AEGIS

Loss Control

Utility Wood Pole Maintenance

White Paper

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Purpose

The intent of this paper is to outline issues utility companies should consider when developing or modifying wood pole maintenance strategies. The consequence of pole failures represents a significant exposure resulting in possible loss of life, permanent injuries, property damage and/or utility system-initiated wildfires. Effective asset management strategies are essential for pole owners to reduce the likelihood of such incidents. This paper also addresses the implications of joint pole agreements and the importance of effective coordination among stakeholders to maintain system integrity.

Introduction

Wood poles are integral components of electric utility infrastructure. As aging infrastructure poses increasing risks, managing these assets has become a critical concern for electric utilities. The consequences of pole failure are significant and can result in fatalities, serious injuries, property losses, utility-initiated wildfires and can be a negative impact to system reliability. The multifaceted impacts of such failures highlight the need for effective maintenance and inspection strategies.

Comprehensive asset management strategies that encompass regular inspections, timely maintenance, and proactive risk mitigation should be part of the utility's pole maintenance program. Elements of a robust wood pole inspection program include inspection methods, reject criteria, and quality assurance practices. Additionally, the impact of joint pole agreements on pole maintenance, and the importance of effective coordination among various attachers to maintain system integrity, must be considered.

Consequences of pole failure

Failure of in-service wood poles can result in:

- loss of life or significant permanent injuries to members of the public from contact with energized electric facilities and/or from being struck by a falling pole
- injuries to electric and/or communication workers due to pole failure
- motor vehicle accidents
- property damage
- utility system initiated wildfires
- service interruption and negative impact to system reliability
- negative perception by regulators, customers and community

Claim Experience

Pole related losses have resulted in many significant claims over the years; some so serious that they resulted in exhaustion of a member's AEGIS policy limits. The following three incidents demonstrate the potential severity of such events:

Pedestrian struck

A utility pole struck and killed a pedestrian. The incident occurred when a low hanging telecommunications wire was pulled down by a truck passing underneath. The truck continued down the street, snapping the pole attached to the wire, as well as six additional poles. The pole that struck the pedestrian has a questionable history of ownership. The pole was not listed in the electric company's mapping system. However, a streetlight and the electric company's identification tag were installed on the pole. The electric utility, for decades, billed the local municipality for the usage of the street light.

Two years prior, the municipality clerk informed the electric utility that certain poles were leaning and had low hanging wires, specifically, near the area of this incident. In response, a utility representative visited the location and concluded that the poles and wires in question were not owned by the electric company. No further action was taken to address the hazardous condition.

Wood pole failure causes massive wildfire

Another incident involved the failure of a distribution wood pole, which sparked a wildfire that scorched one million acres before being brought under control. The fire claimed the lives of two people and destroyed more than 130 homes and ranches, causing substantial damage to livestock. The investigation revealed that the electric utility's pole had snapped at the base, falling into a grassy area and igniting the extensive wildfire.

The utility's pole inspection contractor inspected the pole earlier in the year and designated this pole as a *Priority 1* reject pole, which is the highest level of alert. The pole inspection contractor advised the utility that the pole had minimum strength left and installed a red tag as per their procedure. It is unclear however, what the utility's internal procedures were regarding the replacement time frame for a red-tagged *Priority 1* pole. The electric utility publicly accepted responsibility for the wildfire within several days of the onset of the fire.

Car crash triggers pole collapse, resulting in driver's death

On a rainy day, a car driver attempting to avoid a two-car accident, struck a utility four-pole wood structure. This structure contained a bank of three overhead distribution transformers. The transformers fell onto the vehicle and killed the driver.

The structure was designed to support a bank of three 7,900 lb. overhead distribution transformers. However, the actual weight of each transformer was 8,600 lb., which exceeded the maximum specified weight, including its safety factor, which the structure could safely support. When this four-pole structure was constructed, the utility company did not perform a wood pole loading analysis to determine if the design of the structure was adequate for the transformer bank installation. Instead, it relied on design standards that showed typical four-pole transformer supporting structures.

