Transmission Tower Maintenance
Bottom Line Savings Through Active Maintenance

PPG Protective & Marine Coatings

Introduction

Transmission towers/poles are among an electrical utility's largest and most important commercial assets. Unfortunately, as the need to generate profits and shareholder dividends has intensified, regular investment in tower/pole maintenance has often been reduced or eliminated to cut costs. Ironically, such cost-saving measures have the potential to double or triple long-term maintenance costs while increasing the risk for power outages and public safety problems.

This white paper describes how electrical utilities can implement active transmission tower/pole maintenance programs, and details the long-term cost savings they can realize when they use them in place of reactive, "fix-as-needed" maintenance regimes.

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On Top of Tower Maintenance

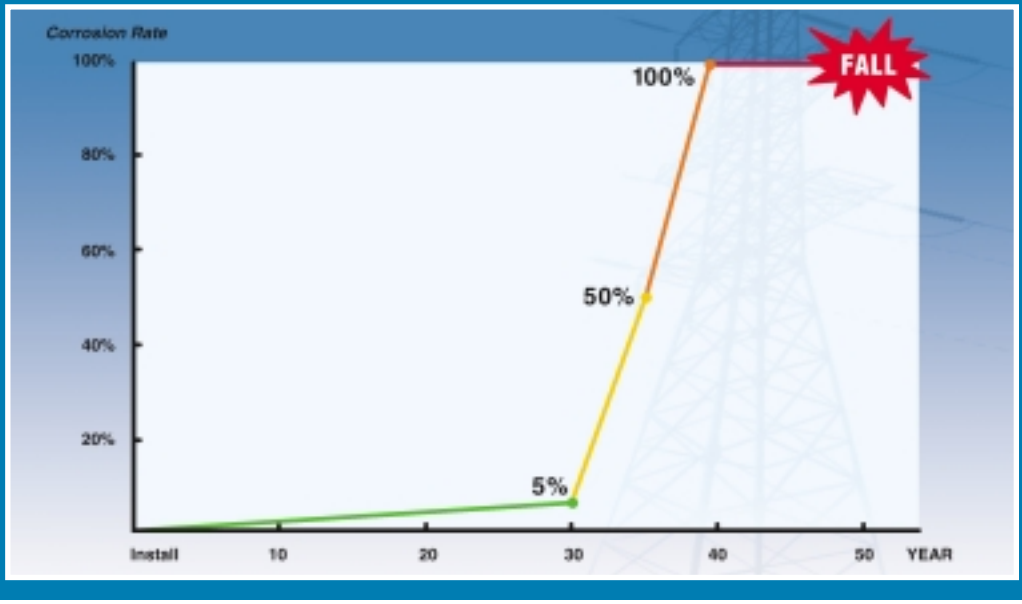
The Principle of Exponential Corrosion

There are hundreds of thousands of transmission towers in the United States, operated by more than 3,200 electrical utilities[1]. These poles and lattice works of galvanized steel typically range from 50 to 180 feet in height, but can reach 900 feet or more. In the United States, the vast majority of these structures were built between 1960 and 1990, which means they have had or will soon be needing maintenance and/or repairs.

Depending on where they are situated, galvanized transmission towers/poles can function for 20 to 35 years before showing the first signs of corrosion. While galvanized steel in rural or desert settings may remain rust-free for up to 50 years, coatings in salty coastal air or heavy industrial environments may only do so for 15 years or less.

Unfortunately, once the corrosion of a galvanized transmission tower/pole does begin, it advances exponentially. As the chart below indicates, a tower/pole with less than 5 percent rust at age 30 can oxidize to the point of failure within ten years. More critically, as the corrosion of the tower/pole accelerates, so too can the cost of time, labor and materials to repair it.

THE PRINCIPLE OF EXPONENTIAL CORROSION



Footnote:

[1]: http://www.eia.doe.gov/electricity/page/prim2/toc2.html

Four Phases of Corrosion

The following section depicts transmission towers through four phases of corrosion and describes the physical condition of each.

