. The general rule is that any artificial device, structure, or excavation adjacent to a highway which poses a threat of injury to travelers can be considered a public nuisance.

JUDGMENTS AND SETTLEMENTS

Tort suits against transportation departments are a relatively recent trend. Before the 1960s, there were almost none; however, claims and suits have grown at a rapid rate since then. A tidal wave of liability suits began to hit state transportation departments in the late 1960s and has continued to grow. It is now including cities, counties, townships, and parishes.

Even where utility companies and transportation departments have not yet experienced major financial losses due to tort liability suits, the threat of these suits is a major factor. Employees dread being involved in liability suits and are often leery of making decisions because of the possibility of being sued. One way to overcome this difficulty is to establish agency or company policies for crash reduction programs and for clear zone treatments and then to operate within these policies.

LAWSUITS

Is there liability for the placement of a utility pole? The courts have struggled to answer this question. Generally, they have ruled a utility company may be liable to a driver who is injured when his or her vehicle strikes a utility pole where placement or maintenance of the utility pole close to the edge of the roadway constitutes a foreseeable and unreasonable risk to users of the roadway. A summary of the results of a few court cases involving vehicles striking utility poles may be found in Appendix C.

INDEMNIFICATION

Because liability is an important issue, transportation departments and utility companies are intent on minimizing its impact. Two simple forms of indemnification involve the use of "hold harmless" clauses and the purchase of insurance.

Hold Harmless Clauses

One way for an agency to protect itself from being sued because of a permittee's negligence is to include a hold harmless clause in its permits. Such a clause stipulates that the permittee agrees to hold the public agency harmless from any liability occurring as a result of negligence. Normally, this protects the agency from judgments assessed against it and requires the permittee to pay for legal services the agency must use because of a claim regarding the permittee's negligence. Even when the hold harmless clause is valid and enforceable, it does not protect an agency whose own employees committed the acts that led to the suit.

As an example, utility companies obtaining a permit from the Idaho Department of Transportation find this statement:

> In accepting this permit, the permittee, its successors and assigns, agrees to indemnify, save harmless and defend regardless of outcome the State from the expenses of and against suits, including costs, expenses and attorney fees that may be incurred by reason of any act or omission, neglect or misconduct of the permittee or its contractor in the design, construction and maintenance of the work, which is the subject of this permit.

Insurance

Selecting the appropriate type and amount of insurance is always a matter to be determined by local officials and local conditions. Transportation departments often purchase a comprehensive insurance package that covers liability, company or employee actions, vehicle collisions, and professional liability for managers. A large transportation department or a large utility company might find it more cost-effective to self-insure. This practice involves setting aside a reserve of funds from which to pay claims. Administration of self-insurance requires a system for carefully tracking the number and amounts of claims and estimating the probable sizes of future claims payouts.

Some agencies prefer to purchase "over and above" or catastrophic insurance coverage. Such insurance comes into play only when an agency must pay a disastrously large claim. For example, an agency may be self-insured for small claims but purchase a catastrophic policy to cover any claim loss over $1 million. This would prevent such a claim from bankrupting the self-insurance program.

One example of insurance coverage is illustrated by the Connecticut Department of Transportation. An application for a utility permit must be accompanied by a certificate of insurance and a permit bond. The Connecticut Department of Transportation requires the following:

> Prior to the issuance of permits to any firm or corporation other than public utility companies, the submission of a certificate of insurance (form Con No. 32) indicating minimum coverages of $750,000 (each accident or occurrence), $1,500,000 (aggregate) for bodily injury liability and property damage liability in conjunction with the following hazards will be required:
>
> A—Protective Liability for and in the name of the State of Connecticut
> B—Contractor's Public Liability
> D—Contractor's Liability
> K—Workmen's Compensation—by Statute
>
> Hazard "F"—Explosion, collapse or underground damage liability shall also be required when applicable (any excavating within Bureau of Highways property).
>
> An umbrella policy used to provide the required coverage must cover all items and it must be so stated on the certificate submitted.

UTILITY POLE CRASH REDUCTION PROGRAMS

Hold harmless clauses and insurance may help limit liability, but some transportation departments and utility companies do much more. The most progressive have developed and implemented utility pole crash reduction programs. Washington State has developed such a program. Information about the Washington State program, other local and state transportation department programs, and utility company programs may be found in FHWA's *Highway/Utility Guide* (*3*) and in other chapters of this report.

Utility pole crash reduction programs normally include the following:

- Categorization of utility poles: Washington State, for example, has three categories called Locations I, II, and III. Location I includes the most hazardously located utility poles, generally those located within 5 ft from the edge of any usable shoulder.
- A systematic process for relocating or mitigating utility poles deemed to be the most hazardously located: This involves a process for determining appropriate countermeasures, a target for relocating or mitigating hazardously located utility poles, and the actual relocation or mitigation of hazardously located utility poles. Mitigation may involve improvements to the roadway instead of to the utility pole.

Courts often look kindly upon transportation departments and utility companies that can demonstrate they are addressing the problem of utility pole crashes in a positive manner. It obviously is impossible to immediately relocate or mitigate all the hazardously located poles that exist. A systematic program and documented results do, however, demonstrate an intent to reduce utility pole crashes in an efficient, cost-effective, expedient manner. A recommended crash reduction program and associated roadside safety countermeasures adapted from FHWA's *Highway Utility Guide* may be found in Appendix B.

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7

Professionalism

Jarvis Michie

Collectively, vehicle–pole collisions represent an annual cost to society of $5 billion. Individually, these tragedies seldom make the headlines, but nationwide they far exceed the annual 285 commercial airline crash fatalities and media-documented events such as the TWA Flight 800 crash. It has recently been estimated that the societal loss due to collisions with utility poles each month is greater than the 5-year societal loss due to the Bridgestone/Ford alleged problem (*1*). The roadside utility pole hazard problem is not new. It was identified by AASHTO in the mid-1960s, more than 30 years ago. Technology to alleviate the hazard has also been available for more than 25 years, although the array of remedial treatments has recently been increased (*2*). An extreme example of effectiveness of the technology is the lack of utility pole collisions on the Interstate, where pole placements are not permitted (*3*). Also, as discussed in Chapter 4, technology to address the utility pole problem can be affordable and cost beneficial.

One must question why we have not been able to make even more progress than we have to date.

HISTORY

Before examining the question, it is appropriate to briefly review the history of roadside safety.

The watershed event occurred in 1966 when Congress passed the Highway Safety Act. The essence of the act required that (*a*) automobiles be designed to be more crashworthy and to provide protection to occupants involved in collisions, and (*b*) roadsides be designed that are more "forgiving" of motorists' mistakes. Thus, for the first time, the national standard of care became that protection was required for the motoring public within practical limits regardless of circumstances causing the event. Thereafter, highway engineers used industrial safety principles designed for drivers who were subject to occasional human error.

Before 1966, highway agencies designed and maintained roads only for drivers who remained on the roadway. It should not be surprising that typical pre-1966 roads had roadsides cluttered with massive fixed objects, including utility poles and nontraversable embankments. It also should not be surprising that most utility accommodation policies of that era were extremely flexible with regard to locating utility poles within the

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road right-of-way, which resulted in many poles being located within a few feet of the traveled way and many roads being located within a few feet of existing utility poles.

After 1966, highway agencies began incorporating the "forgiving roadside" concept into new and existing highways by removing or converting fixed objects to safer designs and making the roadside more traversable for errant vehicles. For high-speed highways, it was determined by pioneering engineers such as John Hutchinson and Ken Stonex that 80% of roadside injuries and fatalities would be averted by providing a 30-ft-wide traversable roadside that was clear of all fixed objects such as trees, ditches, embankments, sign supports, utility poles, and so forth. Since then, highway agencies have done a reasonably good job of treating roadside hazards that are owned or designed by the highway agencies.

Unfortunately, most utility poles located near highways are owned by utility companies and were placed or allowed to remain under guidelines developed in the pre-1966 era. Within the provisions of pre-1966 utility accommodation policies, highway agencies may have lacked the political muscle to treat, move, or require the utility pole owner to safely treat or move the hazard. Many times utility companies have taken the position that highway safety is the responsibility of the highway agency. "It is only through cooperation between highway engineers and utility companies that realistic solutions to car/pole accidents can be established" (*4*).

This historical overview is of course a simplification of a complex problem involving two institutions—highway agencies and utility companies—each with different goals and purposes.

TIME FOR CHANGE

A review of historical vehicle–pole collisions reveals a gradual downward trend in utility pole collisions. This reduction is attributable to the efforts of federal, state, and local agencies that establish clear zones and stricter pole placement policies and the utilities that comply. Nevertheless, the more than 1,100 utility pole fatalities yearly are a national tragedy that calls for further improvement.

Engineers from state departments of transportation, local highway agencies, and utility companies, working cooperatively, can overcome the obstacles and achieve an effective solution. This is because registered professional engineers, regardless of their discipline or employment, are bound to a common code of ethics that transcends the boundary of the utility pole problem. The first fundamental canon of the National Society of Professional Engineers is "Engineers, in fulfillment of their professional duties, shall hold paramount the safety, health, and welfare of the public."

It is noted that the canon refers to the public without qualifying restrictions. Accordingly, the public would certainly include the 1,100 fatalities and 60,000 injuries sustained in 2000 in utility pole collisions. It would also include the projected 5,500 fatalities and 300,000 injuries projected during the 5-year period (2002–2006).

WORKING TOGETHER

There are three items that professional engineers from both transportation and utility organizations can accomplish by working together:

1. Technical information presented in guidelines, policies, and standards can be made consistent and complementary. It may be appropriate to have all the documents refer to a single source such as the AASHTO *Roadside Design Guide* (*5*). For example, curbs have been found to be ineffective as redirectional devices (*6*).
2. Permit and easement models can be updated. A licensed professional engineer's approval is usually required for specific pole location sites in accord with the forgiving

roadside concept. Additional funding mechanisms can be established to relocate and shield utility poles that become hazardous because of changing traffic patterns or roadway geometrics.

3. Plans of action can be developed for treating existing utility poles in hazardous locations. As a first step, teams composed of both highway and utility company staff can conduct surveys and identify problem poles. The identification should be based on both prior collision data and nonconformance to *Roadside Design Guide* criteria. A second step can be to prioritize the identified poles according to degree of hazard to the public. The third step is to establish both short-term and long-term programs to treat the problem poles.

SUMMARY

State and local highway agencies and pole-owning utility companies can work together to approach safety issues with an attitude that strives to obtain the maximum safety benefit that can practically be obtained in the absence of unlimited resources. Run-off-the-road crashes are generally both random and unpredictable, and poles located within the rights-of-way are by nature potential obstacles to errant vehicles that leave the driving surface.

