Make a more resilient grid possible today

Scheduled System Inspection: The Foundation to Safe Operation

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AN OBSERVED DISTINCTION

• In my role as a director of business development, I call on primarily three types of customers who own utility poles: Rural Electric Cooperatives, industrial facilities, and municipalities.

• There is a striking observed difference: almost all REMCs and industrial pole owners in my footprint have a plan in place to have their poles systematically inspected by professional pole inspectors.

• However, many municipal pole owners either do inspection in-house with linemen who may lack expertise in wood pole decay or actually have no plan in place for system inspection at all.
I HOPE HE WAS JOKING...

• I asked a superintendent of a muni down in Kentucky to explain their current pole inspection plan to me. Here is his verbatim reply:
  • “If they are standing up, they’re good. If they are laying down, they’re bad.”
• That philosophy will make a lawyer lick his lips!
• With an uninspected system, it is only a matter of time until someone gets hurt: your lineworker, a landowner, emergency responders—and ultimately, the ratepayers!
  • An uninspected system should keep you up at night!
NESC CODE REQUIREMENTS

• The NESC requires that utilities maintain their wood poles in such a way that each pole in service has at least 2/3 of its original in-service design strength.

• Unless you are inspecting your poles with a means to determine remaining strength, how do you comply?

• If doing in-house inspections, visually or perhaps with a sound and bore technique, can your lineman determine the pole’s estimated remaining strength if decayed?
HEAR FROM AN INDUSTRY EXPERT:

• Dr. Jeffrey Morrell is an expert in the field of wood utility poles at the Oregon State University Department of Wood Science & Engineering. Here is what he says about pole inspections:

• “The National Electric Safety Code mandates that utilities maintain their wood poles so that they retain 2/3 of their original required design strength. In order to meet this requirement, utilities **must** establish some **regular program** of inspection and maintenance.” (North American Wood Pole Council technical bulletin, *Estimated Service Life of Wood Poles*, 2008, bold added. www.woodpoles.org)
REGULAR POLE INSPECTION BENEFITS:

• **Helps comply** with NESC requirements by identifying below-strength poles on the system

• **Manages** pole replacement instead of responding in emergency situations—much safer and cheaper work

• **Can identify** many unsafe conditions—benefits lineworkers and the public we serve

• **Reduces liability exposure** that results from decayed poles and other unsafe conditions

• **Improves** system reliability & resiliency, resulting in increased revenue and a more satisfied customer base

• **When coupled with application** of remedial treatment, helps manage wood pole plant for optimal financial outcome
HOW OFTEN SHOULD A POLE PLANT BE INSPECTED?

• The American Wood Preservers Association has established decay severity zones. Thus, your geographic location should drive the regular inspection interval.

• All of Michigan is in the moderate decay zone, as seen below:
1.1 Scheduling the Inspection and Maintenance Program:
If an ongoing maintenance program is not in place, the suggested timing for initial pole-to-pole inspection and subsequent re-inspection is shown in Table 3-1. Supplementary treatment is performed where necessary after the initial inspection.

<table>
<thead>
<tr>
<th>Decay Zone</th>
<th>Initial Inspection</th>
<th>Subsequent Re-inspection</th>
<th>Total Poles Inspected / Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12 – 15 Yrs</td>
<td>12 Yrs</td>
<td>8.3%</td>
</tr>
<tr>
<td>2 &amp; 3</td>
<td>10 – 12 Yrs</td>
<td>10 Yrs</td>
<td>10.0%</td>
</tr>
<tr>
<td>4 &amp; 5</td>
<td>8 – 10 Yrs</td>
<td>8 Yrs</td>
<td>12.5%</td>
</tr>
</tbody>
</table>

TABLE 3-1 – Recommended Pole Inspection Schedules

p.6
WHAT TYPE OF INSPECTION METHODOLOGY?

• In order to address the question of what inspection type is best, we need to understand what we are looking for when inspecting poles.

• To some degree, that is driven by the species and original treatment of the pole: there are large variables in observed patterns of decay between thin (cedars, firs) and thick (pines) sapwood species.

• In all poles, fungal decay is the primary concern, followed by insects and mechanical damage.
WHY DO POLES DECAY?

