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Utility Safety

Mobilized for Action
and
State, City, and Utility Initiatives in Roadside Safety

PRESENTATIONS FROM TRB COMMITTEE ON UTILITIES (A2A07)

from the

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Foreword

Contained here are presentations by eight of the most knowledgeable and experienced individuals in the nation concerning the problem of roadside safety and utility poles. Speakers were selected and invited by the Transportation Research Board Committee on Utilities, A2A07. These presentations, made in Sessions 249 and 285 of the 79th Annual Meeting of the Transportation Research Board, represent the latest thinking and progress in the national campaign to make roadsides safer while continuing to allow their use by those providing power and communications to the nation.

Contents

EXECUTIVE SUMMARY

Mobilized for Action
Session 249

PRECEDENTS

- AASHTO Strategic Highway Plan. (Potential for saving 6,000 lives per year.)
- Utility Safety Task Group of the Transportation Research Board.
- FHWA support of research and development of status reports on every state.
- State, city, and utility programs to reduce exposure to roadside poles.

STRATEGIES

- Determination of where pole collisions occur using accident and maintenance records.
- Prioritization of safety improvements by accident experience, probability of collision, and degree of compliance with clear zone recommendations.
- Demonstration of the cost-effectiveness and 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. (These include crash cushions, steel-reinforced safety poles, guardrails, and concrete barriers.)
- Demonstration 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.

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.”

State, City, and Utility Initiatives in Roadside Safety
Session 285

GEORGIA

- Georgia conducts a statewide program in cooperation with utility companies to reduce pole collisions.
- This includes identification, prioritization, and treatment of the most probable collision sites.
- In the areas subject to before-and-after treatment study, crash rates have been reduced by almost 70 percent.

HUNTSVILLE, ALABAMA

- A 30-month crash study of 17,431 accidents was conducted that included site surveys of 80 percent of the pole collisions.
- Realistic and practical ways to comply with the clear zone requirements on extant urban streets were sought.
- Included are achievable goals for pole placement on curbed and noncurbed roadways.

WASHINGTON

- Control zone (clear recovery area) guidelines were developed by utility and state departments of transportation representatives in 1989.
- This 10-year program has “corrected the locations of thousands of utility objects and reduced vehicle pole collisions by more than 35 percent on state highways . . .”

FLORIDA

- Studied the problem of competition for space in highway rights-of-way.
- Program developed was cooperative with state and utility representatives.
- Determined where improvements would be most productive.
- The Florida control zone philosophy is “improving safety by assuring that the high standard is applied in areas of greatest risk.”
- Accomplishments to date are described, including relocations in four 3R projects.
- Effectiveness of the policy is being evaluated as implementation progresses.

Precedents for Action

DWIGHT A. HORNE
Federal Highway Administration

UTILITY POLE PROBLEM

- 80 million utility poles nationwide on public rights-of-way.
- 1,100 deaths and approximately 40,000 serious injuries each year.
- Top 10 states have 55 percent of the fatalities; top 20 have 80 percent.
- Only trees and roadside barriers account for more fixed-object fatalities.

AASHTO STRATEGIC HIGHWAY SAFETY PLAN

- Developed by safety experts across the country.
- Potential for saving 5,000 to 7,000 lives each year.
- Substantially reduce health-care costs.
- Strategies that can be implemented in 5 to 7 years.
- Cost-effective and acceptable to a significant majority of Americans.
- Strategies developed for 22 key emphasis areas.
- Approved in 1998.

The following is the strategy related to utility pole safety.

Emphasis Area

"Minimizing the consequences of leaving the road."

Strategy

"Implement a national policy to reduce the hazard from roadside utility poles, particularly on two-lane rural roads."

NCHRP PROJECT 17-18, IMPLEMENTATION SUPPORT FOR AASHTO STRATEGIC HIGHWAY SAFETY PLAN

- To provide various services as directed by a project panel to support implementation of the plan.
- Workshop held in January 1999 to focus on the implementation issues.
- Website has been developed containing a number of studies and publications related to the emphasis areas and strategics. This is an ongoing function.
- Project panel has selected six targeted areas in which to identify promising

strategies and develop guidance documents to assist state and local agencies in implementing these strategies:
  - Aggressive driving,
  - Head-on crashes,
  - Run-off-the-road crashes,
  - Drivers with suspended licenses,
  - Hazardous trees, and
  - Unsignalized intersections.
- A marketing plan is being developed.

Utility Safety Task Group

- An activity of TRB's Committee on Utilities (A2A07).
- Don Ivey (Texas Transportation Institute) and Paul Scott (FHWA) co-chair the task group.
- Made up of representatives from
  - FHWA,
  - State departments of transportation (DOTs),
  - Utility companies,
  - Academia, and
  - Safety hardware manufacturers.
- Objectives
  - Examine the magnitude of the utility pole problem.
  - Obtain information about existing programs, technologies, and strategies.
  - Prepare a state-of-the-art report with recommendations for improvement.
  - Initiate outreach activities to encourage state DOTs and utilities to implement the recommendations.

Future of Utility Pole Safety

- We are anticipating valuable results to come from the AASHTO Strategic Highway Safety Plan and TRB Utility Safety Task Group efforts.
- Until those results are available there are a number of things that can be done. We have a number of published guides and reports that address the issue.

Available Tools for Utility Pole Safety Improvements

- AASHTO *Roadside Design Guide* (1996), including a computer program to assist in the economic analysis of existing or proposed roadside conditions.
- AASHTO "Green Book" (1990 and 1994 metric).
- Highway/Utility Guide (FHWA, 1993).
- Various research reports, some of which will be reported on by Charles Zegeer later in the session. These include models to predict utility pole crashes and determination of the safety and economic results of various countermeasures.

- A number of state and local government agencies have developed safety programs to address utility pole safety specifically. Some will be reported on in the session immediately following this one.
- Breakaway timber utility poles:
  - Kentucky retrofitted 10 existing poles in 1988–1989—none struck during 2-year evaluation period.
  - Massachusetts installed 19 new poles in 1989–1990—struck five times, no fatalities or serious injuries; electricity service unaffected.
  - Virginia retrofitted five poles in 1991—no hits.
  - Texas retrofitted five poles in 1994—struck one time, no fatalities or serious injuries.
- A few years ago Paul Scott made a survey of FHWA division offices to determine what could be done to improve the implementation of safety measures for utilities. One of the results of the survey was a need to improve the coordination, cooperation, and communication between state DOTs and utility companies. It must be understood that safety is a shared responsibility between the utility and highway industries and that a rational safety improvement plan will benefit both.
- As a start, utilities (from maintenance records) and highway agencies (from accident records) can jointly identify individual poles that are struck more than once or groups of poles that are struck far more than the norm. Where corrective measures are to be made on a stretch of highway, the work should be cooperatively undertaken so that a consistent clear zone is provided to the motorist.

Countermeasures—Highway Agencies

- Keep vehicles on the roadway
  - Pavement markings
  - Delineators
  - Skid resistance
  - Widen lanes
  - Widen, pave shoulders
  - Straighten curves
- Safety devices
  - Steel-reinforced safety poles
  - Guardrails
  - Crash cushions
  - Concrete barriers
- Warn motorists of obstacles
  - Reflective paint, sheeting, markers on poles
  - Roadway lighting
  - Warning signs
  - Rumble strips

Countermeasures—Utilities

- Locate underground
- Increase lateral offset
- Locate where less likely to be struck
  - Behind ditches, guardrail
  - Inside of curves
  - Avoid end of lane drop
- Reduce number
  - Joint use
  - One side of highway
  - Increase spacing
- Breakaway poles, guylines

Other Recommendations

- Research and development of safety treatments with specific application to utility poles should be encouraged. FHWA currently has research under way in the areas of breakaway guylines and breakaway fiberglass utility poles.
- Safety management plans and roadside safety audits should specifically address utility pole safety.

Setting Priorities for Reducing Utility Pole Crashes

CHARLES V. ZEGEER
University of North Carolina, Chapel Hill

Imagine a river that is spanned by a long suspension bridge with no side railings, where people drown on a regular basis because of vehicles running off the edge of the bridge deck into the cold water below. Would we allow that bridge to be open to traffic? Further assume that an electrical contractor has a practice of installing wiring in homes with live wires sticking out of the wall that will result in electrocution if touched. Would that be acceptable practice today? Would not the engineers who designed such a bridge facility or installed the faulty house wiring face the prospect of losing their licenses to practice engineering and many lawsuits as a result of the deaths?

Although these examples may seem hard to believe, the practice of installing rigid utility poles very close to travel lanes on high-speed, high-volume roadways is common and results in more than 1,100 people killed and 40,000 to 50,000 people injured each year in the United States. Why do these utility pole crashes continue to occur with such regularity (Figure 1)?

Part of the answer to this question may be illustrated with a real-world example (Figure 2). For more than 50 years, wooden utility poles have been positioned about 6

FIGURE 1 Utility pole.

FIGURE 2 Severely damaged vehicle.

inches from the travel lane of a two-lane road with a sharp curve on the outskirts of a town in a northern U.S. state. The same pole had been reported by nearby residents as having been struck at least once a year for more than 50 years. Neighbors tell stories of hearing vehicles skidding and then loud crashes into the utility pole, followed by the siren of an ambulance and rescue workers attempting to extract the injured occupants from the damaged vehicle and transport them to the hospital. Each time the pole was struck and damaged, the utility company promptly reinstalled it in the same location within inches of the travel lane to await its next victim. Information only came out about the history of the pole during a lawsuit, after a motor vehicle was literally torn in half in a side impact with the pole that left the young driver permanently injured, with a future of pain and misery. To make matters worse, the city traffic engineering department had refused for years to properly mark or sign the deficiently designed curve. It took a lawsuit by an injured motorist to bring this situation to light.

Relocating one or two poles on the outside of the curve 20 or 30 years ago would have saved untold damage and injuries. Even without regard to human injuries and deaths at this location, relocating several poles to the inside of the curve would have saved that utility company thousands of dollars that were spent in replacing the damaged poles over the years, not to mention costs from power outages resulting from motor vehicle crashes into the poles and the costs for a team of attorneys who worked to defend the utility company in a court of law.

This is a true story. With all of our engineering knowledge and our concern for the health and well-being of our citizens, very little has changed in the past 50 years in terms of our placement of utility poles near many of our public streets and highways.

Over the past 30 years, highway engineers have worked to reduce fixed-object crashes through a variety of improvements to roadside slopes and better designs of roadside features. In addition, increases in seat belt use, improved vehicle designs, and other advances have all contributed to a reduction in the fatality rate from 5.6 fatalities per 100 million vehicle-miles in 1966 to a rate of 1.6 in 1996 (*1*).

FIGURE 3 Slick road.

FIGURE 4 Fog.

FIGURE 5 Curves.

A variety of conditions may contribute to the probability of a motorist leaving the road and striking a utility pole or other roadside object. They include slick or icy roads, visibility limitations (such as fog, sharp curves, wide trucks, and narrow roads), and many others(Figures 3, 4, 5, and 6). Although some utility pole crashes result from driver speeding, drinking, and other driver factors, even the best drivers sometimes make mistakes and are killed or seriously injured primarily because of striking a utility pole

FIGURE 6 Trucks.

located too close to the road. Many of these motorists could have avoided such serious consequences if the proper improvements had been made.

Older designs of roadside features include rigid I-beams as sign supports, nonbreakaway light poles, and spear-end guardrail end treatments, and many roads were built with trees located within a few feet of the roadway (Figures 7, 8, 9, and 10). Crashes into such obstacles often result in death or serious injury to the vehicle occupants.

For several decades, highway and safety engineers have installed traffic control measures to reduce the risk of motorists running off the roadway and thus reduce the chance of fixed-object crashes. Such measures include raised pavement markers, advance curve warning signs, and chevron signs around curves (Figures 11, 12, and 13).

Although curve warning signs, markings, and reflectors along roadways may help some drivers stay within the travel lane, such measures alone do not prevent all vehicles from running off the road. The presence of wide, paved shoulders can provide needed recovery room for errant motorists, and shoulder rumble strips are being used along many roadways to give sleepy or inattentive drivers a jolt if they drift onto the shoulder and to aid in their recovery back onto the road (Figures 14 and 15).

Modern engineering principles call for placing rigid poles on the top of concrete barriers or behind guardrail. This can result in a much less severe outcome for a motorist who strikes a guardrail or barrier (Figures 16 and 17).

FIGURE 7 Signpost.

FIGURE 8 Light pole.

FIGURE 9 Spear-end guardrail.

Sound engineering practice often calls for the installation of crash-attenuating devices in front of bridge support structures, which usually results in minimal injury to occupants instead of death or crippling injury. Various types of breakaway end treatments can be designed to absorb the impact of a collision, resulting in reduced occupant injury (Figures 18, 19, and 20).

FIGURE 10 Tree.

FIGURE 11 Raised pavement markers.

FIGURE 12 Curve sign.

FIGURE 13 Chevrons.

FIGURE 14 Shoulder construction.

FIGURE 15 Rumble strips.

Many roads are built in rolling or mountainous areas, where steep roadside slopes exist. An errant motorist who runs off the road on a steep slope will often roll over (sometimes multiple times), which often kills or seriously injures vehicle occupants. Providing guardrails can reduce the severity of the outcome for a run-off-road motorist. However, providing a flatter roadside slope and a clear recovery zone free of rigid obstacles is a much better solution, since it is more likely to allow motorists to recover if they leave the road for any reason (Figures 21 and 22).

ANALYSIS OF UTILITY POLE ACCIDENTS

What do we know 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 1984 study for FHWA collected and analyzed data, which 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 crashes per mile per year (and 16.6 utility pole crashes per 100 million vehicle-miles). Of the 9,583 utility pole crashes, nearly half (46.3 percent) resulted in injury, and about 1 percent resulted in death to one or more occupants (*2*) (Figure 23).

FIGURE 16 Placement of poles.

FIGURE 17 Placement of poles.

FIGURE 18 Sand barrels.

FIGURE 19 BCT end.

FIGURE 20 Flat drainage structure.

FIGURE 21 Steep slope.

FIGURE 22 Flat slope.

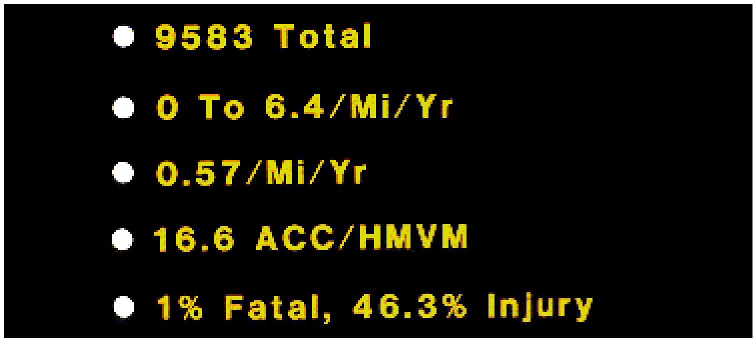

FIGURE 23 Utility pole accident summary.

For the full 2,500-mile sample, photologs were used to record details about the roadway (e.g., number of lanes, roadside details) and utility poles (number of poles per mile, types of poles, and distance of each pole from the roadway edgeline). This information was combined with other locational information, such as traffic volume and utility pole crash data (Figures 24 and 25).

The analysis resulted in a crash prediction model for utility pole crashes on roadway sections that is a function of average daily traffic (ADT), number of utility poles per mile, and average distance of the poles from the roadway edgeline (the "offset" distance). The relationship shows clearly that poles close to the roadway (particularly within about 10 feet of the travel lane) result in a greatly increased risk of a vehicle collision with a utility pole (Figure 26).