Engineers should seek to achieve as much clear area as practical when locating or relocating utility poles, to allow errant vehicles more room to recover with less chance of collision. For existing poles, optimal safety benefits with limited resources are best achieved through mutual cooperation of state and local highway agencies and utilities targeting areas where most crashes occur, including an analysis of why the vehicles are leaving the roadway.

It is time for change (*7*). To lead this mandate professional engineers from both highway and utility organizations can be the principal driving force because of their common ethical and moral responsibility of holding paramount the health, safety, and welfare of the public.

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8
Summary

Don L. Ivey and C. Paul Scott

The Utility Safety Task Group has reviewed and reestablished the magnitude of the utility pole safety problem. Solutions, strategies, and initiatives are presented. Related legal issues are described. Professionalism is treated in the context of the societal tragedy represented.

In 2000, the latest year for which data are available, there were 1,103[1] fatalities and more than 60,000 injuries related to motor vehicles leaving the roadway and crashing into utility poles. Many of the injuries were serious. These numbers were lower than in any previous year but remain far too high. Utility companies (utilities) own the poles involved in these crashes, but most of these poles are located on public road or street rights-of-way. It thus becomes a joint utility, state department of transportation (DOT), and local highway agency (HA) responsibility to take appropriate measures to reduce the hazard of these fixed obstacles.

There are a number of possible solutions to utility pole hazards. These solutions include countermeasures for the following:

- Keeping vehicles on the roadway,
- Removing poles or changing their position,
- Installing safety devices, and
- Warning motorists about obstacles.

Utility, state DOT, and local HA representatives can work together to determine which solution is most appropriate for each problem area or site.

The first objective is to increase the probability of keeping vehicles on the roadway. On certain sites this may be attempted through the use of positive guidance (e.g., pavement markings, roadside delineators, advance warning signs, and other visual cues) and physical roadway enhancements (e.g., skid-resistant pavement, lane widening, shoulder paving, increasing superelevation, straightening sharp curves, decreasing vehicle speeds, lighting, and traffic calming).

If the nature of the site, including a modest or nonexistent clear zone, does not lend itself to confidence in those changes, more direct steps will be necessary. These may

[1]Based on a Texas assessment of recorded utility pole accidents compared with the "first recorded event" criteria of the Fatality Analysis Reporting System, the actual toll may be considerably higher.

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include removing or relocating poles (moving them away from the roadway into inaccessible locations, joint use, increased spacing) or installing safety devices (crash cushions, guardrail, concrete barriers, or steel-reinforced safety poles).

In addition to those well-known treatments, several new countermeasures have been developed that have the potential to reduce utility pole crash severity. They include an energy-absorbing fiberglass utility pole and breakaway guy wires.

All safety devices do not fit every location. Often only one is applicable to a particular site and sometimes delineation is the only practical option. An on-site inspection, attended by both DOT and utility personnel, is usually required to ensure an appropriate choice. Appendices A and B provide examples of practical guidelines for making systematic choices.

A primary objective of state DOTs, local HAs, and utilities that have collision reduction programs in place is to develop a strategy for minimizing utility pole crashes that maximizes the benefit to society for every action and expenditure. A secondary, but nonetheless important, objective is to provide a good defensive position relative to litigation. Strategies and analytical methods to maximize benefits have been developed and used by a few state DOTs, local HAs, and utilities with good results. The following three-path approach (best offense, best bet, and best defense) summarizes the components of a comprehensive collision reduction program:

- Best offense: This approach involves identifying where an atypical number of collisions are occurring, considering available countermeasures, prioritizing for treatment, and implementing the improvements.
- Best bet: This approach involves prioritizing potentially hazardous poles and roadway sections before an accident history develops and implementing appropriate improvements. This may be done with statistical prediction algorithms.
- Best defense: This approach complements the first two strategies. It involves striving to meet the recommendations of the *Roadside Design Guide* (*1*) by a prioritized effort. In the courthouse, a second legally damaging condition, right behind a significant crash history, is failure to meet the recommendations of the *Roadside Design Guide* (*1*). This is true for DOTs and is quite likely to become true in the very near future for utilities.

The following state DOTs and utilities have developed and implemented utility pole collision reduction programs:

- New York,
- Pennsylvania,
- Jacksonville Electric Authority (Florida),
- Washington State,
- Georgia,
- Georgia Power Company,
- Florida, and
- Lafayette Utilities System (Louisiana).

In addition, steel-reinforced safety poles have been successfully used in Kentucky, Massachusetts, Texas, and Virginia. As a result of successful field experience, several designs have been approved by FHWA for use on federal-aid highway projects.

State DOTs, local HAs, and utilities have two major reasons to be concerned about utility pole collisions: (*a*) improved safety for motorists and (*b*) threat of litigation. The threat of litigation is significant and is increasing. Negligence is the leading basis for suits in highway liability cases. The plaintiff usually alleges the state DOT, local HA, and/or utility failed to act in a reasonable manner and thus caused or contributed to a traffic accident. In a typical case, the state DOT, local HA, and utility have a duty to provide a reasonably safe roadside. Breach of this duty could be installing or allowing a pole to be installed too close to the roadway. The courts have struggled for years to determine whether parties to the placement of a utility pole are indeed liable. Decisions rendered have not been consistent. Generally, however, and more frequently in recent years, the courts have ruled that a utility (and sometimes a state DOT or local HA) is liable to a motorist injured when his or her vehicle strikes a utility pole located too close to the roadway or in some other potentially hazardous location. However, recognizing it is not possible to expeditiously alleviate every such hazard, the courts traditionally have looked kindly on state DOTs, local HAs, and utilities that demonstrate they are concerned about the problem of utility pole crashes and are addressing them in a positive manner by development and implementation of a utility pole crash reduction program with documented results.

Even though roadside safety programs and technologies are available to reduce utility pole crashes and the severity of such crashes, they have not been applied more systematically for various reasons. A mandate for change is needed. Professional engineers from federal, state, municipal, and particularly from utility organizations, working together, can be the principal driving force behind an effort to encourage all highway and utility organizations to develop and implement utility pole crash reduction programs by using appropriate technologies.

In summary, the following points can be made:

- Programs and technologies exist to reduce utility pole crashes and the severity of utility pole crashes, and a more systematic approach to their use can have positive impacts.
- Engineers in both transportation and utility organizations can take the lead in promoting utility pole safety through the use of existing programs and technologies.

Implementation of the programs and technology illustrated here can have the following results:

- Utilities
  - An in-house roadside safety program can save customers money.
  - An in-house roadside safety program can save the company money.
  - An in-house roadside safety program can improve public safety and the safety of the people in the maintenance department.
  - An in-house roadside safety program can reduce downtime experienced when poles and conductors are damaged by collisions.
  - An in-house roadside safety program can enhance the company's position with respect to litigation.
- State DOTs and local HAs
  - An agency roadside safety program in cooperation with utilities can improve public safety.
  - An agency roadside safety program in cooperation with utilities can enhance the organization's position with respect to litigation.

In closing, the implementation of utilities-related roadside safety programs has only positive results for organizations that take the initiative.

REFERENCE

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APPENDIX A

Example of Recommended Guidelines for Utility Installations and Modifications

Session on Highway Rights-of-Way: Safety in the Clear Zone and Utility Installations

Don L. Ivey and King K. Mak

RECOMMENDED GUIDELINES

Purpose

The purpose of these guidelines is to enhance traffic safety in practical economical ways that do not significantly detract from the primary responsibility of utility companies, the safe transmission of power.

Applicability

These general guidelines are intended for use with aboveground utility facilities, including the following:

1. New utility installations,
2. Existing utility facilities that are to be relocated or adjusted within the right-of-way of highway facilities under development or construction, and
3. Existing utility facilities that are to be adjusted or relocated for safety improvements.

General Guidelines

The recommended general guidelines for consideration in the design and placement of aboveground utilities within the highway right-of-way are as follows:

- Clear recovery area: New aboveground utility installations should be located outside the clear recovery area or as far from the traveled way (or the face of the curb, if a curb is present) as practical, preferably along the right-of-way line. If a clear recovery area has

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TABLE 1 Recommended Lateral Dimension of Clear Recovery Area Unless Constrained by Right-of-Way or Other Structures (Distance from Edge of Traveled Way to Face of Pole)

Roadway Speed Limit (mph)	Lateral Distance to Face of Poles (feet)
25	5
30	8
35	12
40	15
45	17
50	20
55	24

not been recommended by the entity responsible for the roadway, Table 1 may be used as a guide. Note that the lateral distance values in Table 1 were taken directly or interpolated from the 1977 AASHTO *Guide for Selecting, Locating, and Designing Traffic Barriers* (*1*), which is consistent with the 1996 *Roadside Design Guide* (*2*). In some cases, these distances are reduced when traffic volumes are below 6,000 vehicles per day, as indicated in Figure 1. In situations in which it is necessary to locate aboveground utility facilities within the established clear recovery area of the highway, appropriate measures to improve traffic safety should be considered, such as placing utility facilities at locations that minimize exposure to out-of-control vehicles, using breakaway or impact attenuation devices, or shielding vehicles from the structures with longitudinal barriers.

- Joint pole use: Consideration should be given to the joint use of poles within the right-of-way of roadways to the extent possible to minimize exposure of out-of-control vehicles.
- Span between poles: The largest feasible span between poles should be used to reduce the number of poles so as to minimize the exposure of out-of-control vehicles.
- Susceptible locations: Locations where aboveground utility installations are susceptible to being hit by out-of-control vehicles, such as medians, traffic islands, lane drops, and lane-narrowing zones, should be avoided to the extent practical.
- Accident experience: Consideration should be given to accident history when adjusting or relocating utility facilities. Appropriate safety measures to improve traffic safety should be considered for locations with a significant accident history. Examples of safety measures include placing utility facilities at locations that minimize exposure of out-of-control vehicles, using breakaway or impact attenuation devices, and shielding errant motorists from the structures with longitudinal barriers.

