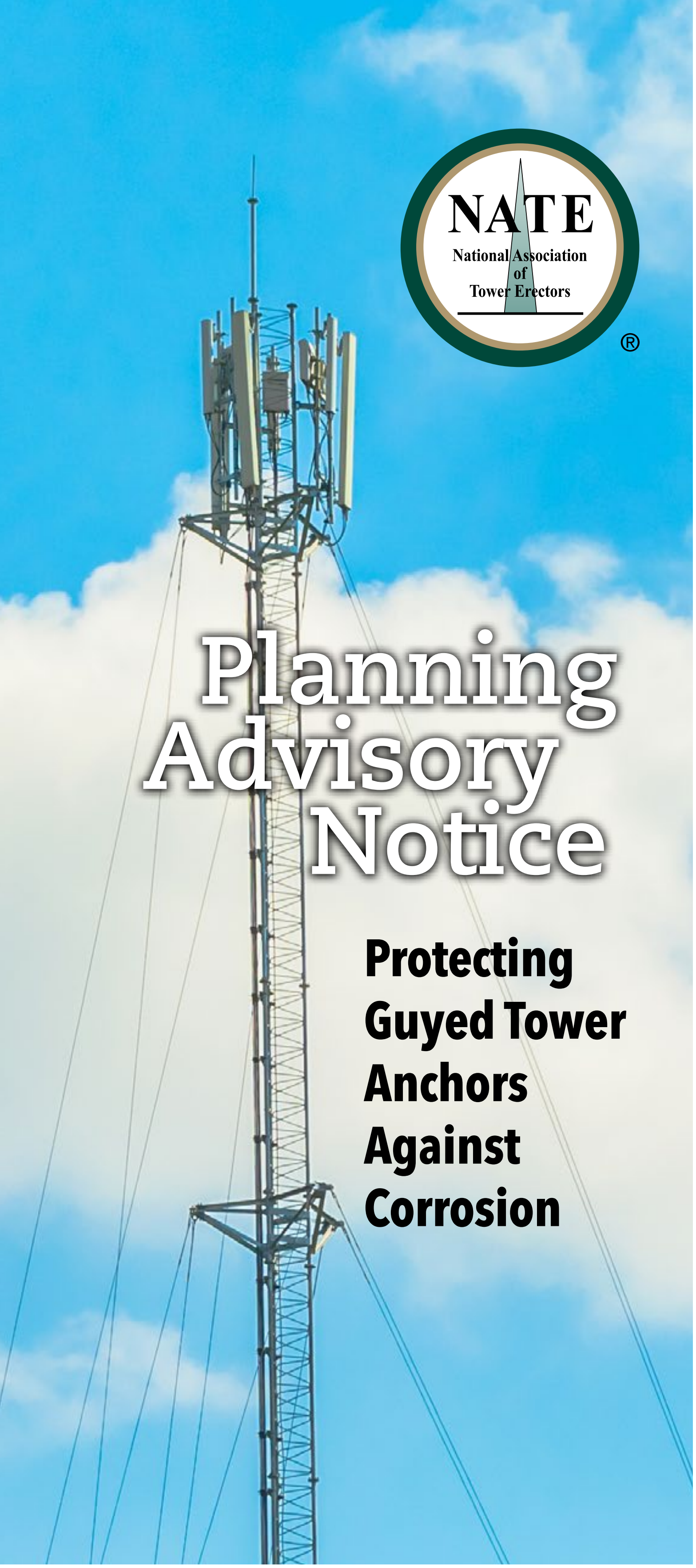

Planning Advisory Notice

Protecting Guyed Tower Anchors Against Corrosion

Guyed towers are popular because of their economical advantages over self-supporting and monopole towers. They can be constructed to much greater heights for significantly less cost per foot. But many towers have failed due to a lack of understanding of the risk of corrosion to the guy anchors.

> Guyed anchors require special attention in order to protect them against corrosion on the underground portion of the shaft.

The members of the **PAN Advisory Group** who are involved in writing and researching each PAN topic include **Scott Kisting** (Vice President, MUTI-Sabre Industries Telecom Services), **John Erichsen** (Principal EET PE, Chairman TIA Committee TR 14), **Craig Snyder** (President, Sioux Falls Tower & Communications) and **Stephanie Brewer** (Compliance Coordinator, MUTI-Sabre Industries Telecom Services).