On the basis of the accident prediction model, a nomograph that can be used to determine the expected number of utility pole crashes was prepa red (Figure 27). For example, assume that a roadway section carries 10,000 vehicles per day and has 50 utility poles per mile along the roadside and that the poles are positioned an average of 5 feet from the roadway edgeline. That set of conditions would correspond to an expectation of one utility pole crash per mile every year. Thus, a 3-mile section would be expected to have 3 crashes

FIGURE 24 Photolog viewers.

FIGURE 25 Photolog viewers.

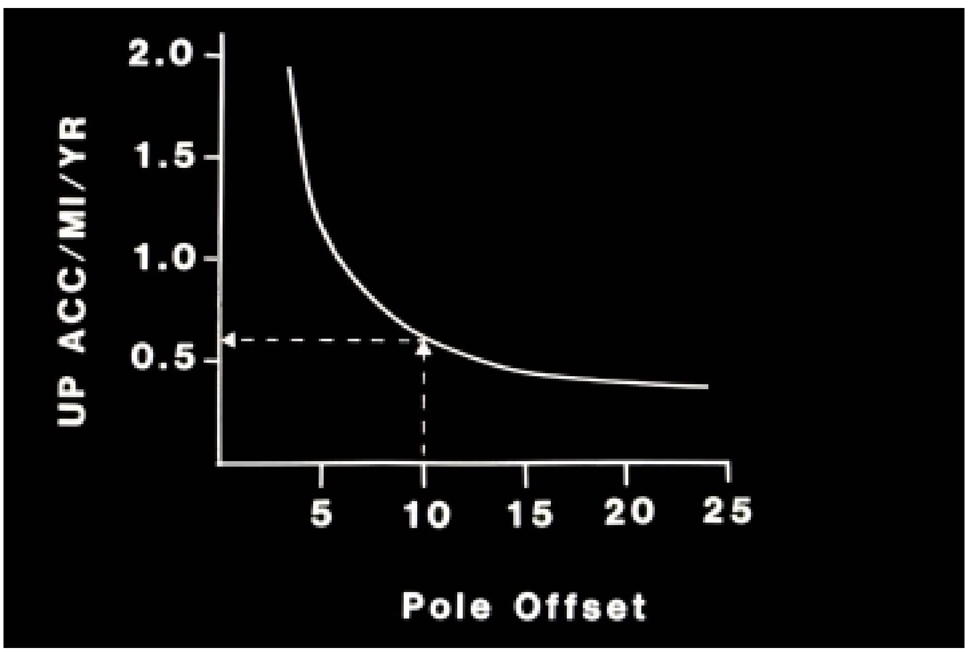

FIGURE 26 Relationship of crashes and pole offset.

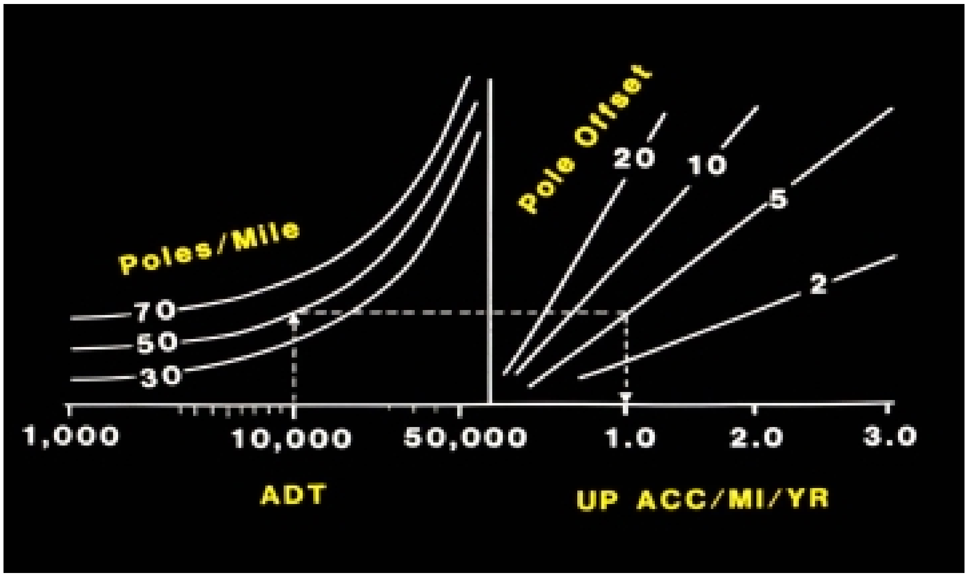

FIGURE 27 Nomograph.

AR FACTORS

Pole Offset (Before)	Pole Offset (After)			
	6	10	15	20
4	30	60	73	77
7		31	54	59
10			33	42
12			15	25

FIGURE 28 Table of crash reductions.

- Wood vs. Metal Poles
- Speed Limit
- Roadway Curvature
- Pole Offset

FIGURE 29 Severity issues.

into utility poles each year, or 30 in a 10-year period. Relocating those poles further from the road would increase the clearance distance to the poles and reduce the number of pole crashes. Increases in pole crashes would also be associated with greater numbers of poles per mile or increases in traffic volumes (Figure 28).

On the basis of the analysis and the prediction model, the study allowed for determining the expected effects of various utility improvements, such as relocating poles further from the roadway at high-crash locations. For example, assume that a roadway section has utility poles positioned an average of 4 feet from the roadway edge and has an average of 20 utility pole crashes per year. The accident reduction factor for relocating the poles an additional 6 feet to a distance of 10 feet from the travel lane would reduce the utility pole crashes by about 60 percent. Thus, the 20 pole crashes per year would be expected to drop by 12 (60 percent of 20 crashes) to 8 pole crashes per year. Eliminating 12 utility pole crashes per year over a 10-year period would eliminate 120 crashes and their associated injuries and deaths (Figure 28).

The FHWA study revealed other information about utility pole crashes. Wood poles, particularly those with larger diameters and in areas with higher speed limits, are associated with higher crash severities. Also, although poles are more likely to be struck if located close to the roadway, placement of poles on the outside of sharp horizontal curves or close to busy intersections is a poor choice, since they are more likely to be struck than in other locations (*2*) (Figure 29).

FIGURE 30 Pole in front of guardrail.

FIGURE 31 Pole behind guardrail.

COUNTERMEASURES FOR UTILITY POLE CRASHES

To reduce the frequency and severity of utility pole crashes at selected high-risk locations, several options exist. For example, placing the poles behind rather than in front of a guardrail can reduce the severity of a run-off-road collision, since a vehicle may strike a guardrail at a glancing angle instead of having a more severe head-on impact with an unyielding utility pole (Figure 30 and 31).

Analysis indicates that relocating utility poles further from the roadway can be cost-effective in some situations, particularly for telephone and most power poles within 10 feet of high-volume roadways (*3*) (Figure 32).

For roadway sections with high traffic volumes and poles close to the roadway without sufficient right-of-way for pole relocation, removing the poles and undergrounding the lines may be feasible. Consideration must also be given to the need for overhead lighting where luminaire poles will be needed. Undergrounding of utility poles will not be effective on roadsides that are cluttered with trees and other rigid objects unless those objects are also removed (*3*) (Figure 33).

Multiple pole use refers to using a line of poles to carry multiple utilities (e.g., electricity and telephone) and thereby eliminating the need for poles on both sides of the road. Fewer poles near the roadway will result in fewer pole crashes. There are situations where this treatment is feasible, particularly where traffic volumes are above 5,000 vehicles per day and and poles are within 5 feet of the road. However, pole relocation or undergrounding of lines (and removal of poles) is preferred because of the potential for reducing utility pole crashes (*3*) (Figure 34).

Over the past several years, breakaway poles have been tested in several states. Several of these designs are quite promising, since they can reduce the severity of a pole

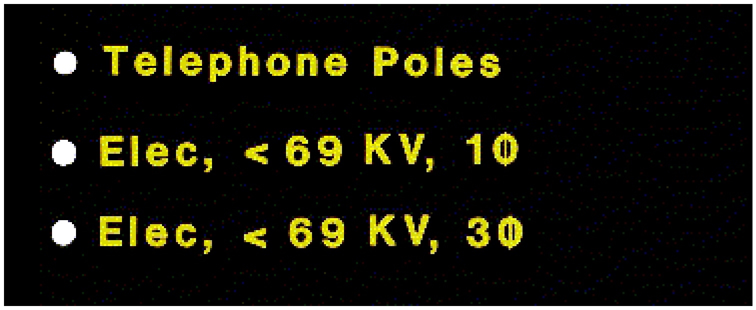

FIGURE 32 Increase pole offset.

FIGURE 33 Undergrounding.

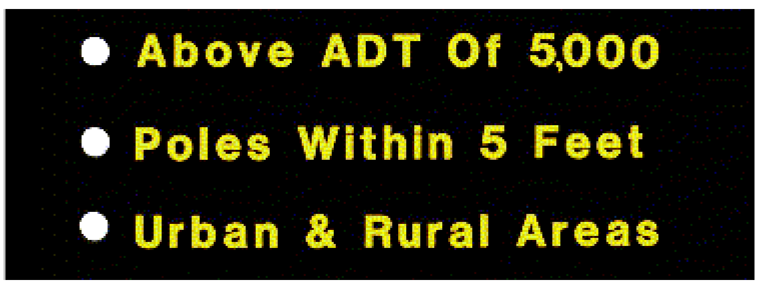

FIGURE 34 Multiple pole use.

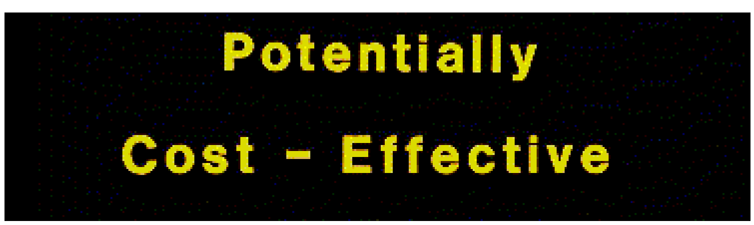

FIGURE 35 Breakaway poles.

crash and yet are less likely to be knocked down by high winds than are traditional wooden poles. Installing breakaway poles at selected locations (in highly vulnerable locations where pole relocation or undergrounding of lines is not feasible) offers much promise as another possible pole treatment (*1*, *3*) (Figure 35).

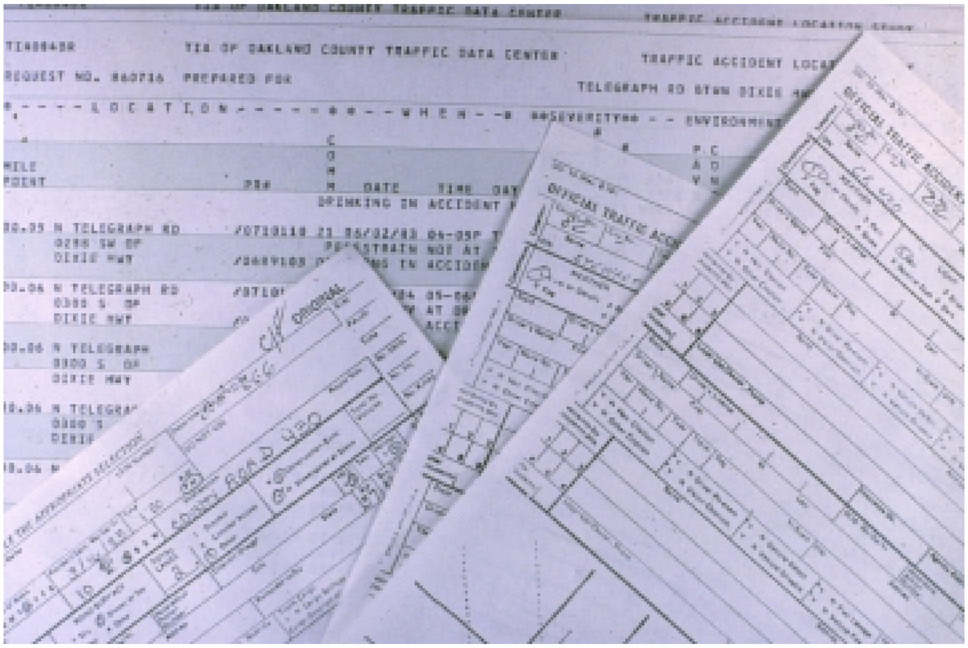

FIGURE 36 Slide of crash reports.

RECOMMENDED STEPS FOR REDUCING UTILITY POLE CRASHES

On the basis of the discussion in this paper, what can utility companies and state and local highway agencies do to reduce utility pole crashes and related injuries and deaths? Consider the following steps as a starting point (Figure 36).

Step 1

Look at the crash history of vehicle collisions with utility poles. See section on Best Offense in Appendix C. Identify the spots and sections with an abnormally high incidence of pole crashes. If you don't already have one, establish a tracking system to keep track of poles that were damaged in motor vehicle collisions. Work with highway agencies to compile copies of crash reports involving utility poles. Each year, the utility company (working with the state or local highway agency) should identify the "dirty dozen" of roadway sites and sections to be improved. If a few of the worst crash sites are identified and improved each year (e.g., with pole relocation or undergrounding, to best fit the problems and conditions of each site and section), the injuries and deaths due to utility pole impacts will drop noticeably after a few short years (Figure 36).

Step 2

Think before replacing a damaged pole. Don't just blindly replace a pole damaged in a motor vehicle impact with another pole without first reviewing the pole location to determine whether it is a high-risk area. The pole may have been struck many times in the past few years (Figure 37).

FIGURE 37 Slide of new pole being installed.

Step 3

Identify the individual utility poles with a high potential to be struck. See section on Best Bet in Appendix C. Be proactive rather than waiting for crashes to occur. Although past crash data can identify high-crash sections, it is not always easy to pinpoint specific poles that are hit, such as poles at high-risk locations. Do a drive-by inventory of utility poles on a regular basis to identify the ones that are

- On the outside of horizontal curves near the roadway edge;
- Within 5 to 10 feet of a busy intersection, particularly intersections that have heavy turning movements or multiple lanes, where vehicles are prone to being struck by an errant vehicle; and
- Placed in the median of a roadway, in a gore area (where a roadway splits into two directions) (*4*) (Figure 38).

Step 4

Develop a plan and relocate such poles to lower-risk locations (Figure 39).

Step 5

Adopt a clear zone policy. See section on Best Defense in Appendix C. Recommended clear zones are given in the AASHTO *Roadside Design Guide*, which can be useful in determining the minimum clear zone width for roadways of various speeds and types. Representative for ADTs of 6,000 or greater are the following (*4*) (Figure 39):

FIGURE 38 Utility pole next to road.

FIGURE 39 Pole near street.

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

Step 6

Establish funding and make improvements. Set aside a reasonable amount of funding each year and conduct pole safety improvements at sites with the highest priority (i.e., sites having the most utility pole crashes and sites with high crash risk). A few utility companies and highway agencies are making efforts to make improvements to reduce utility pole crashes and related injuries. Some are the Washington State Department of Transportation (DOT), the Pennsylvania DOT, Jacksonville Electric Authority, and the city of Huntsville, Alabama (*5*). Each has a unique program to identify and improve sites where there are problems involving utility pole crashes. Most utility companies and many state DOTs, however, have been slow to identify safety problems related to utility pole crashes and to make efforts to reduce the problem.

CONCLUSIONS

Too many people have been seriously injured or killed in collisions with utility poles over the past 50 years in this country. Unfortunately, little has been done to change that trend. It is long past time for utility company officials and state and local DOTs to take action to reduce this problem through a crash reduction program aimed at the most dangerous locations. Making our roads safer through utility improvements will also reap substantial monetary benefits, including

- Utility maintenance and repair costs,
- Utility liability costs,
- Utility legal costs,
- Utility loss-of-service costs, and
- Public health costs from motor vehicle crashes (*1*).

To continue to do nothing is unacceptable. Taking the first step requires courage and a desire to make a positive change for the people we are committed to serve. I hope that we will choose to accept this challenge.

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Click here to see Zegeer's slide presentation.