COMMENTARY

Clear Recovery Area

The guidelines as described here are based principally on the concept of a clear recovery area, which is defined as "the roadside border area, starting at the edge of the traveled way, available for safe use by errant vehicles" (*1*). New aboveground utility installations should be located outside the clear recovery area or as far from the traveled way (or the face of the curb, if a curb is present) as practical, preferably along the right-of-way line. This means, in most situations, locating aboveground utility facilities as close to the right-of-way line as practical. The term "as close as practical" is used because there are situations in which it may not be practical to place the utility facilities at the right-of-way line. For example, for

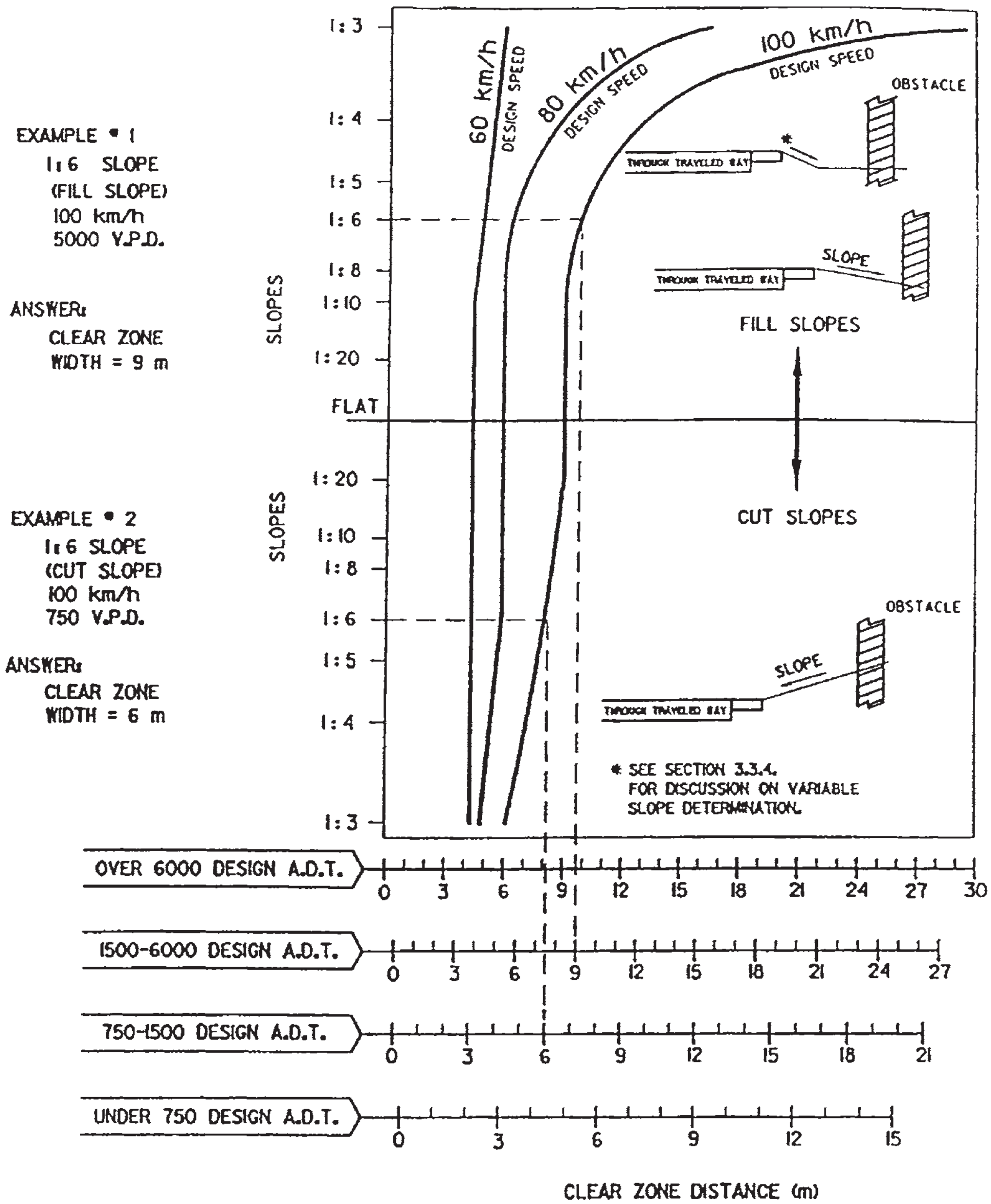

FIGURE 1 Clear zone distance curves (2). V.P.D. = vehicles per day, A.D.T. = average daily traffic. "Section 3.3.4" refers to the *Roadside Design Guide.*

poles with cross-arm structures, it is usually necessary to place the pole inside the right-of-way line to prevent the power lines from encroaching on private property. The presence of existing underground facilities, such as gas and water lines, may also preclude the placement of utility facilities at the right-of-way line.

In situations in which aboveground utility facilities are needed within the established clear recovery area of the highway, consideration should first be given to the feasibility of eliminating those facilities by undergrounding or by selecting alternative locations. If it is determined that the placement of utilities underground is not technically feasible or is unreasonably costly, and there are no feasible alternative locations, other appropriate measures to improve traffic safety relative to utility facilities should be considered.

Safety measures can be divided into two approaches. The first approach is to reduce the probability of a vehicle collision. This approach is the one most commonly used and can be illustrated both historically and technically (*3–7*). The second approach is to reduce the severity of the impact when the utility is struck by an errant vehicle. These two approaches may be considered singly or in combination as dictated by the specific site conditions.

Safety treatments to reduce the probability of utility facilities being struck by errant vehicles include, but are not limited to, the following:

- Place utility facilities at locations that are less likely to be struck by out-of-control vehicles (e.g., on the inside of curves instead of on the outside; on minor streets instead of on major roadways, etc.).
- Increase the lateral offset of utility facilities to the extent practical (e.g., use of vertical construction instead of cross-arm construction to allow poles to be placed at the right-of-way line).
- Reduce the number of poles through joint use or use of the largest feasible span between poles, or both.

It should be pointed out that some of these safety treatments such as vertical construction and increasing the span between poles may necessitate using larger or taller poles. This could result in more severe impacts if such poles are struck. It is necessary to evaluate the trade-off between accident frequency and severity in these situations to ensure that safety is enhanced by such treatments.

Use of Safety Structures

The safety of specific utility pole installations could be improved with the use of safety structures, including breakaway devices, guardrails, and crash cushions. Similar devices have been used to improve the roadside safety of highways for over 20 years, but major improvements have been made since 1980 that render some safety structures applicable to utility installations for the first time.

The most comprehensive guide for the application of safety structures is the AASHTO *Guide for Selecting, Locating, and Designing Traffic Barriers* (*1*), commonly referred to as the Barrier Guide. In most cases, the criteria for use of the three types of safety structures are consistent with the Barrier Guide. It should be noted, however, that the Barrier Guide was intended primarily for use with rural highways and may not always be directly applicable to urban roadways and streets. Also, it is important to point out that many new designs for specific structures have been developed since the Barrier Guide was published in 1977. These new designs are referenced here.

Breakaway Devices

A breakaway device, as applied to a utility pole to be broken away by an impacting vehicle, allows the vehicle to proceed on its errant path without a precipitous stop. The severed pole will then normally descend to the ground after the impacting vehicle passes through.

The criteria for application of a breakaway device to a utility pole or a luminaire support are as follows:

- The pole is within the clear recovery area as previously defined.
- The alternative of relocating the pole is not a practical solution because of constraints of right-of-way, roadside environment, or economics.
- The pole is Class 4-40 or smaller and does not have heavy devices or equipment, such as transformers or capacitor banks, attached to it. (Breakaway devices may be used on poles of material other than wood, but the pole should not be significantly heavier or taller than a Class 4-40 timber pole.)

- The pole is not within a zone of significant pedestrian activity (as defined by benefit–cost considerations).
- After impact by a vehicle, the final rest position of the severed pole and dislocated conductors should not pose a significant hazard to pedestrians, other vehicles, or properties in the immediate vicinity of the pole.
- There is a relatively safe clear recovery area beyond the breakaway pole available for the vehicle to decelerate and come to a comparatively safe stop.

Location of down guy wires should be made with full consideration of their influence on impacting vehicles and the influence of loss of support for the main structure. Where down guy wires are anchored within the clear recovery area, a breakaway attachment to the guy wire should be considered to preclude the occurrence of vehicle overturn or more severe damage to the main structure. Details on breakaway attachments for down guy wires are presented elsewhere (*8*). In some cases, pole guys or tree guys can be beneficial in that they are more effective in preventing a fallen pole from leaning into or falling onto the traveled way.

Under most circumstances, luminaire supports within the clear recovery area should be of breakaway design. The exception to this is where a support would fall in the roadway (on or in the path of other vehicles) or where there is such exposure to pedestrians that the breakaway design would not be cost beneficial. Details on breakaway designs for luminaire supports are presented elsewhere (*9*).

Guardrails

In some places, guardrails are a good choice to protect traffic from a rigid utility pole or luminaire support. Guardrails function by redirecting the errant vehicle away from the pole so that the driver has a better chance of regaining control of the vehicle or coming to a comparatively safe stop. The Barrier Guide states that guardrails may be used for this purpose on the basis of engineering judgment or a cost-effectiveness study (see Table III-A-2 and the discussion on p. 21 of the Barrier Guide).

The criteria for application of guardrails to shield rigid utility poles or luminaire supports are as follows:

- The pole(s) is (are) within the clear recovery area.
- The alternative of relocating the poles is not a practical solution because of constraints of right-of-way, roadside environment, or economics.
- The installation of a guardrail over the length necessary to shield the pole(s) does not constitute a greater potential hazard to the driving public.
- The guardrail will not direct errant vehicles into a roadside zone of greater hazard.
- The face of the guardrail should not be closer than 2 ft from the edge of the traveled lane or the face of the curb. A distance of 10 ft or more is preferred, if practical.
- The guardrail is in a position where it will function as designed; that is, automobiles will strike the rail at speeds predominantly less than 60 mph and at angles predominantly less than 25°. The guardrail should not be placed in a position relative to a barrier curb so that vehicle ramping prevents redirection.

There are several factors to be considered in designing a guardrail installation. These factors are discussed in Section III of the Barrier Guide and are not covered in this document. In addition to the operational guardrail systems described in the Barrier Guide (pp. 36–39), there are now several new systems with somewhat improved performance characteristics.

It should be noted that the end of a guardrail can be a hazard if not designed properly. A crashworthy end treatment should be used if the guardrail terminates within the clear recovery area. In addition to the end treatments described in the Barrier Guide (pp. 50, 51), there are now several new designs available that have vastly improved performance. Details of some of the improved designs are provided elsewhere (*10–12*).

Crash Cushions

Crash cushions protect errant vehicles from impact with a rigid utility pole or luminaire support primarily by decelerating the errant vehicle in a controlled manner and bringing it to a relatively safe stop before the rigid pole is reached. As stated in the Barrier Guide, crash cushions "are used to shield rigid objects or hazardous conditions that cannot be removed, relocated or made breakaway."