PHASE I

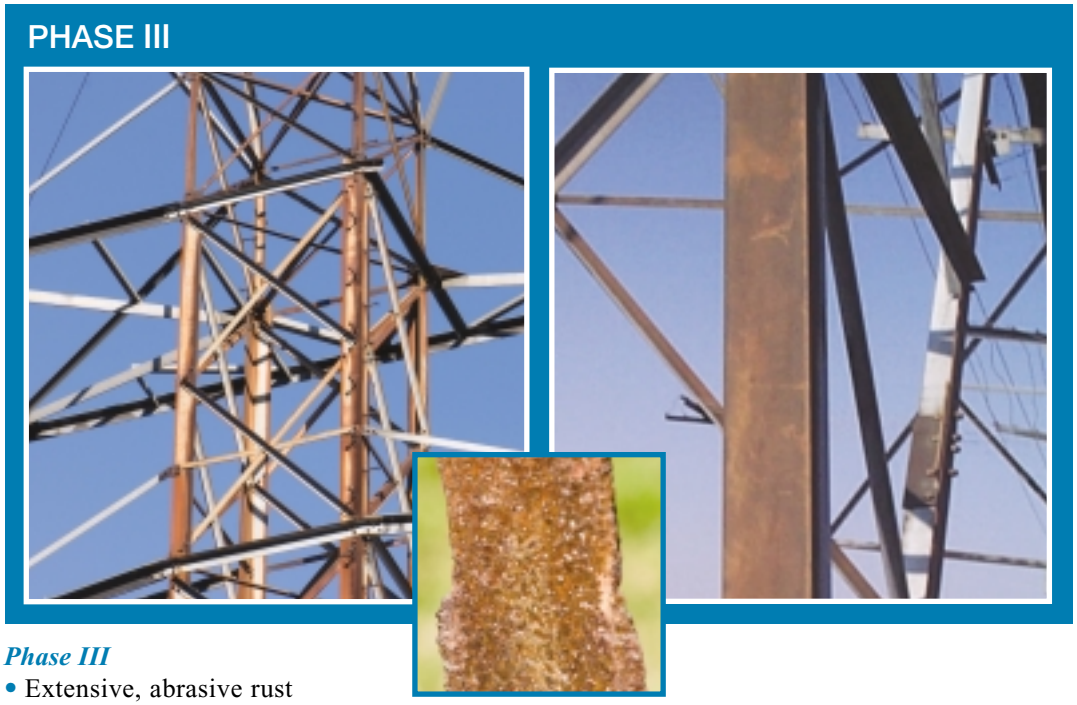
Phase I

- Coffee stain rust (cosmetic, not structural)
- 5% rust
- On edges and bolts
- Approximately 1-2 mils of galvanization remains

PHASE II

Phase II

- Abrasive rust
- On bolts, edges and horizontal flat areas
- Rust falls off on touch



Phase III
- Extensive, abrasive rust

Phase IV
- The tower falls

Managing and Budgeting for Repairs

When corrosion begins to consume a transmission tower/pole, the key to managing repair costs is to arrest its progress before the unit transitions from one phase of corrosion to the next. For electrical utilities, the optimal solution is to repair the entire inventory of towers/poles as early as possible in *Phase I*, when it is less costly. Unfortunately, that simply is not possible for most utility companies because of budget constraints and the varied ages of the towers/poles in their inventory.

The following chart details the repairs and costs for tower maintenance in *Phases I, II* and *III*. The cost of repairing or replacing a tower in *Phase IV* is total.