Engineering for Action

JOHN F. CARNEY III
Worcester Polytechnic Institute

DON L. IVEY
Texas Transportation Institute, Texas A&M University

John F. Carney: When I was first contacted by the Utility Safety Task Group (USTG) and asked to make a talk on this subject, my first thought was, "why?" Everyone knows you don't use crash cushions or concrete barriers or guardrails to protect the public from utility poles. My second thought was a repeat of the first—"why?" Now, however, the "why" meant "why not?"

Perhaps the answer is, "We have never done that before"—the most common and least reasonable answer the protectors of the status quo have used throughout the history of mankind.

After talking at some length to the spokesman for USTG, Don Ivey, it became clear that, as the chairman of the Committee on Roadside Safety Features (A2A04), I was in a good position to show what the work of that committee could contribute to the Committee on Utilities (A2A07), the parent committee of USTG.

For more than 40 years, highway engineers have worked through the TRB in presenting and publishing developments in roadside safety. These developments have included many types of crash cushions, concrete barriers and guardrails, including crashworthy end treatments. They protect the public throughout the nation every day from all kinds of rigid obstacles and nontraversable hazards. Well, not quite all kinds. They have rarely, and in some states never, been applied to utility poles within clear zones on our nation's highways.

Why this is the case will be dealt with in some detail by other speakers. The objective my coauthor and I have is to demonstrate the remarkable safety characteristics of crash cushions, concrete barriers, guardrails, and steel-reinforced safety poles—structures clearly applicable to solving safety problems associated with utility poles placed in areas subject to atypical vehicle movements.

Since my prior commitments make presentation of this speech impossible, at this stage it will be turned over to Don Ivey. You might note when you reach Don's answer phone the message is, "You have reached the phone and fax of Don Ivey. Proceed at your own risk." With that clearly in mind, we now allow Don to proceed.

Don L. Ivey: Galileo has always been my favorite engineer. When Galileo wanted to accomplish an objective, he designed and constructed the necessary equipment, or equipage, as Galileo used to say. Because of my interest in Galileo, I was recently given an accurate replica of the telescope Galileo built in 1609, with which he demonstrated the relationship of the earth and other planets to the sun. On January 1, 2000, at 12:01 a.m., I ventured away from the disgusting hedonistic, bacchanalian activities that many

Americans are so fond of, to view the stars through Galileo's telescope. I searched for a good spot to view the sky, and there it was. The only place where the trees gave a clear view of the sky was filled with Orion, a constellation of seven stars with four at Orion's extremities and three at his belt. You will all recall how Orion, the son of Neptune, was placed in the sky by Cynthia (or Diana).

I knew this was a very elitist way to welcome the new year. I only did it because I was thinking, "Now what would Mo Bronstad be doing tonight?"

Suddenly it happened. The story of Orion is amazingly similar to the story of utility roadside safety, give or take a few names and a few millennia.

Here is that story with minor alterations.

- The utility industry is a giant and a hunter. It is a giant in the service it provides to mankind. It is a hunter in the way it participates in the injury or death of those who are reckless, uncautious, unwary, or simply unlucky.
- It is the son of that great god of power, terrible-tempered Thomas A. Edison. (An unimpeachable source tells us A stood for Apollo.)
- The utility industry has for many years been blinded by the god Oenopion or "Their Own Opinion."
- The utility industry will become the favorite success story of those Greek gods committed to highway safety.
- The utility industry will be placed among the stars of highway safety for its contributions.

With that prediction in mind you may ask, "Are we in a position to help the utility industry achieve such recognition?" That is precisely the question we in TRB A2A04 and the USTG of A2A07 are answering this afternoon.

Here is A2A04's contribution to the goals of A2A07. These two committees are dedicated to reducing the toll of utility pole collisions. A2A07 has the plan and A2A04 has the tools.

It is observed, "Only God can make a tree," but only a utility can take a tree and put it anywhere they want. Unfortunately, in many cases, where utilities would like to have their highly functional trees is not a safe place for highway travelers, presenting a serious problem to those striving for roadside safety.

There are some environmentally excellent uses for poles. One of our field investigations found an Osprey nest with six chicks on top of a pole in Florida and not one developed cancer. Of course Osprey chicks may not be as imaginative as *Homo erectus*.

Obviously, poles are essential to our lifestyle. Electricity has made an unparalleled contribution to our way of life. A small number of these poles, however, seem to be designed for our death and collisions with these poles are also costly relative to utility maintenance and dependability. Incasing poles in concrete sleeves, like some we observed in Texas and Louisiana, will of course solve the maintenance problem but will create a monstrous liability problem.

When a car slides into a pole sideways is the most critical collision. In some cases the car has been cut completely in two. There are some options other than removing the pole. Some cost as little as $1,000 compared to a collision which costs some utilities an average of $7,000 to repair.

There are a number of safety treatments for poles that can't be moved. They are

- Guardrails,
- Crash cushions,
- Concrete barriers, and
- Steel reinforced safety poles (SRSPs).

Guardrail systems are the most commonly used barrier. Modern rail end treatments can even be effective during side on hit collisions. The easiest to install, however, are simple concrete barriers that require no site preparation. Crash cushions have been widely used for protection from other hazardous objects and SRSPs are in use in four states with good success.

First, consider crash cushions. Some of the more elaborate can be placed in front of a utility pole for about $5,000. A simple impact with a pole could cost society $1 million to $2 million and sometimes that cost is transferred to the utility.

Concrete barriers can be placed for about $25 per linear ft or about $1,000 for the 40 ft needed to isolate a utility pole. The low profile barriers are widely used in construction zones. They were designed to increase visibility and do the job of redirecting a vehicle.

Often guardrail systems, no more than 40 ft in length, are used on U.S. highways, protecting the public from poles used for signing.

Perhaps, the oldest crash cushion, John Fitch's brainchild, is composed of sand-filled barrels. They are easily placed in front of an obstacle and can be designed for any speed. The number of these barrels needed for 45 mph zones is usually only seven and may cost in total only $1,500. They perform well and can be cleaned up and replaced quickly after a collision.

SRSPs were originally developed at the request of FHWA. Installations of the federal highway model SRSPs are found in three states: Massachusetts, Virginia and Kentucky. A different model, AD-IV, is in use in Texas. Some utilities have been surprised at the results of collisions and the way an SRSP performs for traditional loads. It is soft for cars but tough for wind loads and ice loads. That's why it is called the Steel Reinforced Safety Pole—in recognition of the fact that it increases the overall stability of the system by about 250 percent. A number of cases have occurred where regular unmodified poles have blown down while SRSPs just keep bearing the load.

In the first collision with an SRSP in Massachusetts, the driver, apparently unharmed, departed swiftly for Mexico and has not been seen again. Several of our task group members have volunteered to fly to Acapulco to interview him but our upper administration has proven somewhat humorless on this subject.

For whatever reason, these solutions to hazardous pole placement have been sorely neglected.

The low-priced and highly effective crash cushions, rail systems, and safety poles are ready for implementation. Dwight Horne, the new head of FHWA safety activities, has illustrated the precedents for that action. Charles Zegeer, the expert on accident data analysis, has shown how to prioritize that action. Later this afternoon four speakers from four different states will demonstrate the great advantages of the initiatives that are under way. Now we are privileged to hear from Jarvis Michie, a pioneer in the field of highway safety, who will convince us we truly have a "mandate for action."

Professionalism
The Mandate for Action

JARVIS D. MICHIE
JDM Consulting Engineer

As described by previous presenters, each year more than 1,100 American motorists are killed and another 40,000 are injured when the vehicles they occupy leave the traveled way and collide with a timber utility pole. Collectively, the 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 or media-documented events such as the TWA Flight 800 crash. The roadside utility pole hazard is not new but has been identified by AASHTO since the mid-1960s, a period of more than 30 years. Technology to alleviate the hazard has also been available for more than 25 years, although the array of remedial treatments has been increased to include techniques such as those described in a previous presentation. An extreme example of effectiveness of the technology is the lack of utility pole collisions on the Interstate, where pole placements are not permitted. Also, as previously discussed, technology to address the utility pole problem can be economically affordable and cost beneficial.

One has to question why we have not solved this continuing tragedy. It is my judgment that the prime enemy is a deeply embedded institutionalism that thwarts any effective solution.

HISTORY

Before delving into what I call institutionalism, it may be 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 to be more "forgiving" of motorists' mistakes. Thus, for the first time, the national standard of care was that protection be required for the motoring public within practical limits regardless of circumstances causing the event. Thereafter, highway engineers, using industrial safety principles, designed for drivers who were not always perfect but were human and could err.

Before 1966, highway agencies designed and maintained roads 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 should also not be surprising that most utility accommodation polices of that era were extremely flexible with regard to locating utility poles within the road right-of-way, resulting in many poles being located within a few feet of the traveled way. The safety of motorists who inadvertently encroached on the roadside was not a major concern of highway agencies and was even a lesser concern of utility companies.

After 1966 highway agencies began incorporating the "forgiving roadside" concept into new and existing highways by removing or converting fixed objects to breakaway 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 percent 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 utility poles. Since then, highway agencies have done a reasonably good job in treating roadside hazards *that were owned or designed by the highway agencies*.

Unfortunately, most utility poles located near highways are owned by utility companies and were placed under lax or nonexistent 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 not their concern and that the poles were legally placed in accord with existing accommodation procedures.

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 that sometimes undermine accountability and responsibility for the health, safety, and welfare of the public. I attribute this lack of accountability of public safety to institutionalism.

TIME FOR CHANGE

Just a summary review of historical vehicle-pole collisions reveals a very gradual downward trend in utility pole collisions, which may reflect pole relocation accompanying major highway reconstruction. Nevertheless, the preventable 1,100 utility pole fatalities yearly is a national tragedy that calls for a change in strategy from the failed, anemic approach of the past in which we have only been "nibbling at the margins" of the problem. We need to address the utility pole problem aggressively at the root cause—the lack of accountability.

I believe that professional engineers from both highway agencies and utility companies, working cooperatively, can overcome the institutionalism that pervades and undermines the achievement of an effective solution. I believe this because 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 1,000 fatalities and 50,000 injuries sustained annually in utility pole collisions.

RECOMMENDED ACTION

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

First, technical information presented in guidelines, policies, and standards should be harmonized so that everyone is on the same page. It may be appropriate to have all the documents refer to a single source such as the AASHTO *Roadside Design Guide*. In particular, standards based on the mythical vehicle redirectional capability of curbs should be removed.

Second, permit and easement models should be updated to the post-1966 era. A licensed professional engineer's approval should be required for specific pole location sites in accord with the forgiving roadside concept. Funding mechanisms should be established to relocate utility poles that become hazardous because of changing traffic patterns.

Third, a plan of action as outlined in a prior presentation should be developed for treating existing utility poles in hazardous locations. As a first step, teams composed of both highway and utility company staff should conduct surveys and identify problem poles. The identification should be based on both prior collision data and nonconformance to *Roadside Design Guide* criteria. Certainly it should not be necessary for a fatal collision to occur before a pole is relocated. A second step should be to prioritize the identified poles according to degree of hazard to the public. And the third step is to establish both short-term and long-term programs to treat the problem poles.

SOME GOOD NEWS

Against this backdrop of a continuing national tragedy, there is a glimmer of light. A growing number of progressive highway agencies have taken steps to attack the utility pole hazard. In the next session, exemplary programs begun in Florida, Georgia, Alabama, and Washington will be described by their leaders. Progressive steps have also been taken toward utility pole safety in Kentucky, Massachusetts, Texas, and Virginia. The import of these early initiatives is that practical and affordable solutions have been demonstrated to work. There is no known reason why these successful approaches would not be readily applicable to other locations.

SUMMARY

In summary, the annual carnage resulting from vehicle-utility pole collisions is a national tragedy that can be practically eliminated. As illustrated previously, roadside safety technology is available and has been available for many years to treat the problem effectively. However, application of this technology has been thwarted because of deeply ingrained institutionalism that has obscured ownership and accountability of the problem. On the basis of gross fatality and injury numbers, the previous approaches to solving the problem have produced anemic results and should be deemed failures. It is time for a change, a major change.

To lead this mandate for change, I believe that professional engineers from both highway and utility organizations can and should be the principal driving force to overcome this institutionalism because of their common ethical and moral responsibility of holding paramount the health, safety, and welfare of the public.

Georgia's Initiative

GEORGENE M. GEARY
Georgia Department of Transportation

First I need to mention that Georgia is proud to have been recognized by FHWA in its Biennial Safety Awards. The Georgia Department of Transportation (GDOT)/ Georgia Utilities Coordinating Council (GUCC) Clear Roadside Program, which I will briefly cover, was awarded the 1998 Best Overall Operational Improvement Safety Award.

Here is a picture of Dudley Ellis receiving the award in Boston last year (Figure 1). Many of you in the utilities arena know Dudley. He is sorry he was not able to attend TRB's conference this year, but I'm sure he will be looking forward to seeing you at the AASHTO ROW/Utilities Conference in Savannah, Georgia, May 7–11, 2000.

The GUCC, through its more than 35 chapters in seven regions in Georgia, provides an overall cooperative effort to exchange information and resolve conflicts in the utility and public works sector.

GUCC also has standing and ad hoc committees, one of which is the Clear Roadside Committee (CRC) (Figure 2). CRC is composed of members of the electrical, telecommunications, and cable TV industries, including local government and GDOT.

CRC investigated the utility pole problem in Georgia by reviewing existing research literature, examining data, and visiting crash sites. It recognized that many of the locations where numerous crashes were occurring involved utility poles that were on curbed roadways. Because of this, CRC identified clear zone recommendations for curbed sections and developed a collaborative effort to remove utility obstructions from Georgia's roadways in an attempt to improve the overall safety of the roadways.

FIGURE 1 Dudley Ellis receives the 1998 Best Overall Operational Improvement Safety Award from FHWA.

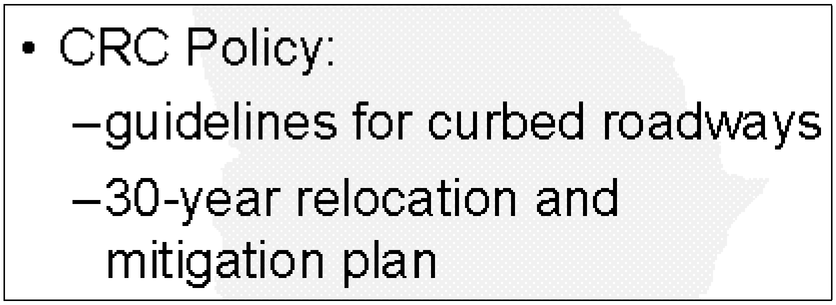

FIGURE 2 CRC policy.

The current version of the *Roadside Design Guide* continues to treat curbed roadways ambiguously (Figure 3). One of the conclusions of CRC was the recommended pole locations noted: 12 ft desirable, 6 ft minimum at speeds of 35 mph or less, and 8 ft minimum for speeds over 35 mph. In accordance with the clear zone guidelines for noncurbed roadways, the recommended distance is adjusted for the speed limit.

One of the problems in enforcing these guidelines is the historical pressure to limit right-of-way to the bare minimum, especially in urban sections, to cut costs for the department of transportation. “Less right-of-way = more asphalt” was a popular mantra. This lack of sufficient right-of-way hindered the utilities’ efforts and also our own traffic signal crews. Either because of a lack of coordination or the addition of a signalized intersection late in the process, many times we did not have enough right-of-way to place our own signal poles according to the CRC guidelines.

The current economy and the recent change in apportionment, which has increased funds to Georgia, is probably one of the best safety enhancements we have had in a while. Couple that with our board’s adoption of a recommendation to include sidewalks in all projects for urban areas, and we are really starting to see the design offices be able to use these guidelines.

The relocation aspect is the part of this program that is really exciting (Figure 4). By identifying critical areas in the state and concentrating on improving the safety of the roadways, CRC believed it could really make a difference.