The use of a crash cushion may be determined on the basis of engineering judgment or a cost-effectiveness analysis. Crash cushions are more likely to be cost-effective for isolated hazards (e.g., a single pole with a high frequency of accident involvement) than for a pole line several hundred feet or more in length.

The criteria for application of crash cushions to shield errant vehicles from a rigid utility pole or luminaire support are as follows:

- The pole is within the clear recovery area.
- The alternative of relocating the pole is not a practical solution because of constraints of right-of-way, roadside environment, or economics.
- The pole does not meet the requirements for breakaway treatment.
- There is sufficient space in front of the rigid pole to accommodate the crash cushion without encroaching on the traveled way.
- The final rest position assumed by an impacting vehicle and an impacted crash cushion as well as debris detached during the impact should not pose a hazard to other traffic.
- The trajectory of an errant vehicle redirected by a crash cushion should be into a zone where a reasonably safe stop can be accomplished. Because of the relatively low frequency of vehicle impacts with utility poles, luminaire supports, or other utility structures, the more sophisticated crash cushions used at sites such as ramp exit gores are unlikely to be cost-effective. Where crash cushions are determined to be a good countermeasure to a specific safety problem, the inertial crash cushions described in the Barrier Guide (pp. 131, 132) will probably be a better economic choice.

Site-Specific Safety Considerations

Some specific situations deserve special safety considerations. Brief discussions of some situations are presented here.

Curves

On urban arterials, especially those with crowned cross sections, consideration should be given to placing a pole line on the inside instead of on the outside of curves. As indicated in Figure 2*a*, poles on the outside of a curve usually have a higher exposure to vehicle impacts. This is particularly important for situations in which there is a single curve after a long straight section of roadway or in which one curve is substantially more severe than other curves in close proximity. However, for winding roadways with sequentially occurring curves in opposite directions, it normally would not be cost-effective for the pole line to cross the road repeatedly to achieve inside curve placement.

When a pole line is placed on the inside of a severe curve (e.g., a curve with a radius of less than 1,700 ft), it may be necessary to place strain poles on the outside of the curve, as indicated in Figure 2*b.* These strain poles should be of a size that is adaptable to a breakaway design. Pole guys and strain poles should be used only if they can be designed in such a way that the fallen pole guy wire will not pose a hazard to traffic. A preferred alternative to the use of breakaway strain poles and down guy wires is the use of a compression strut (push brace or stub pole), as indicated in Figure 2*c.*

Lane Drops and Roadway Narrowing

Placement of poles downstream of a lane drop or the area where the roadway narrows should be discouraged. This is especially important when it can be reasonably foreseen

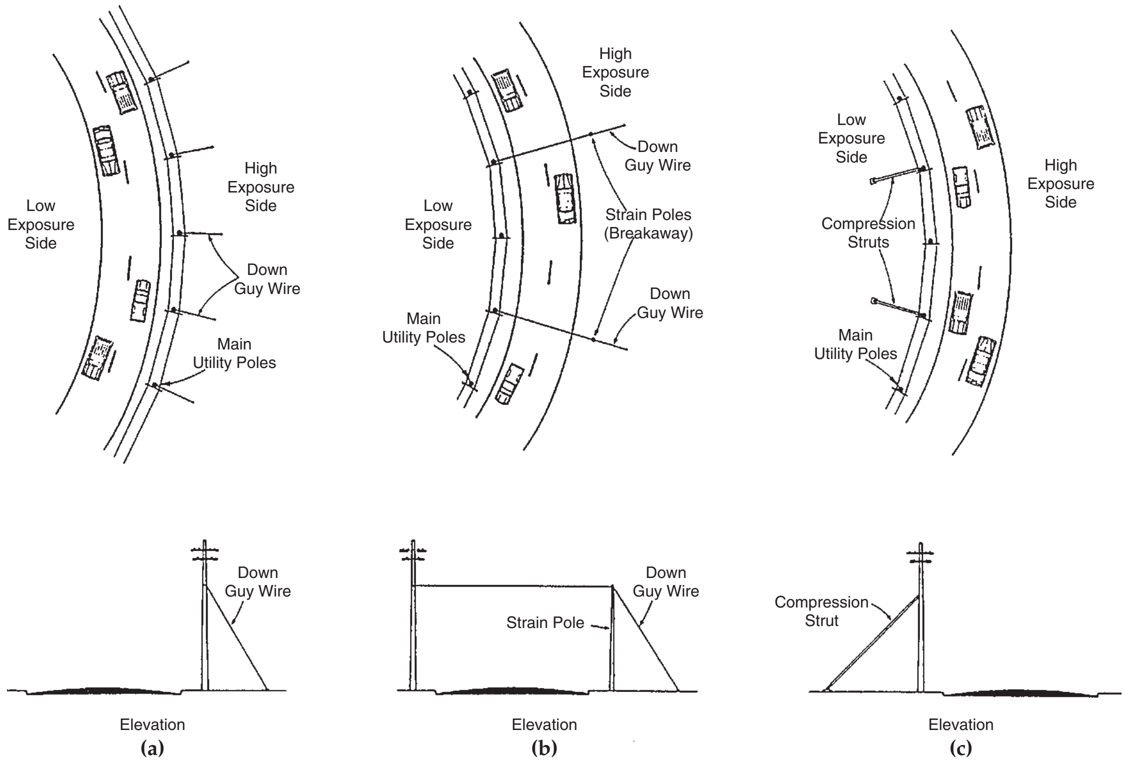

FIGURE 2 Location of utility poles on curves: (*a*) poles on outside of curve; (*b*) poles on inside of curve with breakaway strain poles; (*c*) poles on inside of curve with compression struts.

that an inattentive or physically impaired driver might not be able to accurately perceive the lane drop or lane narrowing. These situations are presented in Figures 3 and 4. Another cause of this problem is a traffic conflict, where a driver is prevented by another vehicle from changing lanes or moving laterally. If it is impractical to span the critical zone without a pole, consideration should be given to the use of a guardrail or crash cushion.

Traffic Island

Placement of poles on a traffic island should be strongly discouraged. Islands are an element of traffic control at an intersection and are usually located within the boundaries of the traveled way. As such, they are likely to be occasionally traversed by errant vehicles. This traversal should not be prevented by a utility pole placed as indicated in Figure 5.

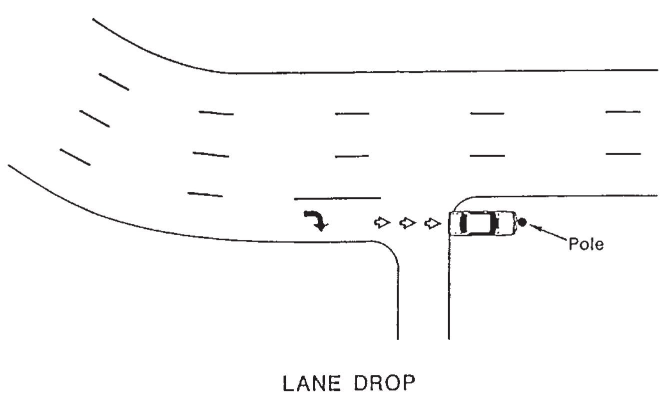

FIGURE 3 Exposure of vehicle to utility pole downstream of lane drop.

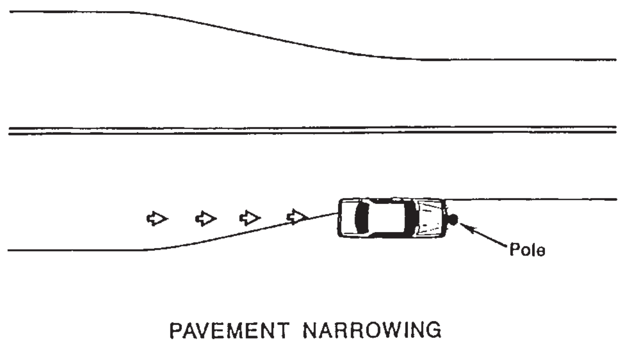

FIGURE 4 Placement of pole downstream of roadway narrowing.

If placement of a utility pole on an island is a practical necessity, consideration should be given to protecting errant vehicles with a crash cushion.

Medians

Placement of poles in medians, as indicated in Figure 5, should be strongly discouraged. Medians are safeguards against head-on collisions and, as such, provide space for errant vehicles to regain control or space for installation of median barriers. A pole or pole line in a median should be considered only if vehicles can be completely shielded from the poles by median barriers. Luminaires are often placed in protected positions on top of median barriers.

Use of Existing Safety Structures

Where guardrails, bridge rails, and crash cushions exist, consideration should be given in pole placement to take advantage of the shielding influence of these structures. An example is presented in Figure 6. During new highway or street construction, coordination of safety structure design and utility facility design should be pursued to reduce the influence of unshielded poles.

Traffic Conflicts

Where critical traffic conflicts can be foreseen, especially at intersections of high-speed roadways, pole placement may be designed to avoid the most critical secondary collisions. For example, if the major roadway is in a north–south direction and the minor roadway is east–west, the most critical quadrants for a secondary collision (collision of a vehicle with a pole after an initial two-vehicle collision) are the northeast and southwest quadrants. Thus, the preferred placement for poles at this intersection would be in the northwest and/or southeast quadrants, as indicated in Figure 7.

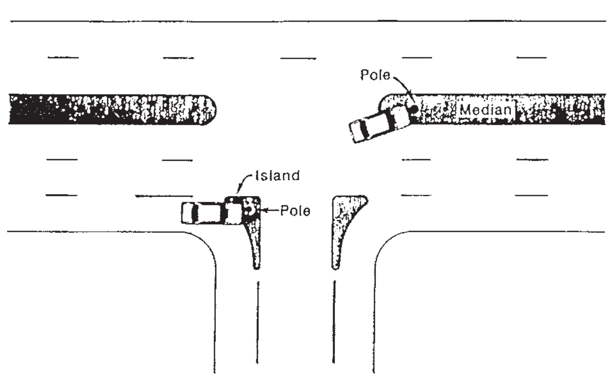

FIGURE 5 Inappropriate location of poles within a traffic island or median.

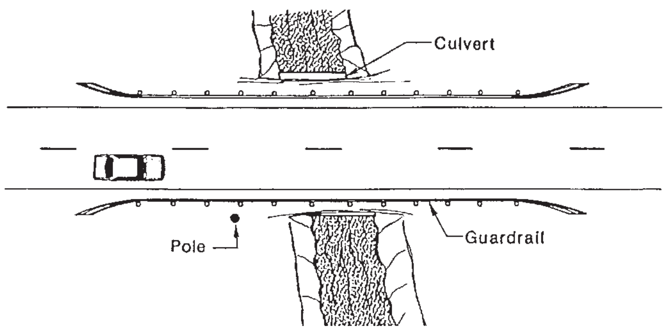

FIGURE 6 Pole shielded from traffic by an existing guardrail.