Prior to the incident, a boring inspection revealed one of the supporting poles had extensive internal termite infestation damage. When the vehicle struck one of the other supporting poles, the impact caused this internally damaged pole to shear and ultimately caused the transformer structure to tilt, resulting in the transformers falling and crushing the driver.

Elements of an effective pole inspection program

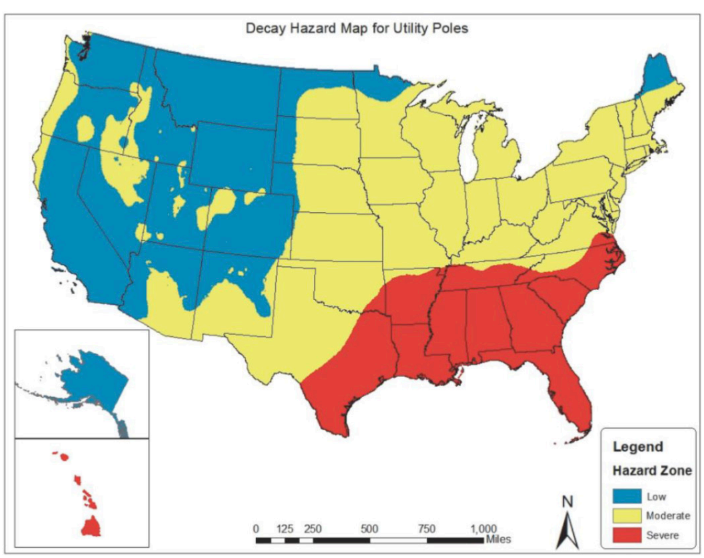
The National Electrical Safety Code1 (NESC) recognizes that wood and reinforced concrete structures will experience some level of deterioration after installation. The code states, Wood and reinforced concrete structures shall be replaced or rehabilitated when deterioration reduces the structure strength to 2/3 of that required when installed. Where facilities are designed for extreme wind or extreme ice with concurrent wind loading, this requirement changes to 3/4 of the original design strength.

Regular utility pole maintenance is essential for the safety and reliability of electric distribution systems. A systematic pole inspection program proactively identifies poles that no longer meet required strength due to decay, damage or other defects.

Asset management strategy

Pole owners should create and administer asset management strategies to identify and replace or rehabilitate in-service poles before they fall below the minimum strength criteria set by the NESC. In certain jurisdictions, regulatory agencies require regular inspection of wood poles at specified intervals. Pole asset management strategies should (i) adhere to regulatory requirements where applicable, (ii) take into account the characteristics of the utility's pole inventory, such as age, species of wood, treatment type, and past maintenance practices, and (iii) consider environmental factors in the service area that may lead to pole defects or decay.

Pole Decay: Decay of treated wood poles is typically a gradual deterioration caused by fungi. Damage by insects (termites, carpenter ants and wood borers) is considered jointly with decay because preservative treatment of wood protects against both fungi and insects. In most cases, the decay will be just below the ground line where the conditions of moisture, temperature and air are most favorable for growth of the fungi. Since the 1970s, pole owners have relied on a map from the American Wood Protection Association (AWPA) to anticipate decay threats to wood poles based on environmental conditions in geographic zones.
In August 2021, the AWPA updated the existing five-zone hazard map to a three-zone map based on field research.



Wood Species: The most common species of wood for utility poles in the U.S. are thick sapwood Southern Pine, Douglas Fir and Western Red Cedar.

Preservative Treatments: There are two general classes of preservative that poles may have been initially treated with: Oil-borne (creosote, pentachlorophenol (Penta), and copper Naphthenate) and water-borne (Chromated copper arsenate (CCA).

Selection of an effective pole inspection method and cycle should be based on each pole owner's experience. Service life records, reject rates and/or a planned sample inspection will indicate if the wood pole decay hazard is typical of the zone in which it is located.