Why Do Wood Poles Fail?
86% Fail due to fungal decay
12.5% Fail due to insects
1.5% Fail due to accidents
DECAY PATTERNS VARY WITH SPECIES

• Fungal decay on southern pines typically starts on the surface of the pole and below ground.
• Through various means, fungal spores can migrate to the heartwood, which does not absorb the initial preservative very well.
• Since about 85% of all distribution poles in America are southern yellow pines, using an inspection methodology that can detect decay below ground is imperative.
DECAY PATTERNS VARY WITH SPECIES

• For the Western Cedars and Douglas Firs, decay can also start internally
• It is also not as concentrated at or below ground as in the pines
• Thus, inspection methods here especially need to be able to detect internal decay conditions above ground
• The best inspection programs incorporate several inspection types into what comprises the scope of work
TYPICAL SOUTHERN PINE POLE DECAY:
Thin sapwood species (Douglas Firs and Western Cedars) can develop decay externally. They also tend to develop scattered internal decay pockets. Early detection of internal decay and fumigation is needed.
WOOD POLE AGING PROCESS
THE RULE OF SIX

• Most of the strength of a pole is in the shell, the outer few inches of wood
• Thus, loss of only a little of the exterior surface is critical to the overall strength of pole
• 1” deep decay, 360 degrees around a pole equates to 6” loss of effective circumference; ½” deep = 3” loss
• The pole on the left is an average distribution size pole, at 32” original circumference
• It has shell rot about ¾” deep all the way around the pole, reducing its effective circumference to 27.5”
• This pole is at about 63% remaining strength—a reject
INSPECTION IS BEST COUPLED WITH EVALUATION OF REMAINING STRENGTH

StrengthCalc: Osmose Proprietary Evaluation Tool

• This is the tool we use to determine remaining strength
• It accounts for observed decay types which are entered into the tablet used to collect the data
• An engineering grade solution is returned taking into account the orientation of decay to line of lead
• Call me for a live demo!
Variations in Pole Inspection Technique

Commonly referred to as “Program Type”

Each inspection technique has a different level of accuracy with respect to identifying rejects.

- **Visual**: 98%
- **Sound**: 90% - 70%
- **Bore**: Up to 50%
- **Partial Excavate**: 15%
- **Full Excavate**: 10%
POLE INSPECTION AND TREATMENT

Visual Inspection
VISUAL INSPECTION FINDS THE WORST OF THE WORST:

- Visual inspection can find a few rejects when decay has been allowed to progress very far.
- We estimate about 10% of rejects on a system will be found when this is the only inspection type employed.
- Other needed maintenance items on overhead issues can often be detected and reported.
POLE INSPECTION AND TREATMENT

Sounding
POLE INSPECTION AND TREATMENT

Boring
POLE INSPECTION AND TREATMENT

Probing: Once bored, a calibrated shell indicator is used
INSPECTION METHODS

Partial Excavate Options – Pull Back

Often is used to screen for decay: in better programs, poles with decay are then fully excavated and treated.
POLE INSPECTION AND TREATMENT

Full excavation: 18” deep
ALTERNATIVE INSPECTION TOOLS & METHODS

- Polux
- PoleTest
- Hot Shot Radar
- Resistograph
- MPT
- PoleScan
- Pole Tester
- Pole Radar
ALTERNATIVE POLE INSPECTION METHODS:

• Many devices have been hailed as a substitute for a trained inspector looking below ground.
• We maintain an active R&D program and test them all.
• To date, no reliable alternative method has been found.
• RUS Bulletin 1730B-121 opines on one such device and concludes: “…not a substitute for traditional inspection because it does not detect decay, especially below ground.” (section 5.2, p. 10)
• That statement can apply to most of these devices.
• Before setting up a program that relies on alternative inspection tools, do your research on the inherent limitations of the method.
INSPECTION METHODS AND ACCURACY

- Southern pine poles almost always start to decay below ground
- All poles, regardless of species or treatment type, eventually decay

Accuracy of inspection increases as more of the below ground portion of the pole is exposed

A skilled inspector is needed to detect internal decay
How Sustainable is Your Present Approach?

Take total number of poles in your plant and divide by total number you replace annually. That tells you how long you need each pole to last. Remedial treatment of poles to extend asset life is the most economical way to create a sustainable system. There are only two ways to bridge a gap:

replace more poles per year
or
get more years per pole by remedial treatment

(See RUS Bulletin 1730B-121, 3.2, p.7, last paragraph)
REMEDIAL TREATMENTS AND SERVICE LIFE
OBSERVED SURVIVAL RATES
-PROJECTED GENERAL LINEAR MODEL-

450,000 in-service poles with no remedial treatment
150,000 in-service poles with previous remedial treatment

2x remediated poles remaining vs. non-remediated

Differences in the % of poles remaining begin to show in the 21 to 25 age range, when poles without pole inspection and remediation begin to fail at much higher rates.
Life Extension of the Asset

Projecting reject rates for poles past age 50 shows an even larger life extension due to pole treatment.