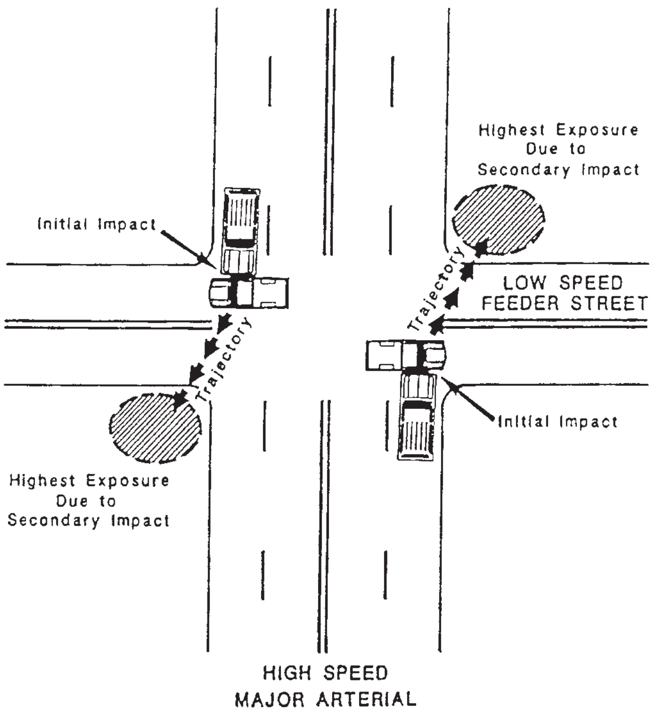

FIGURE 7 Intersection zones having highest exposure to secondary collisions.

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APPENDIX B

Example of Recommended Crash Reduction Program and Roadside Safety Treatments

C. Paul Scott

CRASH REDUCTION PROGRAM

A concentration of crashes at a site or in a small area, or a certain type of crash that seems to occur over and over in a given jurisdiction, may indicate that the highway/utility system is contributing to crash potential. Utility pole crashes are subject to the same types of crash patterns as other types of roadway crashes. They are thus subject to traditional highway crash study procedures. Detailed study of crash records may identify high-crash locations and point out improvements that will reduce the number and severity of future crashes. Road users can also provide input into the nature and causes of highway/utility crashes.

The following steps are normally included in a comprehensive crash-reduction program:

- Setting up a traffic records system,
- Identifying high-crash locations,
- Analyzing high-crash locations,
- Correcting high-crash locations, and
- Reviewing the results of the program.

The size of the organization conducting the program has a great deal to do with its sophistication and complexity. Small highway agencies or utility companies may find it sufficient to place pins on a city map to identify high-crash locations and then review copies of police accident reports to select the best safety treatment. Large utility companies, units of local government, and highway agencies may resort to computers to handle enormous volumes of data. Crash reduction programs at this level frequently use sophisticated statistical software to select the best sites for treatment and to identify the most appropriate countermeasures.

Setting up the Traffic Record System

The first step is to gain access to crash data containing utility-specific information. Local government units and utility companies may need to visit the local law enforcement

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agency to discuss their proposed crash reduction programs and the types of data they will need to identify sites for further study. Once law enforcement officers are aware of the need to collect data on the number and types of utility devices involved in collisions, the availability of such data usually improves. Utilities may find it useful to compile their own files of crash information based on maintenance records of repair to damaged poles, observations of employees, or citizen input. For small utilities and small local governments, it may be sufficient to tabulate the crash information and to identify crashes on local street maps.

At the same time the crash data are being gathered, it may be appropriate to gather information on traffic volumes, speed limits (regulatory and advisory), roadway configurations, roadway and shoulder conditions, street or pavement widths, shoulder widths, right-of-way widths, pavement slopes and superelevation, distances of poles from the edge of pavement, locations of adjacent structures or trees, and other geometric data for sites where crashes have involved utility facilities.

Identifying High-Crash Locations

A high-crash location is a site that has more crashes than similar sites with similar traffic volumes. There is never enough money to fix every site where crashes occur, so it is prudent to concentrate available funds on those sites most deserving of treatment.

There are at least five ways to identify high-crash sites:

1. Number method: This is the simplest method. The number of crashes occurring at each site is identified, and the sites with the highest numbers become candidates for treatment. There is a critical weakness with this method. Sites with higher traffic volumes have a higher number of crashes. It may be normal for an intersection used by 50,000 cars a day to have 20 crashes in a year. However, it would be unusual for an intersection used by 200 cars a day to have the same number of crashes. This latter case might indicate a crash problem.
2. Rate method: This method overcomes the weakness of the number method by taking into account the number of vehicles passing each site. Crash rates are calculated and expressed as the number of crashes per million vehicles entering an intersection or per hundred million vehicle miles driven along a section of roadway. This method also has a crucial weakness. For very low-volume roadways, a single crash may produce a very high crash rate, which would be misleading.
3. Number–rate method: The user calculates the number of crashes and the crash rate. A site with high values in both categories is considered for further investigation. This overcomes the individual weaknesses of the number and the rate methods.
4. Rate–quality control method: This procedure uses statistical tests to determine whether the number of crashes, or the crash rate, at a specific site is above the systemwide average for similar sites.
5. Crash severity method: This method applies when sites are being evaluated. Several state transportation departments have incorporated this procedure. Each injury crash could be equivalent to x property-damage-only (PDO) crashes, and each fatal crash could be equivalent to y injury crashes. Thus, all the injury and fatality crashes at a site could be converted to the equivalent number of PDO crashes. Sites with severe injury and fatality patterns would have large conversions and would rank higher on the priority list.

The best procedure for a particular study depends largely on the size of the area being studied and the number of crashes that have occurred. For very small locations with few crashes, the number procedure may suffice. For statewide studies, the rate–quality control feature may be best. In each instance, the method chosen should determine whether the number of high-crash experiences is above desired limits and where analysis and safety treatments will do the most good for the public.

Analyzing High-Crash Locations

A site may be selected for further study because of the number, rate, or severity of utility pole collisions, or because it fits a pattern of sites that have been designated for systemwide improvements. After a site has been identified for further analysis, the analyst begins looking for patterns of crash types and causes. Once the pattern has been identified, appropriate treatments can be selected. The following steps are found in a typical site analysis:

1. Prepare a collision diagram (i.e., a sketch that uses arrows to show the types of collisions that are occurring). Such sketches may indicate poles too close to the roadway, poles that are hard for drivers to see, turning maneuvers that are too difficult for drivers to master, and similar factors that contribute to crashes.
2. Prepare a condition diagram (i.e., a scale drawing that shows the roadway geometry and any features that might have contributed to the crash). Typically, this diagram includes utility facilities, traffic control devices, street widths, intersection geometry, roadway grade or superelevation that may encourage vehicles to leave the traveled way when wet, and similar features.
3. Tabulate available data and look for patterns. Police accident reports can be used to tabulate type of fixed object (e.g., pole or tree), crash severity, day of week, time of day, weather conditions, and similar factors. Tabulating the time of day and pavement condition, for example, may reveal that most crashes happen at night. This pattern may be a clue that the utility poles are hard to see.
4. Visit the site. The analyst can visit the site to relate the findings from collision diagrams, condition diagrams, and tabulations. The observer may find poles too close to the road, poles on the outside of a curve, turning radii that are too sharp, high-speed traffic, and other characteristics that contribute to the crash pattern.

Sometimes these steps will identify a dominant crash pattern at a site, but often it is not so simple. There may be several crash patterns. Once the pattern or patterns are determined, it is usually possible to diagnose the cause of these patterns and to develop appropriate treatments.

Correcting High-Crash Locations

For each high-crash location, several appropriate safety treatments may be available. Each alternative improvement is evaluated to determine its cost-effectiveness. This involves estimating the number of crashes that will be prevented by a certain treatment and then assigning cost savings due to decreased crash costs. Agencies such as the National Safety Council and the National Highway Traffic Safety Administration periodically publish estimates of crash costs. The cost savings are compared with the cost of installing and maintaining the improvement to generate a cost-effectiveness for the treatment.

Once all the alternatives have been evaluated, the most cost-effective treatment is selected. For a study of a large system, sophisticated computer programs may be used to identify the best sites and the most appropriate treatment at each site. The final step in selecting treatments is to set priorities. Treat those sites first that would do the most good for the public (i.e., prevent the most crashes, injuries, and fatalities). Highway agencies and utility companies are sometimes reluctant to identify sites that need safety treatment or to set priorities for treatment because of perceived liability. They may be afraid a list of high-crash sites could be used in court to show they were aware of crash problems but not concerned enough to do something about them.

Federal legislation has been adopted to help alleviate this problem. Title 23, United States Code, Section 409 (23 U.S.C. 409), prevents the “discovery” or admittance into evidence of most kinds of information gathered or used to identify sites as part of a safety program that utilizes federal-aid highway funds. The intent is to encourage safety programs by shielding the transportation department or utility company from spurious suits.

Reviewing the Crash Reduction Program

An important part of a crash reduction program is to determine whether previous treatments have worked. This involves periodic review of the sites after the treatments have been installed to make sure they have functioned as intended. Crash data may be collected to determine whether the number and severity of collisions have been reduced. A before-and-after study may be undertaken to make this determination.

Many publications are available to provide more complete information to guide highway agencies and utility companies interested in implementing crash reduction programs.

Each state transportation department has a highway safety office or a traffic operations office that can help organize the program and provide pertinent publications, supply crash data, and otherwise contribute to a highway/utility crash reduction program.

ROADSIDE SAFETY TREATMENTS

Ideally, the clear zone should be free of obstacles [clear zone is defined in the AASHTO *Roadside Design Guide* (*1*) as the total roadside border area, starting at the edge of the traveled way and extending a variable distance depending on traffic volumes, speeds, and roadway geometry]. Where these obstacles must be placed in the clear zone, or where an analysis has shown that an existing obstacle may need treatment, many options are available. The following list generally has been considered as the desirable order of treatment:

- Remove the obstacle.
- Relocate the obstacle where it is less likely to be struck.
- Reduce the number of poles.
- Reduce impact severity by using an appropriate breakaway device.
- Redirect a vehicle by shielding the obstacle with a longitudinal traffic barrier or crash cushion.
- Warn of the presence of the obstacle if the preceding alternatives are not appropriate.