Description and Cost of Repairs

Phase	Tower Condition	Repair Regimen	Cost (per tower)*
Phase I	• Coffee stain rust (cosmetic) • 5% rust • 1-2 mils of galvanization remain	• Minimal cleaning (5%) • One coat of paint • One summit of tower	**$2,750**
Phase II	• Abrasive rust • On bolts, edges and horizontal flats • Rust falls off upon touch	• Cleaning (up to 50%) • Spot or full primer as needed • One coat of paint • Two summits of tower	**$5,555**
Phase III	• Extensive, abrasive rust	• Cleaning (75 to 100%) • One full coat of primer • Optional intermediate coat • One coat of paint • Three summits of tower	**$8,883**

Prioritizing Repairs

As the chart demonstrates, because of the relative difference in cost and labor, repairs for *Phase III* damages can be up to 70 percent more expensive than *Phase I* repairs. For this reason, the most effective way to maximize maintenance expenditures is not to fix towers/poles needing the most or least extensive repairs, but to fix those closest to transitioning from one phase to the next.

According to this protocol, repairs to towers/poles early in *Phases I, II* or *III* are typically deferred to those later in each phase. This approach not only saves several thousand dollars per repair over the short term, but also allows utilities to plan on-going repairs in the most systematic way possible.

Long-Term Cost Savings

When electrical utilities were deregulated in the late 1980s, there was an immediate and dramatic drop in the resources directed to transmission tower maintenance. Although utilities often owned or maintained thousands of transmission towers/poles, for many the organizing goal shifted from delivering power to maximizing return on investment. As a consequence, many of today's transmission towers/poles are in need of significant repair.

The chart below shows how much money utilities can save by actively maintaining large transmission tower/pole inventories compared to allowing them to deteriorate before repair.

# of Towers	Phase of Corrosion	Cost of Repair (per tower)	Total Repair Cost	Added Long-Term Cost
5,000	Phase I	$2,750	$14 million	
	Phase II	$5,555	$28 million	$14 million
	Phase III	$8,883	$44 million	$30 million
10,000	Phase I	$2,750	$28 million	
	Phase II	$5,555	$56 million	$28 million
	Phase III	$8,883	$89 million	$61 million
25,000	Phase I	$2,750	$69 million	
	Phase II	$5,555	$139 million	$70 million
	Phase III	$8,883	$222 million	$153 million

** Figure based on standard 50- to 180-foot galvanized steel transmission towers.*

In addition to saving millions of dollars, an active maintenance program delivers the benefits of increased employee and public safety, a lower risk for power outages, and the goodwill of the community for towers that are clean and attractive.

PPG's "Eliminate The Movement" *Program*

A Plan for Active Transmission Tower Maintenance

PPG Industries offers a comprehensive maintenance program designed to "eliminate the movement" of transmission towers/poles from one phase of corrosion to the next. Elements of the program include the following:

- Application of Keeler and Long's *KL4400* Series Paint, an anodic, self-priming PPG paint engineered specifically for use on electrical transmission towers, bridges and substation structures
- Free structural grid evaluations, including on-site surveys by trained and experienced PPG personnel
- Recommendations of trusted and qualified repair contractors
- Development of maintenance plans, including prioritization of repairs
- Paint specification proposals
- Application consultation
- Proposed budgets

Below Ground Inspections, Too

PPG's *Eliminate the Movement* program includes thorough underground evaluation of transmission towers and poles, which deteriorate faster than visible sections due to constant exposure to sub-surface moisture, alkalis and other hazards.

About *KL4400* Series Paint

KL4400 Paints are technically advanced coatings developed specifically for the power industry by Keeler & Long, a leading coatings manufacturer with decades of experience in the power industry. Keeler and Long's anti-corrosive coatings provide year-round protection from severe weather as well as the contaminants and aggressive exposure associated with heavy industrial environments.

In addition to self-priming on weathered galvanized or previously painted steel surfaces, ***KL4400*** Series Paints offer the following benefits:

- Lowest cost-per-square-foot, per-year protection
- Minimal surface preparation
- Excellent surface wetting ability
- Single-coat application
- Easy application by brush or mitt
- Low-VOC formulation
- 90% solids by volume
- Single-component

To learn more about Keeler & Long's coatings for the power industry or PPG's *Eliminate The Movement* transmission tower maintenance program, visit **www.keelerandlong.com**, call **1-888-9-PPGPMC** (1-888-977-4762) or email **PMCMarketing@ppg.com**.

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