Lifecycle distribution example

Poles in pole inspection and remediation programs experience an average 20 year or ~50% increase in lifespan.

Reject rates were modeled using a best fit general linear model based on decay rates for poles ages 0 to 50.
CAN YOU AFFORD NOT TO TREAT POLES?

• One customer did a deep-dive internal economic analysis of the costs of treating poles versus simply inspecting poles
• They based this off 20-plus years of data
• Their answer to the question of whether they should treat their wood poles:
  • “Yes, we can afford to. Better put, we can’t afford not to.”*
HEAR NESC CHAIRMAN NELSON BINGEL:

• The total lifetime costs of treating a wood pole typically amount to about “5 percent to 8 percent of the pole replacement costs when they range from $3,000 to $5,000.”

  • “This cost yields results of a significant 60 percent increase in average life for an additional 5 percent to 8 percent in cost over the life of the pole.”

REMEDIAL TREATMENT SYSTEMS

• The best programs include external pastes, internal liquid treatments for enclosed decay pockets, and fumigation systems for early internal decay or poles that cannot be excavated; fumigation of all thin sapwood poles is recommended

• When we find a pole with detectable decay and leave it untreated, the data establishes that at least 50% of such poles become rejects within 10 years

• When we apply remedial treatments to such poles, data establishes that about 95% will still be serviceable at the next 10 year inspection interval
WEIGH PROGRAM COSTS AGAINST ASSET VALUE

• Let’s say you own 2000 poles with an average replacement cost of $2500. That pole plant is a $5,000,000 asset

• If you inspect 10% of your system annually with a best in-class inspection and treatment program, your annual costs might be about $10K-$20K

• Thus, you would be spending only .2% to .4% of the asset value on routine annual maintenance

• I submit that a robust pole inspection plan is one of the best bargains a utility provider can purchase

  • You can neglect this maintenance and “get by” for a season, but it will always catch up to you in a painful way
EXTERNAL PASTE APPLICATION
FUMIGANT APPLICATION
LIQUID INTERNAL TREATMENT
RESTORE REJECTED POLES

• Regardless of how you inspect poles, the question of what you do with rejects is important

• Rejected poles do not have to be replaced. By code, they can be restored with the proven Osmose C-Truss system—the industry standard for pole restoration—at a fraction of the replacement cost

• Most accounting practices allow for these to be capitalized as our trusses have an established track record for longevity: average life extension for a restored pole is well over 25 years, some have been in service 50 + years

• There is the added benefit of an immediate reduction in liability when the pole is restored

  • A backlog of known rejected poles should keep you up at night!
REMEDIATE REJECT POLES WITH OSMOSE C-TRUSS

Pole Life Extension
- Average over 25 years life extension: some have been in place almost 50 years

No Service Interruptions
- Installed while lines are energized

Engineered Solution
- Optimized design for efficient code compliance

Cost Effective
- Typically only a fraction of replacement costs

RUS Approved
- 100% capitalized cost approved
RESTORE REJECTED POLES

**Restoration**
- Low cost alternative
- No service interruptions
- No scheduling
- Short timeline, Lowers risk
- 100% Capital investment
- Clean, unobtrusive and aesthetic
- Long-term life extension
- No transfers, No switching
- Reduced field Safety exposure (Pole Pulling and Transfers)
- No design/engineering
- Exact strength at groundline as replacement

**Replacement**
- High cost activity
- Potential service interruptions
- Complex scheduling
- Long timeline, Increases risk
- O&M expense required
- Unattractive double wood
- New pole life expectancy
- Requires transfers, possibly switching
- Increased field Safety exposure (Pole Pulling and Transfers)
- Involves design/engineering
OSMOSE HAS END-TO-END SYSTEM SOLUTIONS:

• Call for information on:
• Pole inspection programs
• Pole restoration programs
• Padmount inspection programs
• Substation structure corrosion mitigation options
• Joint-use audits
• A complete line of industry-leading products: guy markers, pole toppers, rodent guard, tagging, pole management software, etc.
Thank you!

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