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# PROACTIVE WOOD UTILITY POLE MANAGEMENT BY NON-DESTRUCTIVE TECHNIQUES

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## Introduction

Many power utility companies in Canada and the United States still use the traditional "bore and treat" method to inspect wood poles. The method utilizes a ½ inch hand drill to estimate the remaining shell thickness. Then based on the remaining shell thickness decisions are made whether to replace the pole or treat it to extend its life. The damage to the pole by the drilling may not be structurally any significant; however, some of the side effects the holes may even result in the replacement of the pole. The holes may become entry points to water and insects, especially carpenter ants, which may destroy the pole in 2-3 years if not properly treated. This method has served the industry very well when there was no other better alternative.

In the recent two decades several alternative methods have been proposed based on the non-destructive approach. Each one of the methods has advantages and drawbacks over the traditional "bore and treat" method. There has been a misconception that the equipment based on the new nondestructive technique will provide all the information about a pole once it is applied to the pole. This is absolutely not correct and the non-destructive equipment is only an important tool in pole testing and evaluation. Human interaction is very essential in any type of pole inspection, whether it is traditional or non-destructive. The method, compared to the traditional method, also provides more accurate and consistent information on the condition of the pole.

The proposed pole inspection and testing procedure is a healthy combination of the traditional and non-destructive methods and avoids drilling holes in the poles. The procedure is outlined in the following steps:

- Use the traditional sounding/hammering the pole to locate weak points at various pole heights.
- Use a reliable non-destructive equipment to assess pole strength at ground line and other necessary locations.
- Check pole for surface decay, mechanical defects, insect damage etc.
- If required, use any other non-destructive method to complete the inspection and testing
- Using the information gathered above and structural code requirements decide on the future status of the pole.
- The information gathered can also be used to decide whether a pole requires remedial treatment or not

This type of pole inspection or similar has been applied by several utility companies in North America for distribution poles.

## Basic Non-Destructive Test Techniques (NDT)

There are several NDT techniques available to test wood poles in the field. The following is a list of techniques, which have been used to develop instruments for field use.

- Ultrasonic and stress wave techniques
- Dynamic response techniques
- Energy absorption techniques
- Other techniques: X-ray, microwaves etc.
- Electronic drilling

Some of the instruments, which are currently in use, are listed here. A summary of their characteristics listed in Table 1.

- DmP Microprobe
- Resistograph
- PURL
- ImRa
- XP-1 Pole Tester
- Poletest
- POLUX
- CLUE

In this study, an instrument based on ultrasonic technique is used for testing poles.

## Traditional Pole Management Program

It is important to briefly review the traditional pole testing procedure, which has been used by utilities for decades before the current techniques were not developed. The key steps in the program are:

- Visually check pole for any obvious defects or damages
- Sound pole for internal decay
- Bore the suspected poles using regular ½ inch or so drill

**Table 1: Characteristics of NDT Instruments***

| Tool | Operation Principle | Predicts Strength? |
|---|---|---|
| **DmP Microprobe** | **Measures penetrating resistance** | **No** |
| **Resistograph** | **Measures penetration resistance** | **No** |
| **PURL** | **Single frequency ultrasonic wave** | **Yes - partial** |
| **ImRa** | **Radio waves** | **No** |
| **XP-1 Pole Tester** | **Gamma radiation** | **Yes** |
| **Poletest** | **A broad frequency ultrasonic wave** | **Yes** |
| **POLUX** | **Measures penetration resistance & humidity** | **Yes** |
| **CLUE** | **Transmission of low frequency ultrasonic** | **No** |

* Reference: CEATI Report No. T994700-5005, June 2001

- If pole is hollow or excessive external damage replace
- Treat poles if necessary

Even if an experienced crew may perform the testing, the main disadvantages are:

- There is no consistency in the outcome because, among other things, it entirely depends upon the experience of the inspector
- The boring causes structural damage to pole
- The holes could serve as entry points to water and insects such as carpenter ants.
- It just separates the bad poles from good ones, but dose not provide any information on poles that have partial degradation

There is no doubt that this method served the industry well in the past; however the inspection and testing of poles could be improved by using the new non-destructive techniques, which will be described below.