These are general treatments, and many variations and combinations may be used.

Researchers have identified the factors that contribute most substantially to crashes along utility pole lines. The most prevalent of these appear to be lateral clearance to the pole, volume of traffic, and pole density per mile. Lists of countermeasures have been developed to address these factors in utility pole crash problems.

Keep the Vehicle on the Roadway

One obvious way to prevent utility pole crashes is to assist the driver in staying on the roadway. This may be done by positive guidance—for example, using pavement markings, delineators, advance warning signs, and other visual cues to tell the driver what to expect and to provide a visual path through a site. Physical enhancements such as improving the skid resistance of the pavement, widening the pavement travel lanes, widening or paving shoulders, improving the superelevation, straightening sharp curves, decreasing the speed of vehicles, and adding lighting in areas where crashes frequently occur at night may also diminish crash potential by decreasing the number of vehicles that for whatever reason leave the travelway.

Underground Utility Lines

By burying utility lines, poles can be removed, greatly reducing crash potential. This alternative saves the utility company the costs of removing and replacing a pole damaged in a collision and of repairing the utility line after a crash. The primary disadvantage of this treatment is the additional initial expense. In addition, the line is now vulnerable to excavation damage, an additional connection may be necessary to provide reliable service, and the line is more difficult to patrol in the case of an outage.

Even with underground utility lines, there still may be a need to safety treat ground surface pad-mounted transformers, switch cabinets, pedestals, and other associated hardware. When these devices are installed, they should conform to the applicable clear zone guidelines.

Underground installations are not the only acceptable treatment, and other types may be preferred for some sites. Rock formations, marsh, and similar site conditions may make underground treatment too expensive. It also may be difficult to handle unanticipated local growth, or it may be impossible to tap some underground facilities to add customers. In spite of these and other difficulties, an underground installation may be the best design solution. In some jurisdictions the utility may collect the incremental cost of placing an underground facility, particularly where overhead facilities are the basis for rates.

Increased Lateral Offset

Both crash rate and crash severity will decrease when utility poles are moved farther from the travelway. Ideally, the poles can be placed at the right-of-way line and outside the clear zone. Vertical construction can sometimes be used instead of cross-arm construction to provide more lateral clearance.

The full effectiveness of moving poles away from the roadway cannot be achieved if other fixed objects are allowed to remain in the clear zone. A utility pole crash reduction program should be part of a comprehensive plan that removes all types of objects from the clear recovery area.

Locations Less Likely to Be Struck

There are many fewer off-road crashes on the inside of horizontal curves than on the outside. Consideration should be given to placing pole lines on the inside of curves. On winding roads, this placement may not be feasible, because the wires would have to cross the road each time sequential curves changed directions. For sharp curves, utility poles would need lateral bracing from compression struts or guy wires. With limited right-of-way, this might not be possible. Some state policies prohibit anchor guys between poles and the traveled way. Some jurisdictions prohibit compression struts. The alternatives include expensive self-supporting poles or anchor guys that extend into adjacent property if feasible and if permission can be obtained.

Where retaining walls, guardrails, nontraversable ditches, and similar features exist, pole lines can be placed behind them. Errant vehicles cannot travel past them to strike the poles.

Reduced Number of Utility Poles

An obvious way to decrease utility pole crashes is to decrease the number of poles beside the roadway. There are several methods available.

- Encourage joint use of existing poles, with one pole carrying streetlights, electric power, telephone, cable television, and other utility lines.
- Place poles on only one side of the street.
- Increase pole spacing by using bigger, taller poles.
- Selectively move poles away from hazardous locations.

Before any of these procedures is adopted, an engineering study should be conducted to determine whether the changes would be cost-effective and appropriate for the specific site. For example, increasing the spacing of poles requires that the remaining poles be larger and taller than the previous ones. These larger poles will be struck less frequently because there are fewer of them. However, the severity of the crashes may be greater because of their larger size and thus cancel any savings that might have accrued because of the decreased number of crashes.

Also, using bigger, taller poles is not a simple solution. In most cases, pole spacing is dictated by conductor size and characteristics and by codes and conductor spacing/

clearance requirements. Some rules require that poles be placed at lateral property lines. Ideal span lengths for power poles may be too great for communication conductors. Typically joint-use spans are shorter than power line spans.

Removing or relocating a few poles in areas of high hazard may be used as a treatment after several crashes have occurred. This countermeasure requires no formal economic analysis and may be particularly appropriate in rural areas.

Breakaway Devices

When a pole must remain in place, it can be modified to break away upon impact and swing out of the path of the vehicle, reducing the severity of the crash. Breakaway sign supports and breakaway luminaire supports have been used for many years. Breakaway timber utility poles have been made available through research conducted for the Insurance Institute for Highway Safety in the 1970s and for FHWA in the early 1980s. Breakaway utility poles cannot be used at every location, but there are instances and circumstances for which they may be the most appropriate crash reduction treatment.

Guy wires for utility poles can also cause crashes. They snag and flip vehicles that strike them and can cause severe injuries to cyclists. Guy wires that are closer to the traveled way than the structure they support should be avoided. Research is being conducted to develop a breakaway guy wire coupling.

Roadside Barriers and Crash Cushions

If it is not feasible or practical to remove utility structures, move them, or place them underground, then other treatments may be necessary. One type of acceptable treatment is to shield the vehicle from striking the fixed object. Roadside barriers perform this function by redirecting the vehicle away from the utility structure, allowing the driver an opportunity to recover control of the vehicle. The AASHTO *Roadside Design Guide* (*1*) may be used to determine whether a roadside barrier is an appropriate treatment and, if so, what design is suitable for site conditions.

A roadside barrier is a longitudinal system used to shield motorists from natural or man-made hazards located along either side of a roadway. There are instances in which a roadside barrier is not appropriate. One example involves flexible and semirigid barrier systems when there is not enough room between the barrier and the fixed object for the barrier to fully deflect during impact. Also, a roadside barrier should be placed as far from the traveled way as conditions permit. Other helpful design information can be found in the *Roadside Design Guide* (*1*).

Another way to shield a vehicle from striking a utility pole is to use a crash cushion, which functions by collapsing upon impact and slowing the vehicle at a controlled rate. A crash cushion is normally used where there is an isolated fixed object hazard. If there are several objects, a roadside barrier is probably a better safety device. Crash cushions typically are much more expensive than roadside barriers.

Crash cushion design is more complex than barrier design. The type of crash cushion and its dimensions must be designed to fit site conditions and to absorb energy (from the impacting vehicle) at the appropriate rate. The *Roadside Design Guide* (*1*) is the source of information for the design process.

Roadside barriers and crash cushions should not be used indiscriminately for at least two reasons: they are expensive to install and to maintain, and they are closer to the road than the objects they are shielding. They are involved in more crashes than unshielded objects. They should be used only when they are warranted to reduce crash severity.

Warning the Motorist of the Obstacle

The number of crashes or the severity of crashes may be decreased by warning motorists of the presence of poles adjacent to the roadway. This may be done with warning signs, reflective paint, sheeting, object markers placed on utility poles, and roadway lighting.

Poles on the outside of a horizontal curve, where a lane becomes narrow, at the end of a lane drop, and in other locations where vehicles are likely to travel close to them are candidates for such warning where more comprehensive treatments are not justified.

Selecting Countermeasures

The method used for selecting countermeasures depends on the size and complexity of the project. For an individual site, the selection may be made through the judgment of an informed individual or a group of individuals. For a systemwide project or for a series of sites, the decision may be based on a cost–benefit analysis or a sophisticated, computer-aided optimization procedure. There is also a methodology specifically designed by FHWA for utility pole treatment determinations.

Diagnostic Review Team

The experience of several agencies and the knowledge of informed parties may be brought together to review a crash problem at a particular site. State transportation departments do this routinely as part of the Federal-Aid Highway Safety Improvement Program. Once a site has been identified for investigation and possible treatment, a diagnostic review team is appointed. The composition of the team is matched to the particular problem. For utility poles, FHWA encourages state, utility company, and FHWA representatives to work together to identify hazardous sites and evaluate the various countermeasures being considered. Utility staff members should be invited to join field reviews. They may be able to supply information about the planned upgrading of the utility line, replacement options, and alternative designs that would assist in making a decision about the most appropriate countermeasures. Whenever possible, utility corrective work should be handled in conjunction with highway or utility upgrading and during utility rehabilitation projects to minimize the overall cost of the program.

Typical results of a field review are a series of recommendations for potential treatments. For small projects, there may be only one or two recommendations. For large projects, the recommendations may be complex and require further analysis.

Cost-Effectiveness Study

The second procedure for selecting countermeasures is to perform a cost-effectiveness analysis. This involves comparing the costs of various treatments to determine the most effective use of limited funding. Costs include items such as potential future crashes, initial construction costs, ongoing maintenance, and similar items. Benefits include a reduction in the number of crashes with a commensurate savings of crash costs, reduced maintenance costs, possible savings in travel time for motorists, and the salvage value of the facility at the end of the useful service life.

The time value of money is considered by applying the net present worth procedure (or a similar method) to the costs and benefits. Benefits and costs are compared to determine whether an improvement is cost-effective and to set priorities among the many projects competing for limited highway funds for safety improvements.

The appendix of the *Roadside Design Guide* (*1*) contains a good cost-effectiveness methodology. Example calculations are provided to illustrate the methodology. This procedure has also been adapted to the computer. Instructions about ordering the software for the cost-effectiveness procedure may be found in the *Roadside Design Guide* (*1*).

For large projects or for a statewide crash reduction program, comprehensive computer programs perform many of the calculations. They also may use advanced statistical techniques to optimize funding and to produce master lists of acceptable projects.

Utility Pole Cost-Effectiveness Procedure

Zegeer and Parker (*2*) developed a cost-effectiveness procedure specifically for selecting utility pole countermeasures. This methodology was published as an FHWA report, which is full of tables, graphs, and charts that can predict the number of traffic crashes involving utility poles of different configurations. Once an agency has decided to undertake a treatment program, it can use this methodology to test alternative designs to see which yields the most cost-effective treatment.

This procedure normally requires a field inspection program to gather the data necessary to perform the methodology. The FHWA report provides data sheets for this purpose, along with step-by-step instructions for performing the field inventory.

A research project conducted for FHWA developed a computerized version of the utility pole cost-effectiveness model. This program was called UPACE. It performs the drudgery of calculating the anticipated number of crashes; making adjustments for the various types of crashes in the clear zone; and estimating the expected cost of treatment, expected total reduction in crashes, expected cost savings, and other predictions needed to evaluate the effect of the treatment. The software is now marketed by the McTrans Center in the Civil Engineering Department at the University of Florida.