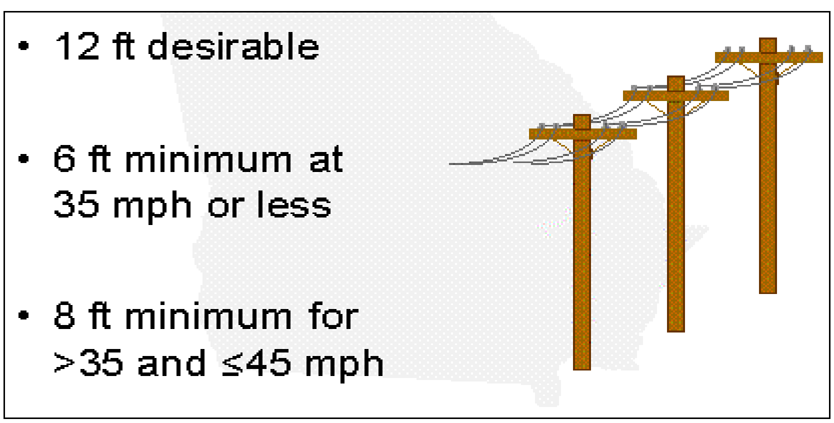

FIGURE 3 Curbed roadways.

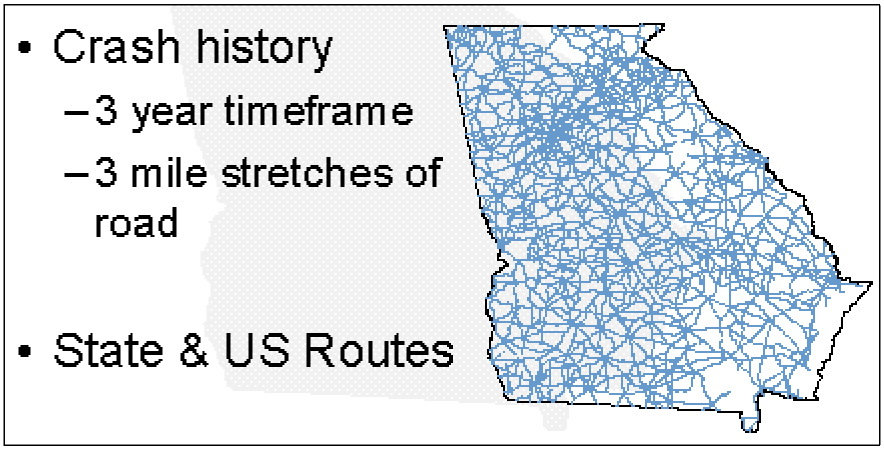

FIGURE 4 Relocation Plan.

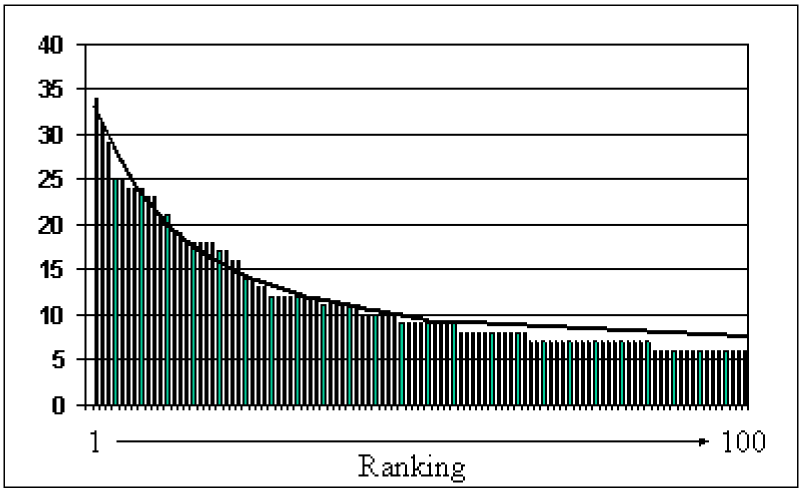

FIGURE 5 Number of crashes—top 100 sites.

By consensus the group recognized state and U.S. routes as the most critical. A report providing a 3-year time frame for crashes involving utility poles based on 3-mile stretches of road was prepared by the Traffic Operations section of GDOT. These routes were prioritized by total number of crashes, not just fatal crashes. Total crashes and total injuries were looked at, along with feasibility, to prioritize the relocation efforts (Figures 5 and 6). In essence, CRC was trying to get the most bang for its buck.

Not surprisingly, the majority of the locations identi fied in this manner were in metropolitan areas. The top 10 sites ranked this way were all located in Fulton County, which is the heart of the metropolitan Atlanta area.

The CRC policy is based on a give-and-take premise (Figure 7). The utilities voluntarily move a certain number of poles each year to a safer location, and GDOT allows variances to a previously strict policy of not allowing pole attachments to any pole deemed within the clear zone.

The number of poles to be moved is estimated as the number of existing poles that need to be mitigated over a 30-year period. The intent is to clear the more crash-susceptible areas first while still having a plan to clear all state routes within 30 years. This is a win-win-win situation for the utilities, GDOT, and the traveling public. The

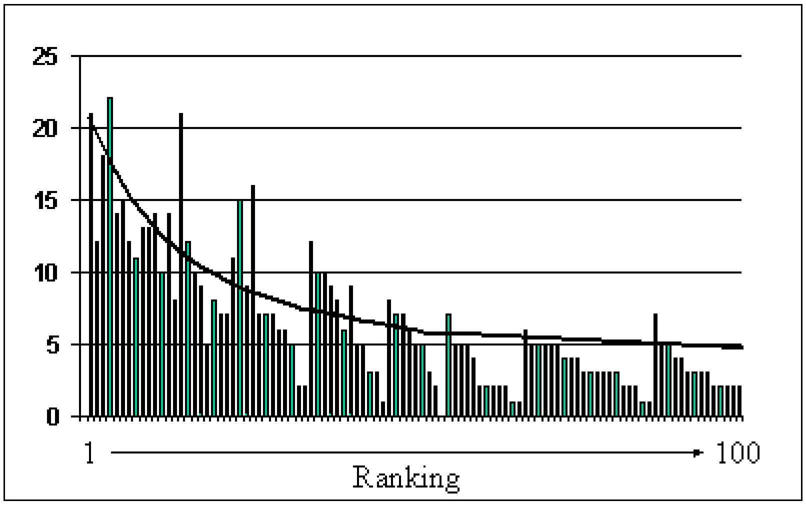

FIGURE 6 Number of injuries—top 100 sites.

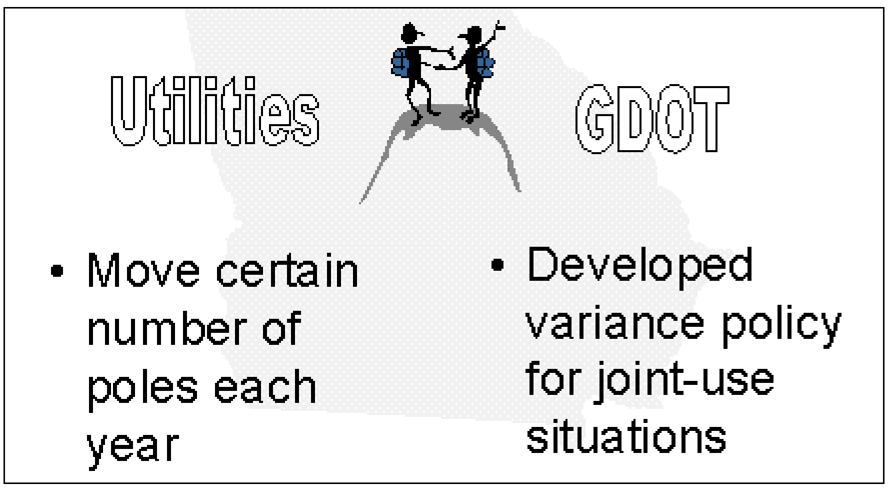

FIGURE 7 Give and take.

high-crash locations are mitigated first, to improve the safety to the traveling public. The utilities get to mitigate the areas that are having the most costs for maintenance due to damage, and GDOT gets joint-pole usage. (The downside of the old policy was that utilities would seek alternative locations for their pole line to provide service if they could not go joint-use with a company because their poles did not meet the criteria. GDOT does not permit all roads in Georgia, so this often meant more poles on the roadway.)

This is a geographic information system depiction of 18 of the 20 sites with the most utility pole crashes (Figure 8). Two of the 20 sites are outside the metropolitan Atlanta area and are not shown here. The roadways coded in orange have the most crashes, up to 34 crashes in 3 years; the ones coded in yellow have from 0 to 17; those coded in red have between 17 and 34. The average is 21 crashes, or an average of 7 crashes per year, per 3-mile stretch of road.

Northside Drive is shown by the arrow with a 1. It is a roadway in Atlanta that is not on this “top 20” list now but was some years back. This is identified as having an

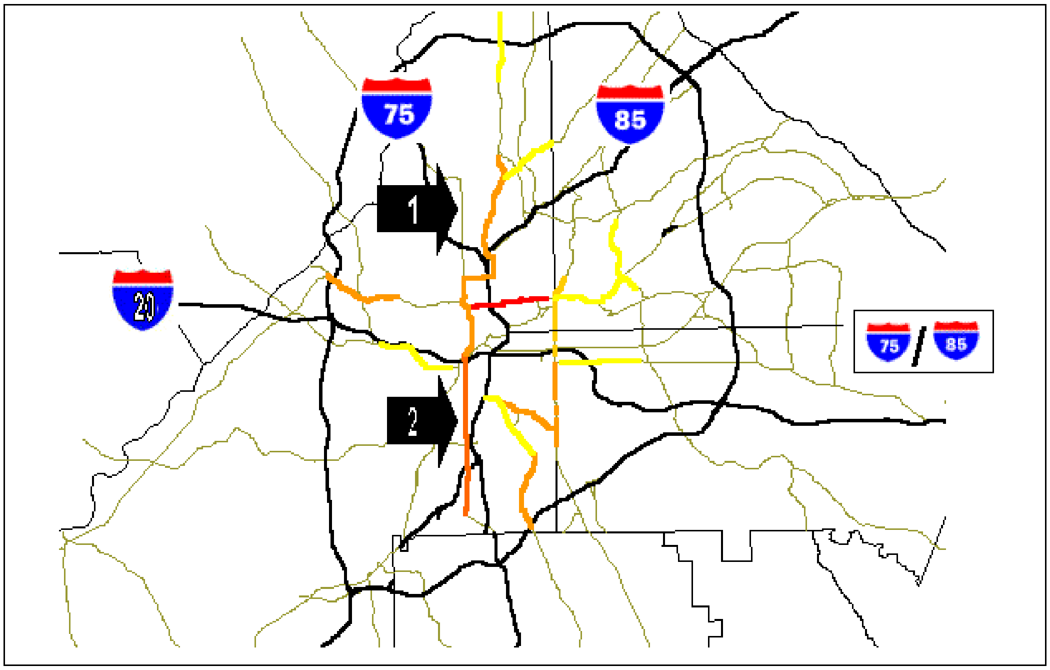

FIGURE 8 Sections with most utility pole crashes, 1995–1997 data.

accident problem and is one of the success stories for CRC. You can see that this is mainly a straight roadway in a horizontal sense. It is located north of I-75 in the northwest area of Atlanta, within the I-285 perimeter.

The next section, which is south of Atlanta or the southern portion of Atlanta, is one that is being worked on right now, and as you can see it is along a very long section of 9 miles. It is composed of three continuous 3-mile sections. Those three sections are three of the top six crash sites in the whole state. You can really identify a problem by looking at crashes this way. There were more than 84 crashes in that 9-mile section in a 3-year period. I think 40-some injuries related to that. One interesting thing—there were no fatalities along that section. Sometimes you hear opinions on whether it is better to look at fatalities or overall crashes in determining safety needs, and it becomes a balancing act. I think it is best to look at both fatalities and overall crashes.

This is Northside Drive (Figure 9). It's a straight section of roadway. Here is Northside Drive today. Northside Drive is also State Route 3. It was identified in the 1930s to be one of the original state routes. Poles were probably right there on the curb line from the beginning. As part of the CRC effort, the poles were moved back away from the curb line. They are hard to see because they are brown, but they are actually concrete poles. In an ironic twist, an environmental group, the Northside Alliance Action Group, protested the utilities' moving these poles because (*a*) they didn't want the additional trimming and (*b*) since it was joint use they were going to have to put in taller poles. The action group got together to fight this because they didn't want this "environmental damage" in Atlanta. Georgia Power and GDOT worked together with the local groups, and this was the compromise. They used brown concrete in construction of the poles to blend in with the surroundings.

FIGURE 9 Northside Drive.

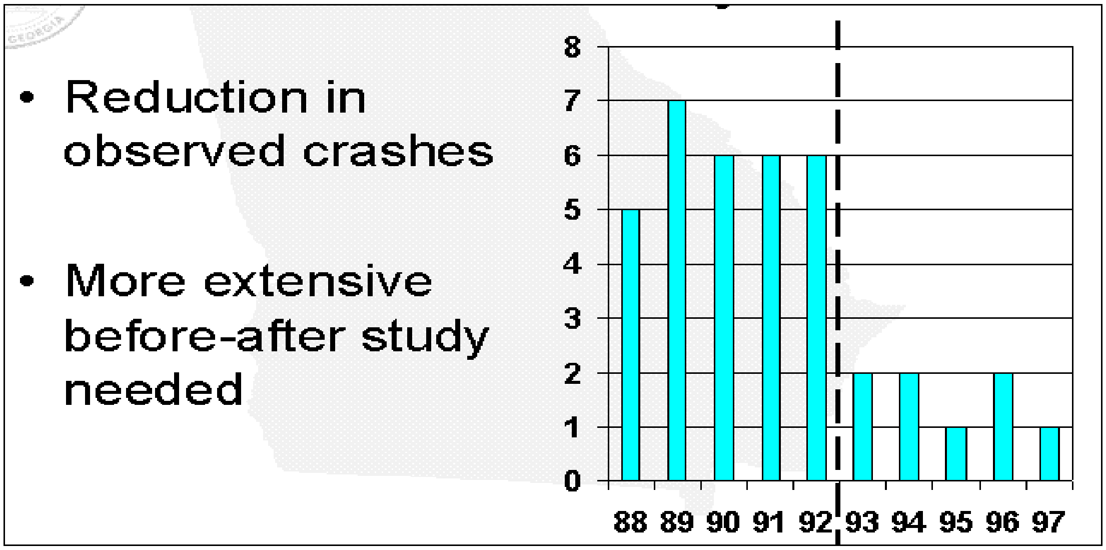

FIGURE 10 Crash history.

The graph shows the number of crashes per year for a 3-mile section of Northside Drive (Figure 10). The dotted line indicates the time frame when the poles were relocated. An obvious reduction in the number of crashes was observed over a relatively long time period. This is just the counts of crashes in this location—the 3-mile section of roadway. This site experienced an average of six crashes per year before the poles were moved and fewer than two crashes per year afterwards. It would be nice to have a more extensive before-and-after study done on this. We looked at crash rates also (Figure 11). There was an average of 0.8 crashes per 10^8 AADT (annual average daily traffic, or average volume) before the poles were moved, and the number is down to 0.2 in the "after" time period. There is an observed reduction in crash rate and actual crashes.