Pole inspection methods

During inspections, utilities should assess the overall condition of the poles, including hardware and other components. These assessments can include wood pole detailed inspections, visual inspections, pole-top inspections, and pole integrity (sound-and-bore, excavate or non-destructive inspection method) testing to determine the internal condition of the pole. In addition to identifying damage and decay, inspections can identify poles that may be overloaded from existing or unauthorized attachments or in need of reinforcement.

A utility pole inspection program should have the following elements:

- **Preparation:** A maintenance plan should be developed that is consistent with the company's asset management strategy.
- Prior to working on the pole, company employees and contractors should be trained to perform a visual inspection of a pole. Components of the pole inspection should include:

- A visual inspection of a wood pole that includes:
  - **Damage:** Check for cracks, splits, leaning and other signs of avian (woodpecker), or wildlife (bear, deer, moose), damage
  - **Hardware:** Observe all hardware, including bolts, braces, crossarms, and insulators, are properly installed, aligned, and secure
  - **Ground conditions:** Check for signs of soil erosion, water damage, or other factors that may affect the pole's stability
  - **Knots:** One large knot or several smaller ones at the same height may indicate a weak point.
  - **Depth of setting:** Look for evidence of a former ground line that is higher than the current ground level.
  - **Soil conditions:** Soft, wet, or loose soil around the base of the pole may indicate that it won't support any change in stress.
  - **Burn marks:** Burning from transformer failures or conductor faults could have damaged the pole.
  - **Grounding:** Ensure adequate grounding is present to prevent electrical hazards. Look for broken or unsecure ground lead.
  - **Insect infestation:** Look for signs of termites, ants, or wood borers
  - **Pole information:** Note the pole's number, ownership, size, class, installation date, and material type and the last pole inspection tag.

- **Rocking test:** Applying a horizontal force to the pole will provide further clue to pole integrity especially if it cracks.
- **Vibration:** Listen for noise or humming, and observe for visual movement or loosening of attachments
- **Probe Testing:** A probe test of a pole is a way to assess the pole's structural integrity by looking for signs of decay or weakness. This test requires using a probing tool which is inserted (probed) into any cracks, crevices, or soft spots in the pole and paying attention to resistance felt. The amount of resistance the probe encounters can indicate the severity of internal damage. Making note of the depth of penetration, this can indicate the severity of internal damage.
- **Bore Testing:** This is an intrusive method to test wood poles. It requires drilling small holes into the pole at strategic locations, collecting core samples to examine for signs of rot, decay, or insect damage. The bore drill is angled at about 45 degrees to get a larger sample area, and uses a feeler gauge with a curved end to determine the pole's internal structure. A soft, punky center with fibrous pieces indicates rot or bug damage and water intrusion. Rot is present when large pieces of wet wood is removed.
- **Excavation:** A full excavation test of a wood pole involves manually digging around the pole to a depth of up to 24 inches to examine the below grade pole for rot. This method is considered one of the most comprehensive ground line inspection methods and is highly accurate.
- **Chip and Scrape Testing:** Involves a use of a chisel or scraping tool to remove surface layers of wood, paint, or other materials for closer inspection of decay, rot, or insect infestation beneath the surface including consistency and color of the wood, as well as the presence of moisture or fungal growth.

Industry practice suggests that a comprehensive pole inspection program can be highly successful in identifying and treating wood poles to significantly extend the life of the asset. The most common pole inspection approaches include:

- Sound and selective bore
- Sound and bore
- Sound and bore with partial excavation and selective treatment
- Sound and bore with full excavation and remedial treatment

New technologies to improve upon the labor intensive pole inspection techniques that are still common in the industry continue to be researched. A summary of the various technology classes includes:

- **Wood Inspection Resistance Drilling:** The Resistograph is one commercial application of this approach. Resistance measurements are recorded while drilling into pole. Soft wood, rot, or cavities can be detected through the observance of difference in resistance.
- **Sound Velocity Measurement:** The IML Micro Hammer is an example of a product that uses this technology. This technique introduces a soundwave into the pole and evaluates the reflected wave to determine pole condition. Early stages of brown and white decay, cracks, and cavities have been successfully detected using this approach.
- **Fractometer:** A core sample is removed from the pole and analyzed to determine the stability and strength. Results are extrapolated to provide an overall assessment of the pole.