Corrosion is an electrochemical process. It is the tendency of a refined metal to return to its native state. There are four elements essential in order for a corrosion cell to function as illustrated in Figure 1. They include; 1) an anode, 2) a cathode, 3) an electrolyte and 4) an electrical path between the anode and cathode. These four elements are inherent with a typical guy anchor design and therefore can lead to corrosion as seen in Figure 2.

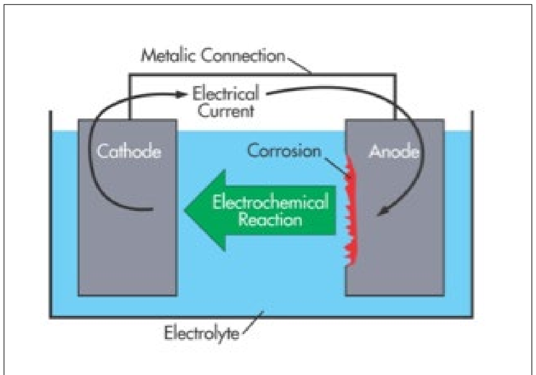

Figure 1:
Basic Corrosion Cell

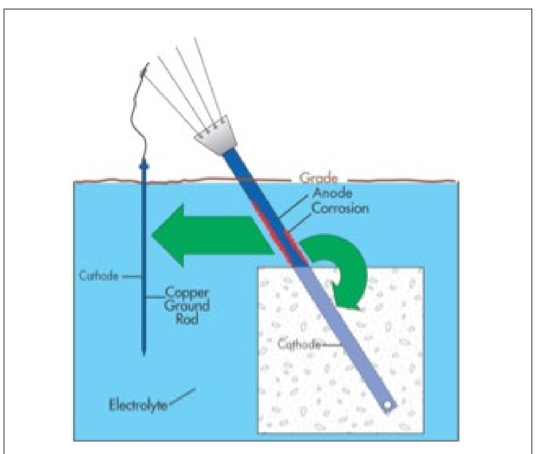

Figure 2:
Typical Anchor Corrosion Cell

There are certain conditions which accelerate the corrosion process. The conductivity of the electrolyte is typically the largest factor. In the example of a guyed tower anchor, the soil is the electrolyte and the portion of the anchor shaft exposed to the soil is the anode. Soil resistivity is measured in ohm-centimeters. The lower the measurement, the more electrically conductive the soil and therefore more subject to accelerated corrosion. If the soil is high in sulfates (salts) or certain other minerals, it will lower resistivity and can contribute to accelerated corrosion. Table 1 shows soil resistivity measurements and their relation to the rate of corrosion.

Table 1: Soil Resistivity Classification

Resistivity in ohm/cm	Category
0 – 5,000	Very Corrosive
5,000 – 10,000	Moderately Corrosive
10,000 – 25,000	Mildly Corrosive
Source: A.W.Peabody – Control of Pipeline Corrosion	

The second most common condition to accelerate corrosion in a corrosion cell is disparity between the size of the anode and the size of the cathode. The larger the cathode, the faster the anode will corrode. This relationship is shown in a typical anchor design in Figure 3.

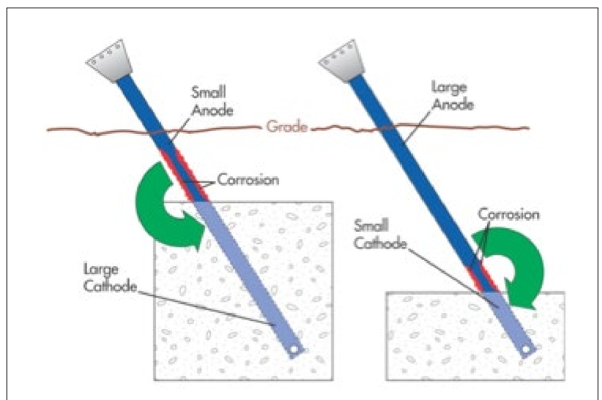

Figure 3:
Anode/Cathode Size Relationship

ANSI/TIA 222-G, Annex G recommends that soil is measured for electrical resistivity and pH as part of the geotechnical analysis. The standard further recommends additional corrosion control measures are taken into account if these measurements fall within a given range. The standard states:

> *"Additional corrosion control methods are required for steel in direct contact with soil when the measured soil electrical resistivity is less than 50 ohm-meter [5000 ohm-cm] and/or the measured soil pH values are less than 3 or greater than 9, for Class II and III structures"*. (ANSI/TIA-222-G, Annex H: Additional Corrosion Control)

The ANSI/TIA 222-G standard calls out these additional corrosion control methods in Annex H as follows:

a) Cathodic protection utilizing sacrificial anodes

b) Cathodic protection utilizing impressed current

c) Concrete encasement of the entire anchor shaft

d) Taping or coating the anchor

The standard states that taping or coating should only be used in conjunction with cathodic protection since anomalies in the coating can actually cause accelerated corrosion at the point where the breach occurs.