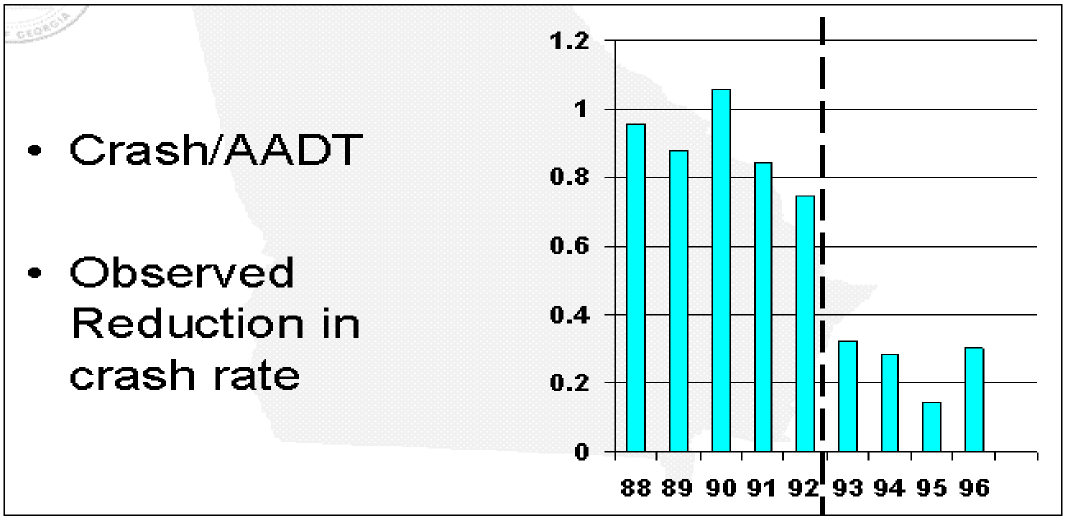

FIGURE 11 Crash rates.

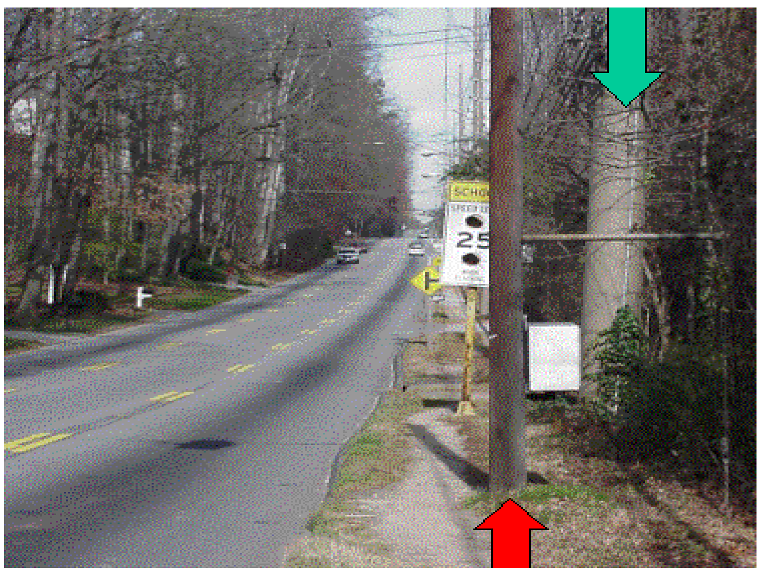

FIGURE 12 Northside Drive.

It had been mentioned earlier that sometimes we are our own worst enemy at the DOT. The green area in the back of this slide is one of those poles on Northside Drive (Figure 12). I had to stop and take this picture as I was driving by it. That is a traffic operations pole holding up the sign for the reversible lane in the center. It was closer to the roadway when there was a pole that could have been used joint-use to put that sign on. I think one thing that's important is this: the committee originally had a traffic operations person at DOT involved, and you need to keep those people involved. The traffic operations side sometimes forgets what the utility side is doing.

The next location is called Stewart Avenue (Figure 13). Recently the name has been changed to Metropolitan Parkway. This area has a lot of nightclubs and dance clubs and that type of thing. It makes it a really interesting case because statistically it is the most proportioned of those groups that get involved in utility pole accidents (drunks and young

FIGURE 13 Stewart Avenue/Metropolitan Parkway.

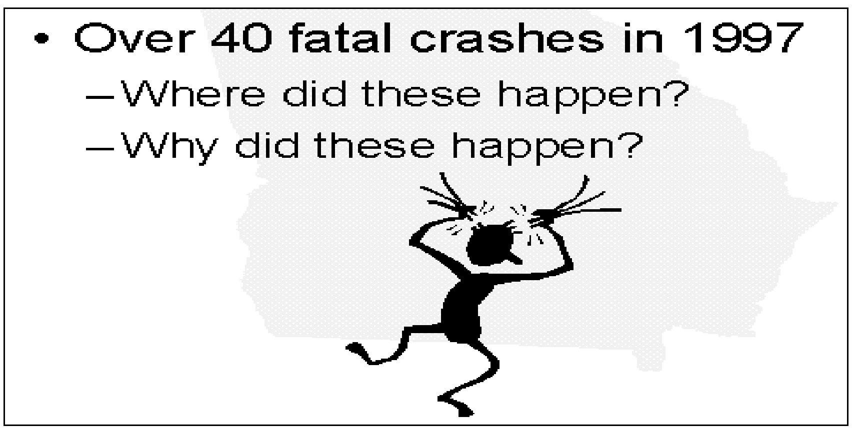

FIGURE 14 Number of fatal accidents involving utility poles.

men). These are the poles that are existing right there on the curb line, a typical old state route look, and we have the new poles on this side down the sidewalk. They have gone joint use, and if the cable company would just get its act together and remove the old pole line, we will have a clean roadway through there. I was hoping that it would be done and I could get a clean picture. Sometimes if you're almost there it's not as good. You have to get all the way there. Hopefully, we'll have a success story a few years down the road.

Last year at our meeting Don Ivey brought to our attention how many fatal accidents were happening with utility poles. People on the committee really hit on this. There were 40 fatal crashes in Georgia in 1997, and more than 40 people died (Figure 14). That is something you can really feel. Why did this happen? Where did it happen? What can be done about it? These are questions that were asked. What was put together in conjunction with Karen Dixon from Georgia Tech, Georgia Power, and Georgia DOT was a fatal crash review (Figure 15). We looked at those crashes closely to determine what was happening. We determined where the poles were located and tried to estimate the influencing factors involved, the most important factor being what can be done about it. Can these factors be changed?

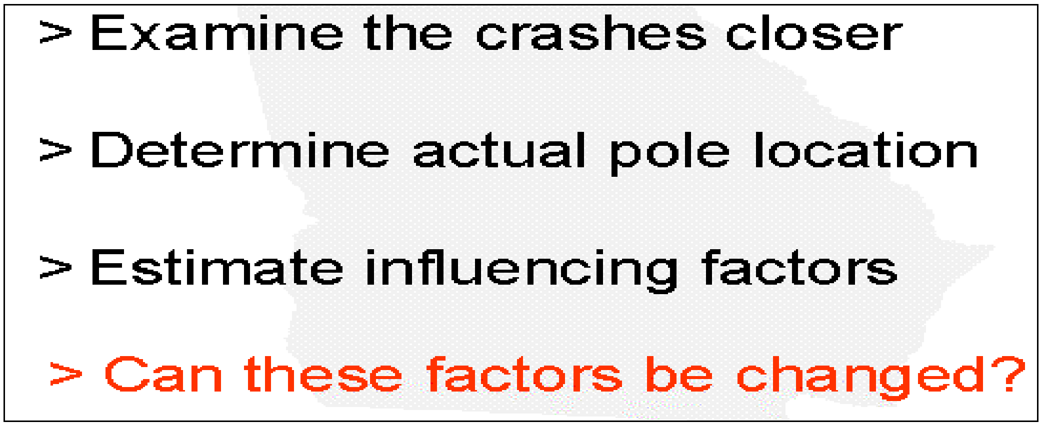

FIGURE 15 Fatal crash review.

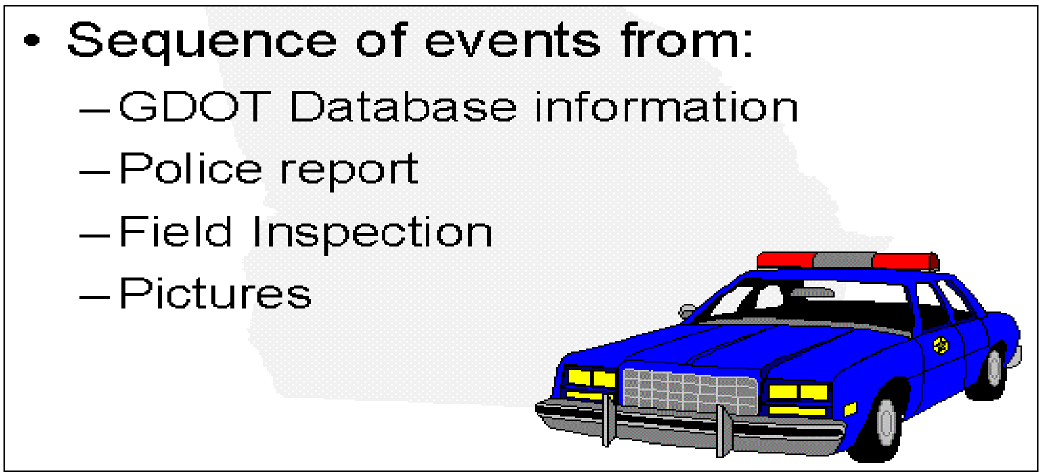

FIGURE 16 43 fatal crashes in 1997.

There were actually 43 fatal crashes in 1997 (Figure 16). For each of these crashes, we put together a sequence of events by using information from the database that GDOT had that was based on public safety information and GDOT roadway information, plus police reports, field inspections, and actual locations of the poles and pictures from all the sites.

This chart is just to give you an idea of the data (Figure 17). I mentioned earlier that alcohol and male drivers are heavily involved in utility pole crashes. In this study we found that alcohol was involved in 53 percent of these crashes. Adding cases where the information was not reported could potentially put the figure at 84 percent. It was interesting that out of the 43 cases, 13 were undetermined as to whether alcohol was involved. A year or two previously, Georgia passed a law that for every fatal crash, drivers had to be tested. It was said that we did not have that information, but potentially those could have been under the influence. In addition, 78 percent of the crashes involved occupants who were not wearing seat belts, and 76 percent of the crashes involved male drivers.

This is a typical utility pole crash (Figure 18). You have young male drivers, alcohol/drug involvement, lack of seat belt use, and lower-speed roads in metropolitan areas. An intense study was done in 1997, and we are just starting on 1998.

Data	Percentage (%)
Alcohol Involved (*potentially)	53 (*84)
No Seatbelt	78
Male Driver	76

FIGURE 17 Utility pole fatal crashes.

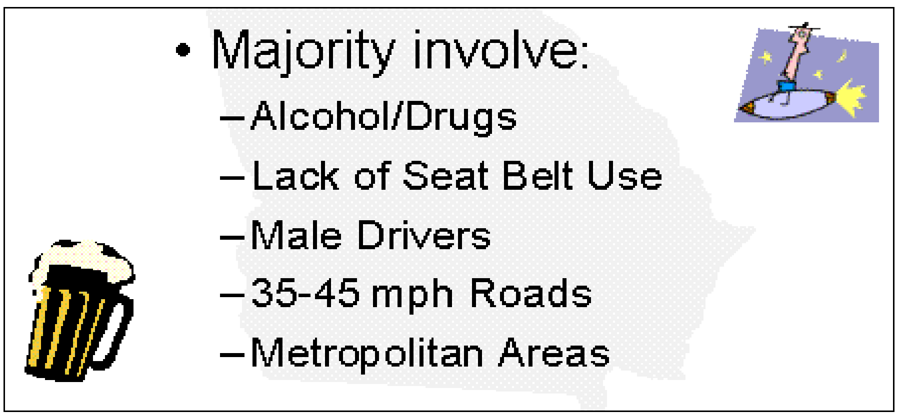

FIGURE 18 Typical utility pole crash.

In a comparison of the pole locations for fatal crashes on curbed and noncurbed roadways, most of the poles involved in curbed sections were located further than the traditional 2.5 feet distance, but only a quarter met the CRC recommended values for the speed limit (Figure 19). This 25 percent is somewhat comparable with the 33 percent of noncurbed roadways involving fatal crashes that did meet AASHTO *Roadside Design Guide* criteria.

One interesting thing in the 1997 study was crossover crashes (Figure 20). A benefit of looking at the crash sites in a microscopic manner was the ability to determine how far a vehicle actually traveled out of its lane to hit a pole. In a crossover crash, a vehicle crosses over a lane of traffic and hits a pole on the other side of the road. In a 1978 FHWA study, 35 percent were actually crossover crashes. Almost 50 percent of the crashes in Georgia involved a vehicle traveling over the opposing lane of traffic before leaving the roadway and striking a pole. I would not have thought there were so many. More research needs to be done to determine whether this is an anomaly for Georgia in 1997 or utility pole crashes that result in fatalities have a higher percentage of crossover incidents.

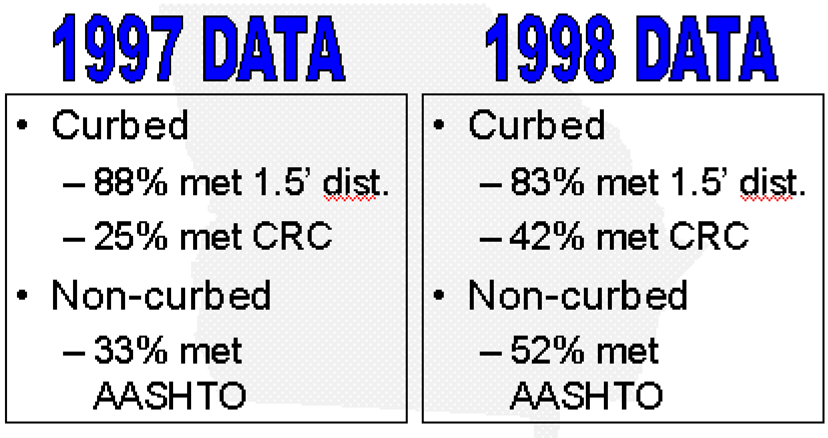

FIGURE 19 Pole location comparisons.

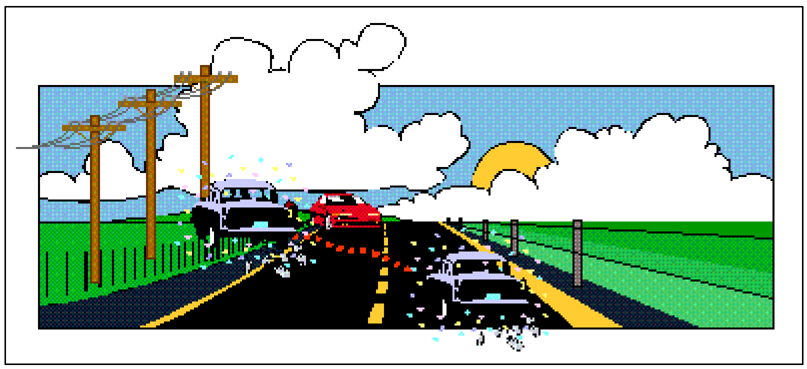

FIGURE 20 Crossover crashes.

This could have been a head-on collision instead of a utility pole crash. In earlier talk about some of the initiatives for safety, run-off-road and head-on collisions were two of the six that were listed.

Question: What can you conclude about pole placement due to the high injury in crossover crashes?

Pole placement may be an issue, but there are other factors. Seat belt use and alcohol/drug use (primarily alcohol use) are also issues. It may behoove the utility industry to get involved with public announcements, public awareness. Locate and make an effort to educate drivers in the use of restraints and avoiding alcohol when driving. This may reduce the utility pole maintenance costs in the end.