Best Method

There is no such thing as a method that is always the best. The best method for selecting countermeasures depends on local conditions, size of the program, funds available, and other factors.

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APPENDIX C

Examples of Lawsuits Involving Utility Pole Crashes

C. Paul Scott, *Editor*

Lawsuits involving utility pole crashes have been separated into the following categories:

- Judgments in favor of transportation departments,
- Judgments against transportation departments,
- Judgments in favor of utility companies,
- Judgments against utility companies, and
- Miscellaneous.

JUDGMENTS IN FAVOR OF TRANSPORTATION DEPARTMENTS

Case 1: Vigreaux v. Department of Transportation and Development, 535 So.2d 518 (La.App. 4 Cir. 1988)

The driver was injured when he swerved his vehicle to avoid a head-on collision, lost control of his car, and struck a utility pole located 8 in. from the street. He had not been drinking and the road conditions were dry at the time of the accident.

The driver sued the city of New Orleans, the Louisiana Department of Transportation and Development (DOTD), and the New Orleans Public Service Incorporated, the owner of the utility pole. Both DOTD and the utility company moved for a summary judgment.

The Civil District Court, Parish of Orleans, granted the utility company a summary judgment and dismissed DOTD because DOTD did not own or maintain the street where the utility pole was located.

Case 2: Anderson v. Macomb County Road Commission (143 Mich.App. 735, 372 N.W.2d 651)

A passenger was permanently paralyzed below her neck when the automobile in which she was riding skipped a curb and struck a utility pole located 24 in. from the curb.

The passenger brought action against the county road commission and others, alleging negligence in placement and maintenance of the utility pole. The Macomb Circuit Court entered summary judgment in favor of the commission and the passenger appealed.

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The Court of Appeals held that the county road commission was not liable to the passenger who sustained injuries because statutory waiver of the state's sovereign immunity with regard to the improved portion of the highway did not extend to the utility pole located 2 ft behind the curb.

Case 3: Boteler v. Rivera, 96-1507 (La.App. 4 Cir. 1997), 700 So.2d 913

The children of a passenger who was killed when the automobile in which she was riding ran off the road and struck a utility pole sued the driver, the Louisiana DOTD, and the utility company.

Following bench trial, the 34th Judicial District Court, St. Bernard Parish, entered judgment for the children. The DOTD and the utility company appealed.

The Court of Appeal held that:

- The condition of the road was not cause-in-fact of the accident.
- DOTD could not be held liable because the pole, although located only 3 ft off the road, was located outside DOTD's right-of-way. Even though DOTD had cut grass along the road, they did not place the utility pole or give anyone else permission to place poles along the road, and they did not own the land adjacent to the road.

JUDGMENTS AGAINST TRANSPORTATION DEPARTMENTS

Case 1: Smith v. City of New Orleans, Louisiana Department of Highways, and New Orleans Public Service Incorporated, 616 So.2d 1262 (La.App. 4 Cir. 1993)

An automobile rounded a curve, ran off the road, and struck a utility pole located 18 in. behind the curb. Suit was brought on behalf of the driver and passengers who were injured or killed against the utility company, the city of New Orleans, and the Louisiana DOTD.

The Civil District Court, Parish of Orleans, entered judgment against the city and DOTD and entered judgment on jury verdict against the utility company. Appeals were taken.

The Court of Appeal held that:

- There was no basis for a suit against the company because placement of the pole was in accordance with applicable standards, the road in question was a state highway under state control, and the utility company had no traffic engineers and made no studies as to traffic conditions, depending on the public entities to do that.
- There was no basis for suit against the city because the Louisiana DOTD had designed and built the road and alone was responsible for the configuration of the curve and the location of the pole.
- DOTD could be found liable for allowing the pole to be located so as to present a hazard and for not adequately protecting against the hazard.

In summary:

- Although DOTD is not a guarantor of the safety of travelers, it does have a duty to keep state highways and shoulders reasonably safe for nonnegligent motorists.
- Evidence of prior accidents involving collisions with the utility pole in years leading up to the incident was sufficient to establish constructive knowledge of a defective condition so that DOTD had an obligation to discover the defect and take measures to protect the public from injury.
- DOTD was at fault by failing to move the pole 5 or 10 ft away from its location 18 in. behind the curb and installing an attenuating device, or by placing a solid line, chevrons along the curve leading up to the pole, and/or a flashing signal to warn approaching vehicles of a dangerous curve.

- The driver of the car was found to be 75% negligent in the accident. The area had been posted for a 35-mph speed, two signs warned of a sharp curve, and there was no evidence the driver made an effort to avoid hitting the pole. Even so, the driver was awarded $600,000 to cover general damages, including medical expenses, pain and suffering, and future loss of earnings. An injured passenger was awarded $375,000 to cover general damages. General damage awards of $250,000 and $125,000, respectively, were warranted for the death of two passengers.

JUDGMENTS IN FAVOR OF UTILITY COMPANIES

Case 1: Federation of Insurance & Corporate Counsel, FICC Hot Tips, 6/16/99s

A utility company may be liable for collision with a pole located off a traveled portion of highway—but not usually. The Maryland Court of Appeals affirmed dismissal of a case against a utility company, as follows:

- A utility company clearly has a duty not to endanger or "incommode" persons and vehicles traveling on the portion of the roadway set aside for lawful travel.
- If the placement of the pole was either directed or expressly or tacitly approved by the government body responsible for the construction or maintenance of the road, the utility company has, at least presumptively, complied with any duty it has to persons on the road arising from that placement of the pole. A utility company is ordinarily entitled to rely on the expertise and superior interest of that authority on matters of highway safety.
- In placing or maintaining a pole near a public roadway, a utility company may ordinarily anticipate that travelers will use the road in a lawful and reasonable manner. If the utility company has a choice about placement, however, it must take account of any particular road or site conditions, such as sharp curves, narrowness of the road, lack of a shoulder, or a potentially dangerous intersection, that may make a deviation more likely and therefore foreseeable and not place or maintain the pole so as to create an unreasonable risk of harm to travelers.
- Utility companies are under no tort duty to make any massive engineering inspection of all their poles now existing along the streets and roads of the state. They may reasonably assume that poles that have remained standing for any significant length of time without serious incident do not incommode or unreasonably imperil traffic on the road. If made aware, however, that particular poles have been involved either in frequent accidents or in any accident that is not freakish and that reasonably indicates a likelihood of future collisions, a question of fact is created whether the pole incommodes or unreasonably imperils traffic on the road.

Case 2: Gouge v. Central Illinois Public Service Co., 144 Ill. 2d 535,544 (1991)

The Illinois Supreme Court held that:

- The electric utility owed no common law duty of reasonable care to ensure that if an automobile leaves the traveled portion of a roadway and strikes a utility pole, the pole will fall away from the roadway.
- Generally, the liability of a utility company for injuries to a motorist resulting from a collision with a utility pole depends on whether the pole is located in or so close to the traveled portion of the highway as to constitute an obstruction dangerous to anyone properly using the highway.
- Utility companies owe no duty to motorists who collide with utility poles unless it is reasonably foreseeable that the vehicles would leave the roadway in the ordinary course of travel and strike the utility poles.

Case 3: Armand v. Louisiana Power and Light Company, 482 So.2d 802 (La.App. 4 Cir. 1986)

The father of the driver injured in an automobile accident when the automobile slammed into a utility pole brought action, individually and on the driver's behalf, against the power company. The driver suffered severe permanent injuries when the car she was operating jumped a curb and slammed sideways into a utility pole located 29 to 30 in. behind the curb.

The Civil District Court for the Parish of Orleans following a jury trial entered judgment against the utility company for $1.2 million. The utility company appealed. The Court of Appeal held that:

- The location and design of the utility pole was not cause-in-fact of the accident, and therefore the utility company could not be held liable for the damages caused.
- The driver's negligence breached her duty to control the automobile and maintain a proper outlook and was the sole cause of the accident.

In summary:

- The driver had a duty to control her vehicle and to maintain a proper outlook.
- For negligence to be the legal cause of the driver's injuries, the utility company's negligence must be a cause-in-fact of injuries, and risk and harm encountered by the driver must fall within the scope of protection afforded by the utility company's duty, which was breached by its negligence.
- An inestimable number of poles and trees line our streets.
- The utility company's pole was no more a cause of the plaintiff's injuries than if the plaintiff had hit an object in the road, lost control, and then struck the pole.
- The driver's negligence in driving with a blood alcohol content of between 0.23% and 0.30% and in failing to maintain control of the automobile was the sole cause of the accident. (She is now a quadriplegic.)
- A utility company has no obligation to guard against rare exigencies such as an out-of-control vehicle leaving a traveled roadway.

Case 4: Roux v. Louisiana Power and Light Company, Inc., 597 So.2d 118 (La.App. 5 Cir. 1992)

Driver and passenger were injured when their vehicle skidded into a utility pole after the vehicle hydroplaned during a heavy rainstorm. They brought suit against the utility company, alleging that the placement of the pole within 12 in. of the roadway was negligent.

The 24th Judicial District Court, Parish of Jefferson, granted summary judgment in favor of the utility company. The plaintiffs appealed. The Court of Appeal affirmed the District Court's decision and held that:

- The plaintiff did not show that placement of the pole was in fact the cause of the accident or that its placement created an unreasonable risk of harm to passing motorists.
- Without prior knowledge of previous accidents involving the pole, the utility company owed no duty to passing motorists regarding the location of the pole.

The following precedents were cited:

- Paige v. Commercial Union Insurance Company, 512 So.2d 507 (La.App. 3 Cir. 1987), writ denied, 523 So.2d 823 (La. 1987). It is well established that motorists are under a duty to drive prudently and that this includes the duty to keep control of their vehicles and to keep a proper lookout for hazards.
- Lang v. Prince, 447 So.2d 1112 (La.App. 1 Cir. 1984), writ denied, 450 So.2d 1309-1311 (La.1984). South Central Bell was negligent for failing to remedy a hazard created by one of its utility poles. The pole was placed in the improved shoulder of the road. If drivers left the roadway even partially, they would contact the pole. South Central Bell knew of the danger yet failed to correct it.

Case 5: Smith v. City of New Orleans, Louisiana Department of Highways, and New Orleans Public Service Incorporated, 616 So.2d 1262 (La. App. 4 Cir. 1993)

An automobile rounded a curve, ran off the road, and struck a utility pole located 18 in. behind the curb. Suit was brought on behalf of driver and passengers, injured or killed, against the utility company, the city of New Orleans, and the Louisiana DOTD.