Reject criteria and work management practices

Inspection results should indicate if a pole is deemed “serviceable” or “reject.” The criteria for “serviceable” poles should confirm the level of decay present would not be expected to reduce the pole strength below NESC criteria over the course of the next inspection cycle. Poles that do not meet the above conditions should be classified as “reject.”

Reject poles may be further classified as “reinforceable reject” or “candidate for replacement.” A “reinforceable reject” is any pole which would be suitable for restoration of the ground-line bending capacity with a method of reinforcement such as a C-truss. A “replacement” candidate would be a rejected pole which is not suitable for rehabilitation or reinforcement and would require replacement. Most companies determine pole replacement priority depending upon the condition of the pole. Poles that represent an imminent hazard should be addressed immediately. Other replacements should be completed within established timeframes.

Quality assurance

A comprehensive and effective pole inspection program should include a quality assurance program to assess compliance with the pole owner’s standard requirements for wood pole testing and treatment completed by internal resources or contractors. A field audit component may be considered as part of the overall assurance program. An adequate audit sample size of completed inspections should be pre-determined and audits should be performed by qualified personnel from the pole owner, a third-party contractor or the pole inspection contractor completing the inspections. Verifying the accuracy and completeness of the records and documentation and ensuring that auditable records and documentation are current and readily accessible should also be part of a quality assurance program.

Joint pole use

With deregulation and advent of cable, fiber and internet communications, Congress enacted regulations to permit new attachments and gave cable operators and telecommunications carriers a right of nondiscriminatory access to utility poles and rights-of-way. Recently, the number of third party attachers and attachments have increased and is rapidly growing with installation of 5G and higher Wi-Fi technology and build out of broadband infrastructure driven by available federal funding.

These regulations have resulted in an increase in third party requests for attachments on company owned poles, challenging electric utilities to manage accurate pole records and adequate and enforceable joint pole agreements. Experience and surveys conducted often find many of these attachments are not permitted, and many of those that are allowed are not in accordance with the NESC standard or meeting the utility’s requirements. By not following the rules, attachments can create safety, reliability, legal and financial issues for the utilities. Whether these acts are deliberate or unintentional, the pole owner needs to address the situation and any issues that may result from those attachments.

Impact on pole maintenance

It is advantageous to take regular inventory of utility poles and other field assets and important to keep abreast of what is attached to the company's poles at any given time. It is also important to maintain an unambiguous record of ownership, have clear processes for attachment authorization, clarify responsibilities for removal of double poles, retain transfer notification and take immediate corrective actions where violations such as low lines or damaged or reject poles are identified.

Indemnification and hold harmless provisions in joint use agreements allocate risk between the parties and help ensure that one party will not be held financially responsible for damages or liabilities incurred by the other party during the use of the pole. These clauses together with other provisions in the agreement clarify the responsibility of each party. Electric utilities should review new and existing joint use, joint ownership and attachment agreements to ascertain if appropriate indemnification and hold harmless provisions are in place.

Generally the most common discrepancies identified with respect to NESC Requirements are:

- **Minimum Height:** The NESC generally sets a minimum height over the ground above which all attached cables must be hung, depending on the type of road or crossing. As an example, a truck got caught on low-hanging communications lines over a roadway, snapping the top of the pole and leading to an eight-hour outage for more than 200 utility customers.
- **Communications Worker Safety Zone:** To keep workers safe, the NESC requires minimum separation between the lowest energized electric line and communications cables and equipment at the structure. Experience has shown that this "Communications Worker Safety Zone" is not always maintained. This can pose a danger to workers by inhibiting their ability to maneuver on the pole away from the energized lines.
- **Boxing the Pole:** Attachments are required to be on only one side of the pole. This allows line workers to climb the pole in situations where electrical equipment is not accessible via bucket truck, or when a truck is not available. By placing equipment on both sides of a pole, called "boxing," attachers block the ability of line workers to climb the pole to reach the electric working space.
- **Make Ready Issues:** Communications companies seeking to attach to a utility pole must work with other attachers to "make ready" the pole, which involves moving equipment around so that it can fit and be adequately spaced while also meeting NESC clearance and strength requirements. If there is not enough ground clearance remaining, it may be necessary to replace the pole.
- **Overloaded poles:** A group of California residents sued the local utility when poles fell in mudslides damaging their properties. The poles were overloaded with communications equipment from shared usage by telecommunications and cable TV providers. There is growing demand from telecommunications companies seeking to attach broadband equipment to existing utility poles. This results in additional loading creating problems with excessive weight if not engineered correctly. If asset records do not accurately reflect the number of attachments on a pole, it could potentially exceed the design loading of the equipment, posing a significant safety risk to the public.
- **Inaccurate data:** Data stored on legacy spreadsheets or paper records can become outdated and may not accurately reflect field conditions.

Managing challenges of Double wood poles

When wood poles are replaced, joint-use agreements between electric and telephone utilities usually provide for specified time limits for transfers to be completed and old poles to be removed. Non-pole-owning cable telecommunication service providers such as CATVs, fiber optic companies and other third-party pole users also have access to utility owned poles through attachment agreements. Many attachment owners struggle with transferring their attachments in a timely and efficient manner. Over time, the number of double wood poles may grow to an unmanageable volume (double wood backlog). Double-wood conditions may present safety concern and are eyesore to the public. Two poles at one location may expose the poles' owners to unnecessary risk if the transfers and removals are not completed in a timely manner, as parties injured in accidents involving the poles may allege that damages resulted from the unnecessary pole.

There are vendors in the industry that provide services to assist pole-owners to reduce their double wood backlogs. The service is commonly known as "One Touch." These vendors can act as a single-service provider to identify, manage and reduce double wood pole backlog by:

- Identifying double wood and otherwise stranded pole conditions that exist in the field
- Transfer communication attachments from old to the new poles
- Removal of old poles
- Construction invoicing and notification ticket closeout

Electric utility companies and other pole users may consider accelerating double wood removals by adopting this "One Touch" concept.

Conclusion

A comprehensive maintenance strategy for in-service wood poles helps ensure the safety and reliability of electric utility infrastructure. The potential consequences of pole failure underscore the importance of proactive inspection and maintenance strategies. Implementing a robust inspection program enables utilities to effectively assess and manage the condition of their assets, allowing for timely replacement or rehabilitation in accordance with regulatory standards. Additionally, addressing the complexities of joint pole agreements is essential in mitigating risks associated with third-party attachments, pole maintenance and removal.

AEGIS Loss Control is available to discuss, review and/or evaluate electric maintenance programs with member companies. Please contact Laura Strowbridge at laurastrowbridge@aegislimited.com or 201-289-0787 or your assigned Senior Electric Utility Professional.

References

Bishell, A. and Kirker, G. AWPA Biodeterioration Hazard Map Revisited. American Wood Protection Association. Madison, WI. AWPA Biodeterioration Hazard Map Revisited (usda.gov)

Cooperative Business Services. (2018). Tech advisory: NOVEC pole attachment case study. https://www.cooperative.com/programs-services/bts/Pages/Case-Study-How-One-Cooperative-Leveraged-Data-to-Advance-its-Pole-Attachment-Policies.aspx

Institute of Electrical and Electronics Engineers. (2023). National Electrical Safety Code (NESC) (2023 ed.). IEEE-C2.

U.S. Department of Agriculture, Rural Utilities Service. (2013). RUS Bulletin 1730B-121: Specifications for the installation of overhead electric distribution lines. Pole Inspection and Maintenance (usda.gov)