I'll explain a little of how we came up with the clear zone data on crossover traffic Figure 21). If you crossed over a lane of traffic we added 12 feet to where the pole was, and if you crossed over two lanes of traffic you are actually 24 feet away from where the pole was. If you look at the clear zone requirements with that kind of idea in the curbed areas you have 50 percent of crashes that meet the 6-foot or 8-foot requirement because the vehicle actually crossed over a lane. Also in the noncurbed area you have 60 percent meeting the requirements because they actually went further than the AASHTO *Roadside Design Guide* recommends because of the crossover. The 1998 data are even more interesting because 50 percent met the CRC requirements, but they have about 80 percent that met the AASHTO requirements. To me that does cry out that people are driving

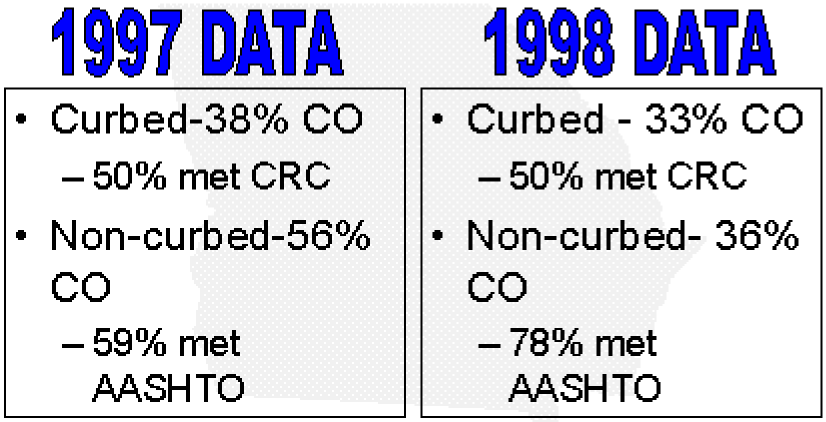

FIGURE 21 Pole location comparisons.

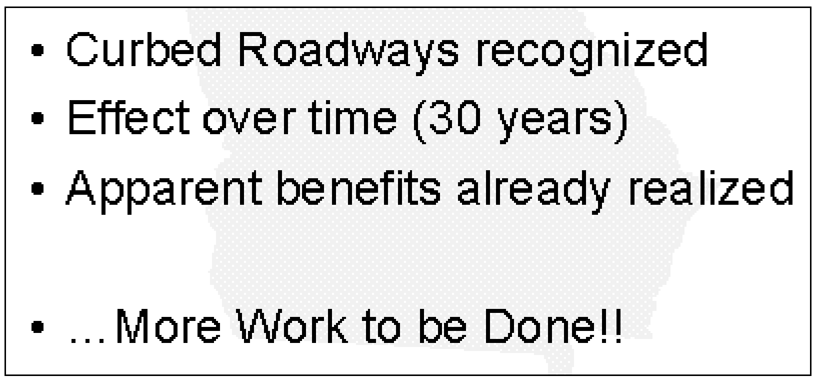

FIGURE 22 Conclusion: Georgia experience.

farther laterally than the actual guidelines. We're trying to cover at least 80 percent of the drivers with our guidelines, but it looks like we are only getting 22 percent. Maybe we

need to put more effort into other things we can do. Some of it is political. Our governor recently proposed raising the driving age to 17 because there are so many young kids getting killed in accidents, and it may be a policy that we need to get behind and say this is good. It's good for safety and the utility industry also.

To conclude the Georgia experience, we recognize the need to have a clear-space policy for curbed roadways (Figure 22). I think that is important, and it was mentioned in the earlier session that the idea that curbs can be treated as nontraversable is just not true anymore. It was also recognized that the mistakes of the past could not be changed overnight, but with a plan and a goal in mind there would be an immense effect over time.

In looking at one successful project the benefits appear to be realized. It looks like a success story for Northside Drive, and I hope to see the same things in the Metropolitan Parkway section, but there is more to be done. It would also be prudent to conduct some extensive before-after studies that take into account traffic, the overall decline in DUI, and other related factors for these types of sites.

Click here to see Geary's complete slide presentation.

Huntsville's Initiative

JAY K. LINDLY
Department of Civil Engineering, University of Alabama

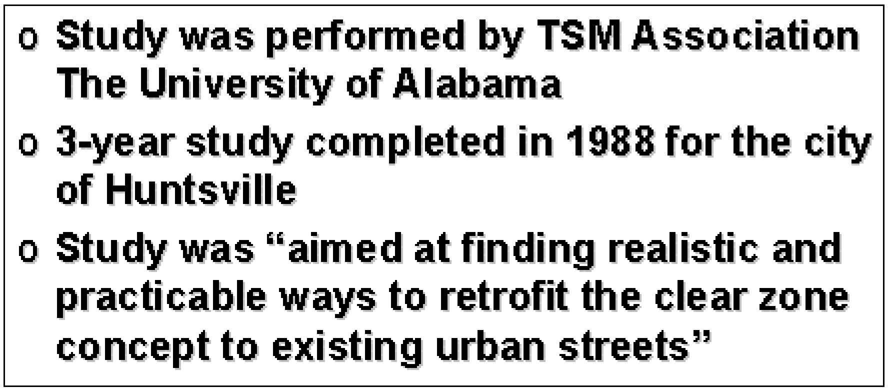

FIGURE 1 Study information.

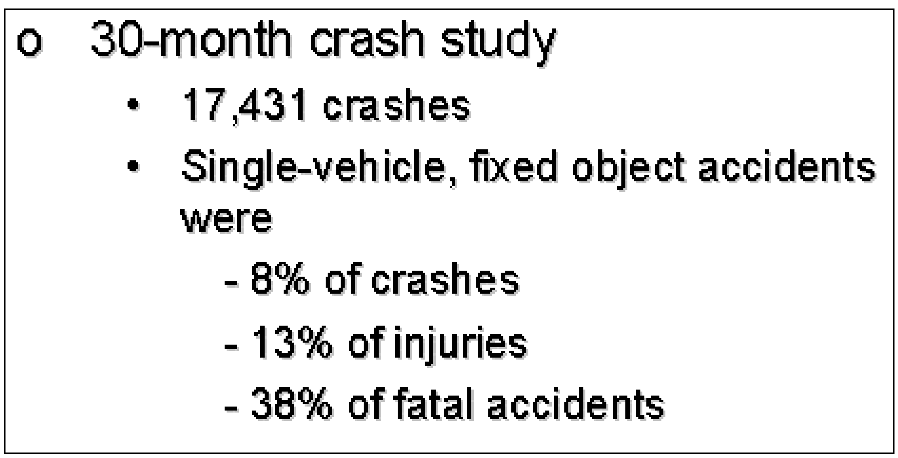

FIGURE 2 Background.

o Mailboxes	94
o Trees	177
o Poles	458
o Barriers	516
	1,254

- Drainage devices
- Barrier rails
- Etc.

FIGURE 3 Roadside obstacles were broken into four categories.

o Distance from travel lane

o Was it on a curve or hill?

o What side of road?

FIGURE 4 What field data to collect?

o Visited 538 Sites (Multiple Crash Sites)

o Successfully Investigated

- 85% of Barriers
- 80% of Poles
- 50% of Trees
- 20% of Mailboxes

FIGURE 5 Procedure.

- o Engineer, arborist, garden clubs, press
- o 59% of crashes on curves, but only 5%-10% of roadway is curved
- o Tree crashes took place further from the road (50% >25’away)
- o Recommendations for future trees
  - Plant trees that mature at $\leq$ 4” diameter
  - Clear zone of 25’ for $\leq$ 50 mph speed limit
  - No trees in medians < 60’wide for 50 mph

FIGURE 6 Trees.

- o Recommendations for existing trees
  - Inspect once a year for dead limbs or trees
  - Remove trees at high-priority locations ($\geq$ 2 crashes per year)
  - Send tree accident reports to city arborist

FIGURE 7 Trees.

- o 90% of investigated pole accidents occur within 10’ of pavement
- o Recommendations for new poles
  - Poles minimum of 2' behind curb with parking and 6' if no parking
  - Poles minimum of 20' from travel lane if speed limit <50 mph
- o Recommendations for existing poles
  - Concentrate on high-priority locations

FIGURE 8 Poles.

- 75 percent of crashes within 2' of road
- Less severe than other crashes
- Recommendations for new mailboxes
  - Adopt AASHTO's "A Guide for Erecting Mailboxes"
  - Raise awareness; work with contractors
- Recommendation for existing Mailboxes
  - Request/require homeowners at identified locations (>30 mph on curves) to modify mailboxes

FIGURE 9 Mailboxes.

- Fatality rate was double [3%]
- Half of crashes on arterials/freeways
- 75% within 5' of roadway
- Future installation: Use Roadside Design Guide
- Existing installations: Prioritize sites, concentrating on retaining walls and bridge rails

FIGURE 10 Barriers.

City population: 130,000

Project cost: University of Alabama charged $10,000 (but faculty time of Dr. Dan Turner was donated)

Implementation results: Results have not been publicized

FIGURE 11 Results.

Click here to see Lindly's slide presentation.

Washington's Initiative

RICHARD L. ANDERSON
Washington State Department of Transportation

Shared Roadside—Shared Responsibility is the foundation for Washington State's Roadside Utility Safety Program.

The Control Zone Guidelines were cooperatively developed by the Aerial Utility Advisory Committee in 1989. This committee consisted of statewide utility and department of transportation (DOT) representatives. Compliance with the guidelines is required in DOT's utility accommodation policy. Let's review the guidelines.

The *control zone* is a calculated distance located within highway right-of-way (ROW) in which the placement of utility objects is controlled. It varies with speed, traffic, and roadway slope and is based on the control zone distance calculation table. The control zone ends at the highway ROW line. The guidelines classify utility objects into three separate categories: Location 1, Location 2, and Location 3.

- Location 1 objects are located within the control zone in one of the following areas:
  - Within the radius of public road intersections,
  - Within a position where roadside features may direct a vehicle, or
  - Closer than 5 feet beyond the edge of the shoulder.
- Location 2 objects are also located within the control zone, but they do not meet the Location 1 criteria.
- Location 3 objects are located outside the control zone.

The plan for implementation of the control zone guidelines provides an understandable and user-friendly process to administer the guidelines to make correction decisions. The control zone objectives within the plan for implementation provide a flexible decision path for determining object correction.

- **Objective 1:** To locate all utility objects outside the control zone.
- **Objective 2:** To correct objects with the use of an alternative measure. Alternative measures include locating on private easement outside the ROW, putting utility lines underground, reducing the number of utility objects, increasing lateral offset distance, and other mitigation.
- **Objective 3:** If compliance with the first two objectives is not possible, Location 1 objects may be granted a variance. In our 9 years of experience in using the control zone, we have never revised a request for a variance from a utility company.
- **Objective 4:** If compliance with the first two objects is not possible, Location 2 objects may be granted a reclassification.

An analysis of our pole collisions led to the development of the 5/15 rule. This is a simplified reclassification process requiring that an object be located within 5 feet from the highway ROW line and at least 15 feet from the edge of the travel lane.

Continued communication between the department and the utility industry has resulted in successful application of the guidelines. The project application section of the plan for implementation identifies the type of construction to which the control zones are applied.

- **Case 1:** All new utility facility construction must comply with the control zone.
- **Case 2:** Reconstruction of existing utility facilities must also comply with the control zone requirements. In one case a pole line was being reconstructed by the utility company. The company increased the spacing between the poles, eliminating several poles. It increased the lateral offset distance of the line and moved it to within 5 feet of the ROW and then was issued a 5/15 reclassification. The previous location for the utility line was on the south side of the highway. The utility company moved the line to the north side and placed it in an area inaccessible to vehicles.
- **Case 3:** "Utility relocation required by DOT projects." This section of the guidelines is currently being modified to reflect the department's new project preservation and improvement classifications. The application is similar to our previous 2R/3R process, which will be discussed.
  - Resurfacing project—Individual Location 1 utility objects that demonstrate a need for correction must be corrected during the project construction.
  - Resurfacing and restoration projects—All Location 1 objects must be adjusted to comply with the control zone guidelines. Location 2 objects will be adjusted to the extent that the department is doing safety work on that project.
  - Resurfacing, restoration, and rehabilitation projects—All Location 1 and Location 2 objects will be adjusted to comply with the control zone guidelines.

- **Example 1:** The roadway was widened to add a bicycle lane and curb, and sidewalks were constructed. The pole was located adjacent to the travel lane and has been relocated outside the control zone.
- **Example 2:** Safety work was done and slopes were flattened. The pole line on the left was relocated from the edge of the highway out beyond the control zone.
- **Example 3:** Curb and sidewalks were added. The poles that were adjacent to the travel lane were relocated behind the sidewalk.
- **Example 4:** Safety work was being completed. The service cabinets that were in Location 1 position up against the highway were relocated up and over the control zone. This Location 1 pole line was moved to the top of the back slope of the ditch and was reclassified using the 5/15 rule. A telephone line was located along the edge of the highway. That line was buried, eliminating the poles. Location 1 objects were moved, increasing the lateral offset distance, and reclassified using the 5/15 rule. One pole in a Location 1 position was up against the highway. It was relocated to an area that is inaccessible to vehicles. Another pole was moved behind a guardrail that was designed for another use but would provide shielding for that pole.

This is not as complicated as it may seem. The key to making the process work is what we call our “utility object relocation record.” A relocation record is completed for every project. Utility objects, speed, traffic, and side slopes are identified, and the control zone distance is calculated. The utility identifies the planned object correction in each case.

The cooperation and teamwork between the utility industry and the Washington State DOT has resulted in successful implementation of the guidelines. We have corrected the locations of thousands of utility objects and reduced vehicle pole collisions by more than 35 percent on state highways within Washington.

Florida's Initiative

DENNIS M. LA BELLE
M&T Consultants

In Florida we began to look at the problem of safety in 1993 and to develop a policy to address that issue. We saw what Georgia was doing. We knew what was going on in Washington and we wanted to come up with a policy, but we went through two state utility engineers in the meantime, and every time we had a new person on board we had to start over. We looked at some of Don's work with TTI and studied the "Jacksonville Report" to help put together a program we thought would be right for the state of Florida.

Our objective was to come up with a very cost-effective program—something that was reasonable and that everybody could live with. Originally we had looked at simply moving the poles back. Move all the poles back to the right-of-way (ROW). Before we implemented the policy we wanted to educate everyone on what the policy was going to do and show that there was going to be some sharing of responsibility involved in putting together this program and implementing the system so we had appropriate safety improvement. We felt we should define the problem, develop the strategies, gather and analyze the data, and then come up with a solution. Not just jump right into a solution of what we thought and what we had seen from the other reports, but what was best for Florida.

We found that a big part of the problem was competition for space. Everyone in the world was trying to get in the ROW, a limited ROW. You have public versus private interest in the ROW. You can't go on many of these highways and acquire new ROW to build these extensive clear zones anymore. You have to come up with something that will effectively reduce the hazards and still try and live with what we have.

The Florida statute states the department of transportation (DOT) is the one to maintain the ROW, and in a safe and cost-effective manner. It also states that the utilities have the right to access the ROW, but they also have to comply with the safety constraints established by Florida DOT (FDOT). FDOT can set polices, and utilities have to comply with those safety policies. The biggest problem we have is how to accommodate everybody that is out there now with a very safe and convenient location and not create additional hazards in the future and also find a way to resolve the existing conditions that we have now.

We had to develop some strategy. The first thing we did was to establish a task team. I think it is similar to what Georgia did. We identified the hazards by different types. We identified high-risk locations. We identified cost-effective measures. We also had to establish a plan of action. This is where we are right now. This plan has just been implemented. What we are going to be doing is reviewing it and reevaluating it on an annual basis to see if what we have come up with is really going to work and also reduce accidents. What we wanted to do in gathering the data was to get the right people involved to ensure that anyone who had any interest in the program we were putting together was involved from the very beginning—not to drop a bomb on them in the end, but to get them involved up front. So, the Florida Utility Coordinating Committee was involved, as was the Florida Electric and Power Coordinating Group (which is a group of people from all the power utilities in Florida), the Natural Gas Association, the American Water Works Association, and cities and counties. With all these different organizations represented I don't know how they finally managed to agree on a solution, but we did and I think it is a solution that is going to work.

