BREAKAWAY POLES

James A. Bauer
Manager - Operations Network
Distribution Services
American Telephone & Telegraph Company
Basking Ridge, New Jersey

Utility pole safety is an important part of the highway safety program for the traveling public and of serious concern to the various pole users throughout the nation. The Southwest Research Institute of San Antonio, Texas, researchers at the University of Nebraska, material vendors and others have invested considerable time, money and effort in their attempts to come up with a viable solution to the hazard of roadside utility poles. The continuation of research on the concept of breakaway poles (hereafter referred to as "retrofix") reflects the fact that we are dealing with a complex problem. The utility industry and various study groups have addressed this problem for many years. In fact, both AT&T and Commonwealth Edison of Chicago, Illinois commented on breakaway poles in 1974 when the concept was first presented. The lack of a totally acceptable solution to the hazard of roadside utility poles attests that it has been no easy task.

This discussion will accomplish several things: 1) define some of the existing concerns about the breakaway pole concept for utility poles, 2) outline some of the situations where making existing plant poles into breakaway type (retrofix) would be applied and the resultant public hazards, 3) discuss why utility pole users do not see retrofix as a viable solution, and 4) describe a joint industry effort to minimize pole hazards through awareness and selective elimination of hazardous conditions.

The Bell System has been in the pole business for a long time. As roads were improved and widened poles often remained in the same limited right-of-way. Over the years the power companies began to share poles with the telephone industry along with, in some cases, cable television facilities. In addition, telephone facilities expanded to carry fire and police alarms, traffic control circuits and other vital communication facilities. It is now estimated that 80% of Bell System poles are shared with electric or other users.

Today, many jointly occupied poles are typically 35-40 feet in height and are of a size 4 or 5 classification. A Class 4 pole has a ground circumference of approximately 33-34 inches but may vary in diameter by wood type, whether cedar, pine, fir, etc. Many joint poles are Class 1's or 2's and are considerably larger in circumference. The majority of jointly occupied poles are classified as Grade C construction. The National Electrical Safety Code is, in some states, a legal requirement of construction. In terms of pole strength Grade C means new poles must have a resisting moment which is at least twice the maximum applied moment due to the wind and ice forces acting on the supported structure. If the ratio of resisting moment to applied moment drops to 1.33 the code calls for replacement. Unfortunately, even with that margin of safety weather conditions still drop pole lines that are designed according to these standards. For greater assurance against failure some jointly occupied poles must meet the more stringent requirements of Grade B construction. These requirements are twice the requirements for Grade C. That is, the required ratio of moments or "safety factor" is 4 for new poles and 2.66 for replacements. This margin of safety is based on the rated fiber strength which is a variable.

Poles supporting certain high voltage facilities or other facilities crossing railroads or highways are normally of Grade B or higher construction. These poles are required to have extra strength to support the aerial structure (generally strand and cable conductors) to avoid the hazard of falling onto the roadway or railroad tracks. Any deliberate weakening of poles in these situations will increase the probability of pole failure under adverse weather conditions with all of the hazards that this entails.

Some have said that pole lines are overbuilt. A field comparison of actual pole strengths with loads may occasionally yield some rather misleading results, as a pole line might not carry its ultimate load until later in its life cycle. It may be found that the actual safety factor of a given pole or group of poles at a given point in time is 2.5 or 3.0 for a particular Grade C line. Let's consider the load limitations of a Class 4 pole for Grades B and C construction. Obviously, the removal of any wood near the ground line reduces the force, or moment, the pole can withstand. An undamaged or unmodified Class 4 (40') pole is rated (or designed) to handle a horizontal force of 2,400 lbs. (2 x 1,200 lbs. or a moment of 76,00 ft. lbs.) applied 2 feet from the top with the pole set 6 feet deep. Because of natural variation in fiber strength from one pole to another occasionally a given Class 4 pole may not have much more strength than a Class 5. Thus, in a new Class 4 pole the margin of strength (above failure) may be as low as 720 lbs. At replacement the margin above failure could be only 80 lbs. for the weak fiber pole. This small residual of strength is one of the reasons why "safety factors" are specified.

Therefore, for existing poles the actual "safety factor" can be anywhere between the new and replacement values. Existing poles would have to be checked very carefully to ensure that retrofix did not weaken them below the point where they should be replaced. Pole inspection involves determining the extent of deteriorated wood and evaluating the strength of the remaining sound wood. This strength must then be compared with the actual load on the pole. Pole inspection is a time consuming procedure and currently no proven methodology exists for evaluating retrofix poles.

Pole designs are predicted on a wind factor of #4 plus a half an inch of radial ice building up on the cables and wires in the span between the poles in the heavy loading area. There is, of course, nothing to stop nature from applying heavier loads and sometimes this happens. In spite of the previously discussed safety factors poles do break under these loadings without any weakening such as retrofix. Retrofix can only increase the number of poles which will fail under storm loading. Downed poles, with attendant low hanging conductors, make it hazardous for the general public as well as telephone and power personnel who have to make repairs; and the more poles that fail the greater the amount of service disruption and the more hazards to the public.