## Non-Destructive Pole Management Program

It is important to choose the appropriate NDT instrument and then develop an inspection and testing program to gather the necessary information for an effective pole management program. The following are the main steps in such a program:

- Select a suitable NDT technique
- Develop a method for field application
- Collect relevant information about poles including strength, mechanical condition etc.
- Use the information in pole management and life extension
- Establish a database for future use

It should be understood that the NDT instrument is only a tool to provide an assessment of the remaining pole strength and does not decide the overall condition of a pole because the physical condition of a pole also considered in the pole management process. The ultimate objective of a pole management program is that replacement is only a last option and every effort should be made to extend the pole life. In other words the rules of preventive maintenance should be applied.

## Data Required for Pole Management

The following items should be gathered for each pole in the field for establishing an effective pole management:

- A measure of pole strength
- Extent of mechanical defects such as surface rot, crack, arms rot and top split
- Extent of carpenter ants or insect damage
- Internal decay at, below, and above GL
- Details on installation date, original and remedial treatment, height, class etc.
- Condition of pole below ground line
- Any other relevant information

## Tools Required for Pole Inspection and Testing

It is important to choose the right type of tools for pole inspection and testing in the field. The suggested list of tools is given below:

- A reliable testing equipment, preferably one that estimates strength
- An electronic drill with drill bit not larger than 2 or 3mm for checking interior pole decay
- A caliper to measure pole diameter
- A shovel to dig below ground line

- A set of binoculars to check pole top decay
- A standardized sheet or hand-held computer to enter data
- A camera to record damages etc.

These tools assist the pole inspector in gathering consistence information on poles.

**Requirements of an NDT Tool**

The following points should be observed in choosing an NDT instrument to meet the technical and economical viabilities.

- Predicts pole strength or provides relevant information on pole strength
- Compact and simple to operate in field
- Less time consuming
- Relatively inexpensive
- Least destructive

An instrument that is expensive and time-consuming to use in the field may be less practical for every-day application. It should be understood that a more sophisticated and expensive instrument does not necessarily gives more accurate results.

**Non-Destructive Testing Instruments Chosen for the Field Application**

A number of techniques were evaluated for field use and the following were chosen for field application:

- An ultrasonic instrument capable of assessing remaining pole strength
- A drill with a very small bit and capable of generating pole resistance as a function of diameter for checking the internal decay below and above ground line.

These instruments in general meet the requirements listed earlier. Samtech has tested thousands of poles using the above instruments and is confident that the end results are very reliable. It is important to remember that any instrument is as good as the field inspector; the human interaction is very important in using the instruments.

**Mechanical Defects and Insect Damage**

For any non-destructive pole management program to be useful the pole strength and the following basic information should be collected during the field inspection and testing. This information is necessary to assess the current pole condition as well to predict the condition of the pole a few years into the future.

- Cracks or checks which are convenient entry point for insects such as carpenter ants and water, which may lead to possible decay

- Surface rot at below and above ground line
- Loss of outer wood which may lead to reduced pole strength
- Loss of treatment leading to possible surface decay
- Pole top feathering or split, which may lead to loosening or loss of hardware (clamps, bolts etc.)
- Carpenter ants (once infested pole could be severely damaged in 3-4 years)
- Cross arms and joints for rot

## Pole Inspection and Testing

The following is a brief outline of pole inspection and testing in the field. The outline is also shown in the block diagram.

- Collect information on mechanical defects and insects damage discussed above
- Sound pole at ground line and above to identify weak locations
- Use ultrasonic tester to get strength reading at ground line and other locations, as required
- Apply the special drill, if required, to detect internal decay above and below ground line; avoid using a standard hand drill because it may cause further damage
- End testing
- Make recommendations on pole replacement, pole retesting etc.
- Suggest, wherever necessary, the type of treatment for pole life extension

The procedure is outlined in the block diagram in the next page.

## Benefits of a Non-destructive Pole Management Program

The benefits of a non-destructive pole management program can be classified as follows:

- No structural damage to poles
- Consistent and more precise results
- No drilled holes, which can act as entry point for insects and water leading to decay
- Results in remaining pole strength or related information
- Information gathered could be used in estimating remaining life of poles
- Resulting database is very beneficial for future management planning

## Establishing A Database and its benefits

Making use of the data collected during the field inspection and testing of poles a database, which can be utilized for the following purposes, can be established:

- A permanent record for future use
- To assess pole capacity for future upgrading
- To estimate degradation of poles on a short term basis
- To plan long-term maintenance plans
- To add to the existing database

## Summary and Conclusions

The program discussed in this paper uses non-destructive techniques to manage poles in the field. It provides information not just on pole condition but also on how to manage the poles in the next several years by establishing a comprehensive database on poles tested.

The proposed program, if implemented properly, could extend pole lives and thereby reducing maintenance cost.