A survey of the roads to see what types of objects are in the clear zones right now was informative. We found that 26 percent of the objects in the clear zones are trees, and 19 percent are poles or posts. Curbs, ditches and culverts at 17 percent and 14 percent are others. Guardrails are 10 percent. There are also embankments and bridges. As you can see, poles were the second highest of the hazardous objects.

We took the police accident data from 1997 and identified pole-related hits. There were 42,800, of which 267 involved fatalities. Of these pole hits and related fatalities, only 44 percent occurred in nonintersection areas; 56 percent occurred on intersections. Only 26 percent of all the miles are intersections. The conclusion is that only 20 percent of the relocation funds are spent where 56 percent of these accidents occur. To look at the results another way, if relocation is the only approach, utilities would be spending up to 74 percent of their pole relocation funds where only 44 percent of the crashes occur. Up to 30 percent may not have been effective. Most of the crashes occur in urban areas (60 percent of them). We also looked at the fatalities, and again the urban areas were the highest. Rural areas again came in second. That is probably because of the speed of the accidents involved, since there are higher speeds in the rural areas.

What significant differences exist in the urban areas? Traffic movement. Stop-and-go traffic. Also you have major conflict points in the urban areas versus the rural because of the limitations in the ROW and the number of different users in the ROW.

This revealed that you could not treat every area in the same way. There would have to be different ways of treating different areas—residential areas, open country areas, and business areas. Each area needs a different treatment to be optimally effective. So we began to access the available tools we had to treat these areas. We said, "This is the Bible." This is the book we will use to make our determinations—to do our analysis of risk for the cost-benefit ratio. This is the *only* book. This is the AASHTO *Roadside Design Guide* (RDG).

The RDG recommends that a district design engineer collect the data, such as traffic count, needed for the analysis. The analysis methods will come directly from the RDG. Also needed are technical advisors. They are going to help develop the cost-benefit ratio. A computer program is also available. This is what we are going to use. I don't care if you have some other way you want to do it, this is the way we are going to treat it in Florida, looking at every road the same way.

We came up with a proposed solution to promote cost-effective safety by setting more stringent criteria where most run-off-road accidents occur. Set a goal that is practical. Don't come up with something that is unachievable. Let's come up with criteria that we can all live with and that we can get implemented. Establish a process that will ensure that the most critical areas will be addressed first and that will minimize the need to address areas that are less crash prone. You start off working on your worst cases and work down to the other ones, estimating the risk by going through the cost-benefit analysis.

This control zone is a little different from the "clear zone" that Mr. Horne was talking about. We wanted to establish this control zone concept. This control zone concept allows us to prioritize cost-effective safety.

What is this control zone? It's an area set aside where statistically it shows within a clear zone that there is a high potential for accidents to occur, or an area where there are more than two hits in 3 consecutive years in the recent 5-year period. Those would be considered a control zone. That would be the areas they are going to attack to resolve the major problem. Within these control zone areas they want to use the new construction standards versus the 3R standards of relocation. If you're going to move something, then move it back as far as possible. In turn, by the utilities moving out of these control zone areas where they do have some problems, it is going to allow them to have a variance report, but they are also going to have to use a cost-benefit analysis that shows it is more expensive to move something than the benefit derived from it. There is legitimate analysis you put together to come up with this very low-risk area and longitudinal relocations where you don't have any pole hits and it is within a clear zone. This would not be the best place to spend the money at this point. Look at the high potential problem areas and move those facilities first.

These are the control zones that have been identified. Within a major intersection the four curvature areas have the highest probability of cars going off the road, and only two of these are commonly exposed. Where you have a T intersection—the curved and adjacent area. Some of these are simply common sense. These are the areas they are going to concentrate on first because these are the areas that have the highest run-off-road potential.

An example of the relocation scenario: You have an area 3 miles long, 10 intersections involved, 100 poles in it. Within the control zones about 40 poles must be relocated. The presumption was that you will save unnecessary spending of about $150,000. The cost of a typical utility pole relocation is $2,500, and 60 of 100 poles will not be relocated. That will save the utility $150,000, money that can be spent more effectively in other areas. We would only need to relocate 40 poles, and those 40 are in the control zone areas.

The Florida control zone philosophy is, "Improve safety by ensuring that the high standard is applied in areas of greatest risk." We address the areas with the greatest crash risk first. It also reduces expenditures in low-risk areas. Why go out and spend money in a low-risk area when you should be able to take that money and spend it in a high-problem area?

This is what has been done so far. Starting in August 1999, we trained staff members in all the different districts. We had 2-day training sessions on the whole concept. Training was not just for the utilities but also for the DOTs so there would not be any misunderstanding of how the policy was implemented. What they also did was to flowchart the policy and the procedure, saying here's the best way to do it. No one is going to make up their own rules. Everybody is going to do it the same. They've developed the exceptions and variance reports. They've also allowed for the variable levels of approval needed under certain conditions. If you get up to exceptions, at that point you have to go to the state level. Some of the work can be done at the district levels, and they will be reviewing the effectiveness.

Actions to date: Four 3R projects involving utilities. All poles and aboveground facilities have been relocated out of the control zone areas. Longitudinal adjustments have been made on poles near driveways. They have relocated those where they've had some minor pole scrapings (where trucks try to get in the driveway and push around the pole). Exceptions have been granted on two of the projects on some of the poles where there were no pole hits over a 5-year period and where less than the clear zone requirements were met. We are looking forward to evaluating the effectiveness of this policy and feel we will get positive results similar to those of Georgia, Washington, and Huntsville.

APPENDIX A

TTI Researcher Tells Utility Conference Delegates "The Time Has Come" for Utility Safety Programs

DON L. IVEY
Texas Transportation Institute

The following article is a condensed version of a speech delivered by TTI Associate Director Don L. Ivey. Ivey was invited to address the 1991 National Highway Utility Conference held in Denver, Colorado, in February.

When Moses came down from Mount Sinai and found the Israelites having a swinging party, the times did some spectacular and rapid changing.

When Eratosthenes calculated the diameter of the earth in 201 B.C. by measuring the shadow of an obelisk in Alexandria, the times were changing.

When Martha Mother Shipton said in 1526, "Horses without chariots shall go and accidents fill the world with woe," the times of Henry VIII were changing.

When the electric utility companies resisted rural electrification in the late 1920s they were stringently resisting change, but the New Deal was not to be resisted—the times were changing.

In the field of highway safety, I have been privileged to have my career span a most dynamic period. It began by helping T.J. Hirsch design the first crash cushions for elevated gore areas. It began as AASHTO was publishing its *somewhat* revolutionary 1967 Yellow Book, "Design and Operational Practices Related to Highway Safety." From that point in time forward, highway engineers could no longer use "the nut behind the wheel" philosophy. Through the intervening years, the roadsides have changed dramatically. Breakaway ground-mounted signs and luminary supports, crash cushions, traversable clear zones, collision-worthy guardrails and bridge rails, and safer drainage structures are some of the changes that have saved literally tens of thousands of lives in the intervening quarter of a century.

Changes in our society take place when the proper elements for change reach a critical mass. These elements include knowledge, technology, and economic conditions.

In this conference we have brought together some key individuals to work with you in exploring the status of roadside safety with emphasis on utility installations. Many of you have already met them in our workshops. These individuals agree, and I concur, that a critical mass has now been achieved to change our roadsides by safely accommodating one of our great national blessings, our utility physical plant. These individuals include King K. Mak from Texas Transportation Institute, Charles V. Zegeer of North Carolina's Center for Highway Safety, and Jack Humphreys of the University of Tennessee. The credentials of these people span the Highway Safety spectrum. Let me briefly list a series of achievements and events by these individuals and of course by many others. These events relate to knowledge, technology, economics, and finally, precedents. They constitute, in total, the critical mass for rapid change.

Critical Mass Package

1. 1975—Definition of the societal cost of utility pole accidents, Graf, Boos & Wentworth, Public Roads, Vol. 39. (The cost of pole accidents).
2. 1977—Barrier Guide, AASHTO-Clear Zone Policy.
3. 1980—Pole Accident Analysis, Mak & Mason, FHWA. (The nature of pole accidents.)
4. 1981—A Guide for Accommodating Utilities within Highway Rights-of-Way, AASHTO.
5. 1984—Cost Effectiveness of Utility Pole Safety Treatments, Zegeer & Cynecki, TRB 970.
6. 1984—NSC Reiterates the Extent of the Utility Pole Problem, 3.2% of Fatalities, 2.8% of Injuries.
7. 1985—First Practical Breakaway Pole is Developed. Ivey, FHWA.
8. 1985 Federal Rules Promulgated for Accommodation of Utilities on Federal Aid Projects. 23 CFR, Part 645.
9. 1986—Washington State Mandates Phased Relocation of Utility Poles on Highway Rights-of-Way. (Sept. 25, 1987, FHWA approval of "Control Zone Guidelines-Utilities.")
10. 1987—Lexington, Kentucky, First Breakaway Poles Installed in FHWA Demonstration Project.
11. 1988—Massachusetts, Second Demonstration Project Where Breakaway Poles Are Installed.
12. 1988—The Concept of Low Cost Safety Improvements Begins to Gain Respectability. Ivey, Highway Safety at the Crossroads, ASCE.
13. 1989—Jacksonville Electric Authority, Jacksonville, Florida, Announces the Implementation of the First Intra-Utility Roadside Safety Program. (Program is continuing.)
14. 1990—New AASHTO Roadside Design Guide is Adopted. (Pennsylvania Program)
15. 1991—Draft (Summer of 1992) A National Highway Utility Guide Is Under Development. James Thorne, APWA, and Daniel S. Turner, University of Alabama.

These key factors, accomplishments, and situations are providing a basis for discussion in the workshops. In view of this critical mass for change, the key question for this part of the conference is: Should *my* utility company initiate an in-house (or intra-utility) roadside safety program? That is the question you will answer. If you choose not to initiate change, you have answered the question. Other questions we will try to answer in the workshops are:

1. Will a roadside safety program save my customers money?
2. Will a roadside safety program save my company money?
3. Will a roadside safety program promote public safety and the safety of the people in my maintenance department?
4. Will it enhance the position of my company with respect to litigation?

Summary Statement from Dr. Ivey

The implementation of in-house roadside safety programs by utility companies will make a most significant impact on injury reduction in the next 10 years.

APPENDIX B

Biographies

RICHARD L. ANDERSON

Washington State Department of -Transportation

Following an education in Architectural Engineering at Washington State University and the University of Washington, Richard Anderson launched a career in highway planning, design, and construction with the Washington Department of Transportation in the late 1960s. His work on projects and in various specialty fields of transportation has taken him across the diverse environs of western Washington.

Richard has actively participated in state and local utility coordinating councils, in the National Highway/Utility Conference, and on a variety of interdisciplinary teams. Working with the Washington Aerial Utility Advisory Committee, he implemented Washington State's roadside utility object safety program.

He has authored *Utility and Railroad Coordination—Who, What, When and Why; Plan for Implementation—Control Zone Guidelines;* and *Environmental Engineering and Planning—Goals, Objectives, Activities.*

Richard founded and is owner of the Sebastion Group, the company that created Underground Discovery, Shoreshaks coastal life space design, Valuing Our Actions strategy for dynamic accomplishment, and Rosie and the Elephant child adventure series.

Richard and his wife, Mary Ellen, live on the jetty at Point Brown on the North Pacific Coast in Washington State.

JOHN F. CARNEY III
Worcester Polytechnic Institute

EDUCATION

- B.S.C.E., Merrimack College, 1963
- M.S.C.E., Northwestern University, 1964
- Ph.D. in Civil Engineering, Northwestern University, 1966

ACADEMIC EXPERIENCE

1996	Provost and Vice President for Academic Affairs, WPI
1993–1996	Associate Dean for Research and Graduate Affairs, Vanderbilt University
1989–1993	Associate Dean for Graduate Affairs, Vanderbilt University
1983–1996	Professor of Civil and Environmental Engineering, Vanderbilt University
1981–1983	Professor and Head, Department of Civil Engineering, Auburn University
1974–1981	Professor, University of Connecticut
1980–spring	Sabbatical leave, Cambridge University
1969–1974	Associate Professor, University of Connecticut
1973–spring	Sabbatical leave, Oxford University
1966–1969	Assistant Professor, University of Connecticut

PROFESSIONAL ACTIVITIES

- Member, Management Group C, American Society of Civil Engineers (1996–present)
- Member, Executive Committee of Highway Division, American Society of Civil Engineers(1990–present)
- Chair, Executive Committee on Highway Division, American Society of Civil Engineers (1993–1994)
- Chair, Transportation Research Board Committee A2A04—Roadside Safety Features, National Research Council (1993–present)
- Member, National Cooperative Highway Research Program—IDEA Technical Expert Panel
- Member, National Cooperative Highway Research Program Panels 17-13 and 22-10

HONORS AND AWARDS

- Certificate of Appreciation, ASCE, "for developing and conducting Highway Engineering Specialty Conference on Highway Safety" held in Nashville, Tennessee, March 24–26, 1986

- Holder of four U.S. patents
- Chapter Honor Member, Chi Epsilon, Auburn University, 1983
- Certificate of Appreciation, ASCE, Auburn University, 1983
- Research Associateship at Clare Hall, Cambridge University, 1980
- The James F. Lincoln Arc Welding Foundation Award, 1980
- Best Refereed School of Engineering Technical Paper, Vanderbilt University, 1988
- Refereed Research Paper Award, Vanderbilt University, 1991
- Refereed Research Paper Award, Vanderbilt University, 1992

RESEARCH FUNDING

A total of 35 research projects with a total funding in excess of $2,500,000. Sponsors have included the National Science Foundation (NSE); FHWA; Strategic Highway Research Program (SHRP); the Departments of Transportation in the states of Connecticut, Tennessee, Washington, Georgia, Alabama, and Colorado; British Rail; and the British Advanced Railroad Research Centre.

PUBLICATIONS

Author and coauthor of 140 research publications in the areas of structural mechanics, impact mechanics, and highway safety.

PROFESSIONAL PRESENTATIONS

Ninety-nine presentations at national and international conferences, meetings, and seminars.

GEORGENE M. GEARY
Georgia Department of Transportation

EDUCATION AND EXPERIENCE

- BSCE, University of Illinois, 1985
- MSCE, Georgia Tech, 1999
- Registered Professional Engineer in Georgia, 1991
- Employed with the Georgia Department of Transportation since June 1985

AREAS WORKED IN GEORGIA DEPARTMENT OF TRANSPORTATION

1985–1991	Geotechnical, Foundations and Special Studies
1991–1993	Construction Liaison, Roadways, Atlanta Metro Area
1993–1995	Construction Liaison, Bridges, Statewide
1995–1999	Assistant State Utilities Engineer Initiated the DOT/utility electronic plan transfer program Chaired committee that revised the Georgia Utility Traffic Control Manual Set up the first GDOT Utilities Web page Assisted in bringing SUE to Georgia
April 1999	Administrator for the Office of Information Services (OIS) This year took over the development of the Department's Transportation Information System (TIS) as Administrator of OIS. The TIS will be integrated with the Department's GIS to provide meaningful transportation-related information, at a touch of a button, to GDOT and all of Georgia.

Dwight A. Horne

Federal Highway Administration

Dwight Horne is the Director, Office of Highway Safety Infrastructure, in FHWA's Headquarters in Washington, D.C., and is responsible for planning, administering, and evaluating a national program to reduce the frequency and severity of crashes by improving the driving environment on the nation's highways. He has a bachelor of science degree in civil engineering from the University of Florida. He has been with FHWA since January 1971 and has had division office assignments in Arkansas, Connecticut, Florida, Georgia, Mississippi, New Jersey, and Texas. He has also worked in FHWA's former Region 1 Office in Albany, New York, and the former Region 4 Office in Atlanta, Georgia. Mr. Horne has served as Chief, Federal-Aid and Design Division in Headquarters, Region 1 Deputy Regional Administrator, and Connecticut Division Administrator, and he has more than 29 years of experience with highway programs and technologies.