Another point of concern is that the vast majority of poles used by utilities are pressure treated with a wood preservative. Retrofix is likely to expose untreated wood. The majority of utility poles today are southern pine and untreated pine near the ground line decays rapidly. Poles which have been retrofixed will be further weakened to some unknown extent by decay of untreated wood. Although decay can be slowed somewhat by field application of preservative to the cut surfaces, the field application would have to be repeated every 3-4 years; and such field application of preservatives does not completely ensure against decay progressing under the surface of the exposed wood. Hidden decay can eventually lead to pole failure even under moderate weather conditions.

It is true that some poles will remain standing even when completely severed at the ground line. Given sound poles on either side a severed pole may remain standing if short spans, tangent construction, no downpull and no unbalanced load exist. However, if adjacent poles were retrofixed the chances exist that the nearby retrofixed poles would fail and could bring down sound poles on either side (i.e., the domino effect). Methods of construction used by pole users have evolved over the years to keep high voltages and vital communications safely in the air. Violating any member of a designed system of poles will seriously compromise both safety and service.

Let's consider a number of situations where breakaway poles might in fact be a problem instead of a solution, especially in the case of unbalanced loads. Unguyed corner poles are one example of this. Unguyed dead ends used with slack span construction are another example. In these common situations broken poles could be pulled into the roadway by the unbalanced loads on the poles.

Unbalanced loads may also occur when all of the service wires are on one side of the pole line. Power and telephone services together can easily run to 200 lbs. tension per customer; and ice, wind and temperature can multiply these by a factor of two or three. Side arm construction is often employed to clear trees or buildings, avoid overhang or reduce angular load on the pole. Although in some cases side arm construction reduces the unbalanced load on a pole to a point where guying can be avoided there will always be some residual unbalanced forces. Here again, pole failure is likely to result in low hanging conductors; and if the pole falls it will fall toward the unbalance. Another unpredictable situation occurs at any pole with a significant down pull. Such poles receive no support from adjacent poles, and if they break they may fall into the traveled roadway depending on the direction of the wind or unbalanced forces acting on them.

Poles with electric transformers are clearly top heavy, and if retrofixed they could break away putting a heavy strain on adjacent poles. Of course, if adjacent poles were also retrofixed a domino effect could occur. The commonly used 25 kva transformer weighs approximately 475 lbs., the nearly as common 50 kva size weighs 800 lbs. and the voltage regulators and capacitor banks approach 2,000 lbs. These loads would create high bending moments. A high proportion of poles carrying telephone facilities also support power facilities, and the telephone facilities are attached to many poles carrying transformers.

Even where telephone facilities are not on the same pole jointly with power facilities great concern exists about anything which might render power poles more likely to break.

The National Electrical Safety Code (NESC) requires power utilities to maintain their pole strength levels at a higher construction grade to avoid the likelihood of power wires coming into contact with other utilities.

Power facilities don't have to fall directly on communication cables to create possible hazards for telephone people and the public. Broken power poles may cause power wires to short circuit which would result in fault currents measured in thousands of amperes. This type of failure can affect employee safety in two ways: 1) induction - if a fault deenergizes promptly, as it frequently does, a momentary surge of high voltage would be created which is dangerous to an employee working on a pole line; 2) ground potential rise - situations exist in power faults where the ground potential rise forces so much current onto telephone wires that the surge will melt the wires.

The safety benefits that result from breakaway luminaries and signs are recognized. However, a key difference between poles and luminaries is that a pole is not an isolated element. It is part of an engineered system of structures designed to keep power and communications cables safely away from the public and to withstand all the wind and ice loadings to which such a system will be subjected. Materials for pole lines are selected to provide resistance against decay and to retain sufficient strength to withstand storm loads on the poles and supporting structures for many years. A treatment such as retrofix undoes the system engineering that has gone into every pole line. Retrofix must inherently increase pole failures. It cannot do otherwise.

The Bell System policy, and that of many telephone companies, has been and still is gradual undergrounding of facilities. The Bell System policy of undergrounding was initiated in the early 1960's. This policy has resulted in the removal of about 500,000 poles per year and the reduction of the number of poles owned by the Bell System, as well as the total poles in use by Bell companies, by nearly 6,000,000. Retrofixing would involve expenditure of resources which could be better spent by pole users in pursuing a policy of undergrounding or relocation of telephone facilities.

This nation is linked to real time communications for personal, business and safety needs. Any potential for communications disruptions at times when it is most needed is inviting danger.

What then should be done to minimize the potential hazards to the public from utility poles? As a result of the Transportation Research Board meeting in Washington, D.C., July 12, 1979, and at the direction of the Chief of Utilities for the Federal Highway Administration, a group of pole users from both the private and public sectors representing the power industry, the telephone industry and concerned highway and municipal people has been formed. This group is working towards scoping and quantifying the problem of utility pole hazards and creating an awareness among the pole users of high risk areas. The results of this group can have great impact on selected fixes of hazards rather than a wholesale application of retrofix.

The four main points why retrofix as a solution is not viable are:

1) The unknown safety factors of breakaway poles will make it difficult to maintain employee safety. The unbalanced conditions caused by an employee working on a pole would require extraordinary safety precautions to protect employees.

2) Retrofix will cause more broken poles which in turn will affect the safety of the traveling public.

3) Additional broken poles will increase service outages and reduce the reliability of power and communication service.

4) Retrofix will increase the cost of pole maintenance, reduce the life of the pole and require additional poles to be replaced.