Cathodic protection uses the known variables of a corrosion cell to redirect the corrosion away from the anchor shaft and toward anodes as shown in Figure 4. One advantage to this method is the ability to measure the potential of the system to ensure proper voltage is being obtained to achieve cathodic protection. The U.S. Department of Transportation requires buried underground petroleum pipelines using cathodic protection achieve -.85 DC volts in order to be considered adequate protection. Obtaining adequate voltage is usually a function of anode size and quantity.

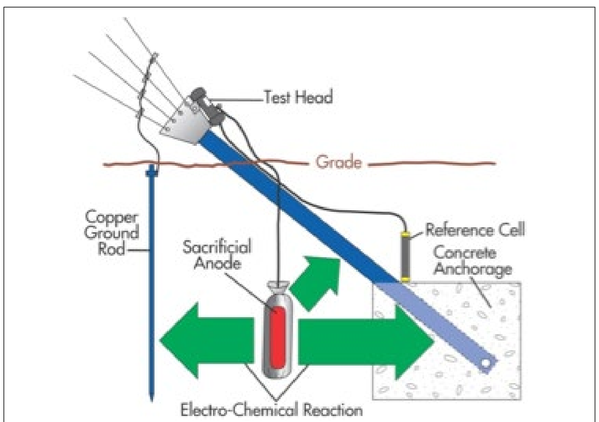

Figure 4:
Sacrificial Anode Cathodic Protection

Another popular method to protect guy anchors against corrosion is concrete encasement as shown in Figure 5. Care should be taken when using this method to protect the anchorage against cracks that could allow accelerated corrosion at the point where the crack meets the anchor shaft as shown in Figure 6. To protect against this ANSI/TIA 222-G states:

"When a concrete deadman is used with an anchor, the reinforcing in the concrete encasement shall be properly developed into the concrete deadman to prevent excess cracking and the concrete encasement shall extend a minimum of 6 in. [150 mm] above grade." (ANSI/TIA-222-G, Annex H: Additional Corrosion Control)

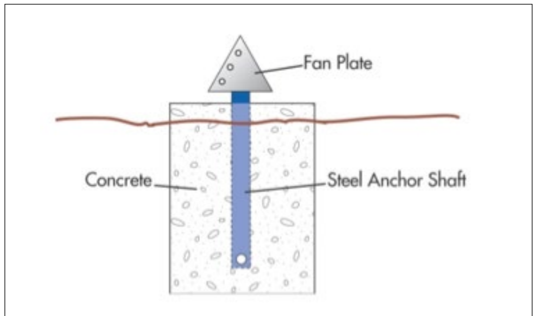

Figure 5:
Concrete Encasement

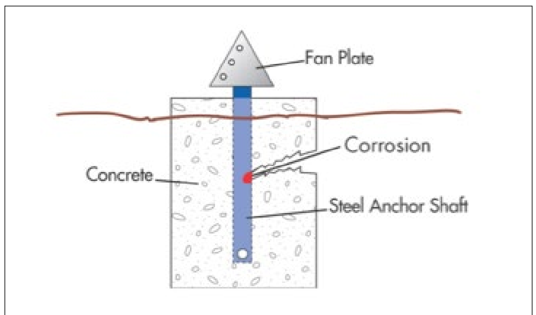

Figure 5:
Cracking Risk of Concrete Encasement

Guyed towers will remain a popular option for elevated antenna systems into the foreseeable future. Protecting guy anchors against the harmful effects of corrosion will ensure these towers meet their design service life. ■

References:

1. *Control of Pipeline Corrosion* by AW Peabody, National Association of Corrosion Engineers

2. *ANSI/TIA-222-G* Telecommunications Industry Association, Washington DC

3. *Understanding and Preventing Guyed Tower Failure Due to Anchor Shaft Corrosion* by Craig Snyder – National Association of Broadcast Engineers – NAB 1993 Proceedings