FHWA ASSIGNMENTS

- Headquarters as Director, Office of Highway Safety Infrastructure
- Headquarters as Chief, Federal-Aid and Design Division
- Region 1 Office (Albany, New York) as Deputy Regional Administrator
- Connecticut Division Office as Division Administrator
- New Jersey Division Office as Assistant Division Administrator
- Mississippi Division Office as District Engineer
- Region 4 Office (Atlanta, Georgia) as Construction Engineer
- Georgia Division Office as Area Engineer
- Georgia Division Office as Design Engineer
- Texas Division Office as Assistant Area Engineer
- FHWA's Highway Engineer Training Program
  - Texas Division Office
  - Texas Highway Department (Fort Worth)
  - Florida Division Office
  - Arkansas Division Office

DON L. IVEY
Texas Transportation Institute
Texas A&M University

EDUCATION

- B.S. in Civil Engineering, Lamar State College of Technology, 1960.
- M.E. in Structural Engineering, The Agricultural and Mechanical College of Texas, 1962.
- Ph.D. in Structural Engineering and Structural Mechanics, Texas A&M University, 1964.

CURRENT RESPONSIBILITIES

- Intellectual Property Program, Texas Transportation Institute
- Professor Emeritus of Civil Engineering, Texas A&M University.
- President, Scientific Inquiry, Inc.
- Chairman of National Utility Safety Task Group under the auspices of the Transportation Research Board

PROFESSIONAL AND HONORARY SOCIETIES

- Registered Professional Engineer, Texas, No. 24617
- Transportation Research Board of National Research Council
- American Society of Civil Engineers
- Society of Automotive Engineers
- American Society for Testing and Materials
- Phi Kappa Phi
- Chi Epsilon
- Sigma Xi

CHAIRMANSHIPS, HONORS, AWARDS, AND ACCOMPLISHMENTS

- National Research Council, Transportation Research Board's Committee on Surface Properties–Vehicle Interaction
- Task Group Leader on the Influences of Roadway Surface Discontinuities on Safety
- ASCE Invited Lecturer, Highway Safety at the Crossroads
- Highway Safety from Fantasy to Reality, 1988
- Chairman of SDHPT/TTI Committee on Standards and Guidelines for Cost Effective Safety Improvements
- Past U.S. Representative on the European Permanent International Association of Road Congresses

- Past Member of the National Automotive Safety Advisory Council
- Outstanding Young Engineer of the Year, 1970
- Engineer of the Year, 1978, Texas Society of Professional Engineers
- "American Men of Science"
- Developer of FHWA's first field Test and Evaluation Center for Skid Measurement Systems
- Holder of patents and pending patents on crash cushions, roadside barriers, and breakaway utility poles
- Inventor of nationally marketed ADIEM Crash Cushion, AD-IV Steel Reinforced Safety Pole, and LP-IV Low Profile Barrier
- Developer of a statewide skid accident reduction program
- Developer of Texas Transportation Institute Intellectual Property Program

PUBLICATIONS, FILMS, AND LECTURES

Over 100 publications and reports pertaining to transportation safety, encompassing subjects such as probability of injury in highway collisions, handling and stability of tractor-semitrailers, skid resistance and automobile stability, tire pavement friction, hydroplaning, wet weather accidents, roadside structures (crash cushions, breakaway signs, luminaire supports, guardrails and bridge rails), and the definition of the hazard and treatment of narrow bridges. Selected papers have won best of sessions awards in both ASCE and TRB state and national meetings. In addition, films produced or written include "War on Wet Weather Accidents," "Response of Drivers and Vehicles to Emergency Maneuvers," and "Pavement Edges and Automobile Stability."

CURRENT ACTIVITIES

Currently working on severity indices and target values for safety installations; CPSI side hit safety device for guardrail end treatment; concrete crash cushion for utility pole installations; Kildare reconstruction methods; conspicuity/expectancy interaction influences on sight recognition, tube crash cushion, and low profile barrier; Chairman, Utility Safety Task Group, TRB Committee A2A07.

DENNIS M. LA BELLE
M&T Consultants, Inc.

Dennis M. La Belle is the Director of Utilities for M&T Consultants, Inc. His areas of functional expertise include engineering and construction of distribution systems; development and implementation of utility bid packages for engineering design; development and implementation of forced relocation and joint use programs for local, state, and federal governmental entities; total quality management program implementation; and project and contractor management. He has developed and implemented various utility-related training courses for the utility industry and highway agencies.

He received his bachelor's degree in electrical engineering from the University of Miami and has continued his education in utility management. He is an active member and past chairman of TRB's Committee on Utilities and is a past member of the IRWA Liaison Committee, IRWA/AASHTO Utilities Committee. He has served on and chaired the various local, state, and federal subcommittees associated with all aspects of utility accommodations within highway rights-of-way.

His work experience includes 24 years of service with Florida Power & Light Company as the Manager of Utility Relocations and Joint Use Affairs and 6 years of utility/highway agency consulting services.

JAY K. LINDLY
Department of Civil Engineering
University of Alabama

Jay Lindly received a Ph.D. in transportation engineering from Purdue University in 1987. Since that time, he has taught and conducted research at the University of Alabama. Jay also teaches National Highway Institute Course No. 13406, "Highway/Utility Coordination Issues," and is coauthor of FHWA's 1993 *Highway/Utility Guide*. He is a P.E. in Alabama.

JARVIS D. MICHIE
JDM Consulting Engineer

Mr. Michie is a licensed professional engineer who has devoted a major part of his career to highway safety. Beginning in 1967, he conducted research for NCHRP and was a principal author of the first national roadside safety document, *NCHRP Report 54*. He has authored more than 100 technical reports and articles on highway safety–related subjects. In 1969 he conducted exploratory testing on techniques to convert existing timber utility poles to devices that would readily break away during vehicle collisions. Additional work on techniques for modifying existing timber utility poles was continued in the 1970s for FHWA. He has held leadership positions with TRB, ASCE, and NSC, organizations concerned with the public hazard of utility poles located near highways. In 1998 he was recognized by his peers with the Kenneth Stonex Roadside Safety Award.

C. Paul Scott
Federal Highway Administration

Paul Scott is currently a Highway Engineer with FHWA in Washington, D.C. He is responsible for coordinating national-level issues pertaining to the relocation, adjustment, and accommodation of utilities on federal-aid highways, including developing and implementing utility-related regulations and policies. For the past few years, he has been actively involved in activities such as wireless telecommunications, utility pole safety, subsurface utility engineering, and utility damage prevention.

Mr. Scott has worked for FHWA for 30 years, the past 9 in his present position. He is a registered professional engineer, a member of the American Society of Civil Engineers, and a member of the Transportation Research Board Committee on Utilities. He is married with four grown children and enjoys walking, reading, baseball, and working in the yard.

CHARLES V. ZEGEER
University of North Carolina, Chapel Hill

EDUCATION

- M.S. (Civil Engineering) University of Kentucky
- B.S. (Civil Engineering)Virginia Tech (VPI and SU)

MAJOR SPECIALTY

Traffic and Transportation Engineering

RESEARCH AREAS

- Accident Analysis
- Pedestrians and Bicyclists
- Roadway Geometric
- Traffic Control Devices
- Large Truck Safety

MEMBERSHIPS, HONORS, AND AWARDS

- Member, Institute of Transportation Engineers, Current Chairman, Committee 5A-5, Design of Pedestrian Facilities (1988–present); Past Member of Transportation Safety Council.
- Member, Project Panel for Transportation Research Board on Truck Access Study (1988–1989) and on Geometric Design for 3R Improvements (1985–1986).
- Transportation Research Board (Former Chairman of Committee on Pedestrians, Past Member of Committee on Operational Effects of Geometrics and Committee on Traffic Records and Accident Analysis). Past Chairman of Section B (Users and Vehicles) of TRB Group 3. (Certificate for distinguished service, 1992.)
- D. Grant Mickle Award presented at 1995 Annual Meeting, Transportation Research Board, for paper "Accident Relationships of Roadway Width on Low-Volume Roads."
- Panel Member, Bus Passenger Safety, National Cooperative Transit Research Program.
- American Society of Civil Engineers, Past Member, Committee on Urban Transportation Safety.
- Member, Traffic Records Committee, National Safety Council (1989 to present).
- Recipient, Technical Paper Award by Southern Section of ITE on "Green Extension Systems at High-Speed Intersections" (1978).
- Special Consultant to NCHRP on Synthesis Topics: "Highway Accident Analysis Systems," "Methods for Identifying Hazardous Highway Elements," and "Pedestrians and Traffic Control Devices."

APPENDIX C

Strategies for Action

DON L. IVEY
Texas Transportation Institute
Texas A&M University

When General Armstrong Custer fell on the greasy grass of Little Big Horn with a bullet in his left temple, 265 men fell with him. The shock was felt throughout the country. It made headlines in every newspaper and was the immediate topic of every speech. Each year four times that number perish during impacts with utility poles, and—for whatever reason—many utility companies and state departments of transportation (DOTs) do nothing.

One reason cited is that there are 88 million poles, and clearly it is not cost-effective to do a safety treatment on 88 million poles. That would cost roughly $365 billion. Even in Democratic budgetary terms or in Republican estimated tax reduction terms that's beginning to sound like some real money. That is, however, the thing that was *never needed* and never will be needed. Attacking 88 million poles is roughly equivalent to 650 soldiers attacking 5,000 determined Native Americans, or charging a windmill on horseback, whichever you prefer. What is needed and what we are capable of is to identify perhaps 1 percent of these roadside poles that are in the most dangerous positions, just as General Custer needed to identify the most vulnerable positions and execute a strategically feasible plan of action, like riding like Hell's Angels back to President Grant's warm office.

You have just heard from Mr. Dwight Horne, who illustrated the overwhelming precedents that have already been set in this area of roadside safety. Here I expect to illustrate that we have a "sure-fire" strategy for saving more than 1,000 lives and 50,000 serious injuries. That accomplishment is feasible, while actually saving utility companies maintenance money.

We will illustrate, before the work of the Utility Safety Task Group is completed, that these strategies can be implemented at a net savings to utility companies and an incomparable savings to our society. In the second session this afternoon you will see a number of different programs applied on both a state and a local level that are beginning to make a difference. Some of these are already clearly demonstrated to be effective. The major strength they all have is that they are legitimate efforts to solve the problem. This is a spectacular contrast to those that would continue to ignore the problem.

As part of our analyses and efforts to achieve an optimum approach we have tried to find and take advantage of the strengths of various approaches while keeping the justifiable objectives and economic constraints of utility companies paramount. In so doing we have considered the following objectives:

1. Prevent the recurrence of a fatality or injury at sites where collisions have already occurred.
2. Prevent the occurrence of fatalities or injuries 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.)

Perhaps the term "clearly random collision or event" is not familiar to everyone. It is this event and our ability to define it that will provide a utility company or state DOT the best legal defense against the unscrupulous or ignorant. One way of defining the "clearly random event" is that it is everything outside the realm of the predictable. If we can develop prediction equations that are strong enough to make cost-effective site selections, and if we act in an appropriate way in prioritizing and treating the predictable, then a strong defense is laid not only against the "clearly random" but also against the lower-priority levels of the "predictable."

How then can we best use funds designated for safety improvements to accomplish the four stated objectives? We are satisfied at this time that the most effective approach is three pronged. Three is a number the ancient Celts held to have special power.

Thus the poem:

Comnadh tri mo dhuil,
Comnadh tri mo run.

For those of you not fluent in fourth-century languages, this translates as

May three aid my hope,
May three aid my lovemaking.

We do not contend that the three strategies we propose will in fact "help you with your lovemaking" unless, of course, you are of Celtic blood. We do contend that reasonable use of the three strategies will form a clear and productive program that will achieve the stated objectives:

1. Prevent the recurrence of a fatality or injury at sites where multiple collisions have already occurred.
2. Prevent the occurrence of fatalities or injuries at sites where collisions are likely to happen.
3. Save the utility maintenance funds.
4. Put a utility in the best position to defend the clearly random collision.

These three strategies are called

- The Best Offense,
- The Best Bet, and
- The Best Defense.

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 arrange 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 can be a clue 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 (*1*) and successfully applied by Jacksonville Electric Company in 1989. However, this approach suffers from requiring unsupportably costly collisions for definition (i.e., it is reactive rather than 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 (*2*) have developed prediction equations and data useful in prioritizing pole lines of significant length. Good et al. (*3*) have also developed useful relationships. These equations rely on traffic volume, pole offset, and pole spacing to predict when the probability of pole collisions is greatest.

They assembled a comprehensive database from 1,534 roadway sections covering 25,193 roadway miles. The sections were 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 (*2*) to predict utility pole accidents:

$$\text{Acc/mi/yr} = 9.84\times10^{-5}(\text{ADT}) + \frac{3.54\times10^{-2}(\text{density})}{(\text{offset})^{0.6}} - 0.04$$

where

Acc/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 (ft) from the roadway edge on the section.

Since 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 ROW expansions or roadway widening (i.e., DOT improvement projects). For example, if a DOT project allowed movement of a pole line from 10 feet behind the curb to 18 feet, there is a good probability the money for utility movement would be better spent elsewhere (*2*, Figure 3). 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-foot to 18-foot project (e.g., where poles could be moved from 2 feet to 10 feet). Further, when a given pole line shows a high priority for change, that could occasionally be used by a DOT to justify the acquisition of more ROW.

Note that this "Best Bet" approach will apply directly to Objective 2 and will help accomplish Objectives 3 and 4.

Finally, we need to accomplish something else while we are saving lives and limbs. We need to use safety money to save money. We do not want to dissipate that on frivolous lawsuits. The final approach will prove a great frustration to plaintiff attorneys.

BEST DEFENSE

In the courthouse, the second most damaging condition for a pole line, right behind a significant accident history, is to not meet the recommendations of the *Roadside Design Guide* (RDG) (*4*). This is clearly 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 where the degree to which noncompliance with the RDG recommendations is slight. In Phoenix last year the city of Mesa was held accountable for a drainage structure 15 feet from the traveled way while the RDG recommended 17.5 feet. 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. Interpret the PC value to secure a priority number (PN). Note the relationship between PN and PC of RDG can be derived to achieve the most productive priority listing using lateral encroachment data (*5*) and relative risk relationships.
3. Prioritize the site according to the PN.
4. Perform safety treatment of a reasonable number of the highest-priority sites each year.

In this way, even if an area is in reasonable compliance with the RDG clear zone (e.g., there is a 15-foot clear zone instead of the recommended 17.5 feet), it will show up as a very low priority for treatment and thus place the state DOT and the utility in a good defensive position if one of these sites is subject to the rare and unpredictable random collision.1

Note that this third strategy when pursued in concert with the first two will clearly accomplish Objective 4. This conclusion is based on our experience and those of professional associates in acting as expert witnesses for state, city, county, and parish governmental agencies during the past 30 years.

REFERENCES

1. Mak, K. K. *Design Considerations for Safety Demonstration Sites*. Texas Transportation Institute, Texas A&M University, College Station, Jan. 1989 (revised Sept. 2000).

2. Zegeer, C. V., and M. R. Parker, Jr. Effect of Traffic and Roadway Features on Utility Pole Accidents. In *Transportation Research Record 970*, TRB, National Research Council, Washington, D.C., 1984, pp. 65–76.

3. Good, M. C., J. C. Fox, and P. N. Joubert. An In-Depth Study of Accidents Involving Collisions with Utility Poles. *Accident Analysis and Prevention*, Vol. 19, No. 5, 1987, pp. 397–413.

4. *Roadside Design Guide*. AASHTO, Washington, D.C., Jan. 1996.

5. Utilities and Clear Zones, Analyses, Observations and Misconceptions. Presented to Committee on Utilities, TRB, Washington, D.C., Jan. 1998.