The Civil District Court, Parish of Orleans, entered judgment against the city and the department and entered judgment on jury verdict against the utility company. Appeals were taken.

The Court of Appeal held there was no basis for suit against the utility company because placement of the pole was in accordance with applicable standards, the road in question was a state highway under state control, and the utility company had no traffic engineers and made no studies as to traffic conditions, depending on public entities to do that.

JUDGMENTS AGAINST UTILITY COMPANIES

Case 1: Professional Techniques Library, P.O. Box 527, Cohasset, MA 02025-0527, www.ziplink.net/~bbarton/cata.htm

Descriptive summaries of million-dollar arguments: No. 106: John Messina, Tacoma, Washington: utilities/leg amputation, burns; Mortimer v. Puget Sound Power & Light. Two brothers driving home after a night of drinking struck a utility pole too close to the winding road. Messina's jury decided the passenger was entitled to a forgiving highway and awarded him $3,141,000.

Case 2: Nicks v. Teche Electric Co-Op, Inc., 93-1418 (La.App. 3 Cir. 1994), 640 So.2d 723

Driver and passenger were injured when they were forced off the road by an oncoming motorist and their vehicle left the traveled way and struck a replacement utility pole lying in a grassy area just beyond the graveled shoulder of the roadway. They sued the utility company.

The Sixteenth Judicial Court, Parish of Iberia, entered judgment against the utility company, which appealed.

The Court of Appeal affirmed the decision and held that:

- Evidence supported determination that the utility company's utility pole located within 10 ft of the roadway was cause-in-fact of harm to the driver and passenger.
- The trial court did not err in imposing duty on the utility company to keep its equipment outside the clear recovery area.

Case 3: McMillan v. Detroit Edison Company (426 Mich. 46, 393 N.W.2d 332)

A passenger in an automobile that left the traveled portion of a highway when struck by a hit-and-run driver and collided with a utility pole brought action against the owner of the pole and others. The utility pole was located in the grassy median, about 3 ft from the traveled portion of the highway.

The Oakland Circuit Court granted the utility's motion for summary judgment and the passenger appealed. The Court of Appeals affirmed.

The Supreme Court reversed lower court decisions and overruled some previous decisions by determining that placement of the poles could be so significant and important as to be regarded a proximate cause of the passenger's injury and that the utility could be found to owe a duty to motorists but that this determination should be made by a jury.

Other courts have concluded that similar situations present questions that should be submitted to a jury. For example, in Scheel v. Tremblay (226 Pa.Super.45, 312 A.2d 45), the car swerved to avoid an oncoming car and struck a utility pole placed 10 in. from the pavement by the Philadelphia Electric Company. The court reversed a summary judgment granted in the utility's favor.

Case 4: Boteler v. Rivera, 96-1507 (La.App. 4 Cir. 1997), 700 So.2d 913

The children of a passenger who was killed when the automobile in which she was riding ran off the road and struck a utility pole sued the driver, the Louisiana DOTD, and the utility company.

Following bench trial, the 34th Judicial District Court, St. Bernard Parish, entered judgment for the children. DOTD and the utility company appealed. The Court of Appeal held that:

- The condition of the road was not cause-in-fact of the accident.
- DOTD could not be held liable based on the location of the utility pole.
- The utility pole, based on its location, 3 ft off the edge of the road, posed an unreasonable risk of harm that substantially contributed to the passenger's death.
- The utility company bore responsibility for the unreasonable risk posed by the utility pole on both negligence and strict liability theories.
- Although the majority of the fault was that of the driver, his inadvertence was not the sole cause of the accident. (Fault was apportioned 60% to the driver, 25% to the utility company, and 15% to the passenger.)

In summary:

- The condition of the rural highway, which had two 10-ft lanes and which lacked edge striping or a curb, was not the cause-in-fact of the accident. The driver's inadvertence caused the vehicle to leave the road.
- DOTD was not liable because the pole, although located only 3 ft off the road, was located outside DOTD's right-of-way. Even though DOTD had cut grass along the road, it did not place the utility pole or give anyone else permission to place poles along the road, and it did not own the land adjacent to the road.
- The utility company was liable for the unreasonable risk posed by the utility pole located 3 ft off the road: it owned and had custody of the pole, it was responsible for the pole's location, it had at least constructive knowledge that the pole caused risk of harm, the pole was not located within the state's right-of-way, and DOTD did not grant permission to locate the pole.

Case 5: Mayoral v. Middle South Utilities, 618 So.2d 436, La.App. 5 Cir. 1993

A driver and passenger were injured when the driver took evasive action to avoid an oncoming car, ran off the road, and hit a utility pole located close to the roadway. They sued the utility company.

The 24th Judicial District Court, Parish of Jefferson, granted summary judgment for the utility company. An appeal was taken.

The Court of Appeal held that genuine issues of material fact existed, precluding summary judgment for the utility company. Issues included the following:

- Whether failure to place a barrier near the pole was cause-in-fact of the collision or the passenger's injuries;
- Whether a barrier would have prevented the collision;
- Whether previous accidents involving the utility pole had occurred;
- Whether the utility company had a duty to protect automobile drivers and passengers from collisions arising from a driver's response to a sudden emergency; and
- If that duty existed, whether the utility company breached its duty.

Case 6: Owens v. Concordia Electric Cooperative, Inc., 95-1255 (La.App. 3 Cir 1997), 699 So.2d 434

The parents of a 16-year-old motorist brought wrongful death action against the parish and the utility company arising from an automobile accident in which the motorist lost control of his vehicle while rounding a 90° dog-leg-left curve and struck a utility pole, dislodging the transformer rack that was affixed to the pole and causing it to crash down atop and crush the vehicle.

The Seventh Judicial District Court, Parish of Catahoula, after polling the jury, rendered final judgment apportioning 65% of the fault to the motorist, 25% to the utility company, and 10% to the parish and granted each parent $1 million in general damages before any comparative fault reduction. All parties appealed. The Court of Appeal held that:

- The trial court committed reversible error by modifying judgment after its improper polling of the jury revealed jurors' misunderstanding of the court's instructions.
- The motorist was 65% at fault given blood alcohol level in excess of legal intoxication and his loss of control of the vehicle.
- The parish's breach of its duty to sign the 90° curve warranted 10% assessment of fault.
- The utility company's placement of the pole within 7 ft of the curve and failure to properly affix the transformer rack to the pole warranted 25% assessment of fault.
- Wrongful death damage awards of $350,000 to each parent were reasonable.

In summary:

- Under the comparative fault system, the motorist's fault in causing the accident does not necessarily relieve the defendants of liability for causing harm.
- The parish's breach of its statutory duty to place warning signs warranted a 10% assessment of fault. Even though the motorist was intoxicated, the risk he might lose control in a 90° curve of unsigned, rutted, dirt road was within the scope of the parish's duty to sign the curve.
- The utility company's breach of its duty not to create obstructions for motorists who stray from the traveled portion of the roadway and of its duty to assemble and maintain its utility pole fixtures warranted a 25% assessment of fault. The utility company placed the pole within 7 ft of a 90° dog-leg-left curve and used 5/8-in. bolts to fasten the transformer rack to the utility pole, even though the manufacturer expressly instructed use of 3/4-in. bolts and experts testified 3/4-in. bolts were customarily used.

MISCELLANEOUS

Case 1: West's Encyclopedia of American Law, www.wld.com/conbus/weal/wneglig2.htm

Perhaps no issue in negligence law has caused more confusion than the issue of proximate cause. The concept of proximate cause limits a defendant's liability for his or her negligence to consequences reasonably related to the negligent conduct. Although it might seem obvious whether a defendant's negligence has caused injury to the plaintiff, issues of causation are often very difficult.

Suppose, for example, that a defendant negligently causes an automobile accident, injuring another driver. The colliding cars also knock down a utility pole, resulting in a power outage. Clearly the defendant's negligence has in fact caused both the accident and the power outage. Most people would agree that the negligent defendant should be liable for the other driver's injuries, but should he also be liable to an employee who, because of the failure of her electric alarm clock, arrives late for work and is fired? This question raises the issue of proximate cause.

Actually, the term proximate cause is somewhat misleading because as a legal concept it has little to do with proximity (in time or space) or causation. Instead, proximate cause is related to fairness and justice in the sense that at some point it becomes unfair to hold a defendant responsible for the results of his or her negligence. For example, Mrs. O'Leary's negligent placement of her lantern may have started the Great Chicago Fire, but it's unjust to hold her responsible for all the damage done by the fire.

In determining whether a defendant's negligence is the proximate cause of a plaintiff's injury, most courts focus on the foreseeability of the harm that resulted from the defendant's negligence. For example, if a driver negligently drives an automobile, it is foreseeable that the driver might cause an accident with another vehicle, hit a pedestrian, or crash into a storefront. Thus, the driver would be liable for those damages. But suppose the negligent driver collides with a truck carrying dynamite, causing an explosion that injures a person two blocks away. Assuming the driver had no idea the truck was carrying dynamite, it is not foreseeable that this negligent driving could injure a person two blocks away. Therefore, the driver would not be liable for that person's injury under this approach. When applying this approach, courts frequently instruct juries to consider whether the harm or injury was the "natural or probable" consequence of the defendant's negligence.

A minority of courts hold the view that the defendant's negligence is the proximate cause of the plaintiff's injury if the injury is the "direct result" of the negligence. Usually a plaintiff's injury is considered to be the direct result of the defendant's negligence if it follows an unbroken, natural sequence from the defendant's act and no intervening, external force acts to cause the injury.

Case 2: Hoffman v. Vernon Township, 97 Ill. App. 3d 721,726 (1981) and Boylan v. Martindale, 103 Ill. App. 3d 335 (1982)

Plaintiff's automobile went out of control, left the roadway, and struck a utility pole that was located 27 ft from the centerline of the roadway and 12 to 16 ft from the easterly boundary line of the roadway.

The court found that it was not reasonably foreseeable by the defendant that the plaintiff would deviate from the road as he did as a normal incident of travel.

Case 3: Letter of the Law, A Quarterly Publication from the Law Offices of Ernest H. Hyde, Vol. 7, No. 3, July 1998, www.erniehyde.com/Newsletter-7-98.html

The Mississippi Supreme Court ordered a new trial in a case in which a passenger was injured while riding with a drunk driver who swerved off the road and hit a utility pole.

- The court stated that the utility company had a duty of care for the safety of those making common use of the right-of-way.
- The court ruled that the trial court should consider factors such as the structure's proximity to the roadway, the configuration of the roadway, whether the utility company had notice of previous accidents, and whether there are feasible alternative locations for the structure that are less dangerous.