Lining Up With Steel

Tucson Electric Power evaluates the benefits of switching from wood to steel distribution poles.

By **Roger Hall** *and* **Ron Runion**, *Tucson Electric Power*

While Tucson Electric Power has been providing power to the same community for more than a century, its employees are always on the lookout for new techniques or technologies that might improve service for customers. In recent years, this commitment to quality and innovation has led the utility to begin upgrading its local distribution system with metal poles. While the initial cost of these poles remains higher than comparable wood poles, metal poles are expected to provide good reliability and solid long-term value.

Founded in 1892 and a principal subsidiary of Unisource Energy Corp., Tucson Electric Power has more than 2200 MW of generating capacity and relies on more than 9000 miles (14,484 km) of transmission and distribution lines to serve more than 400,000 customers in southern Arizona.

Comparing Pole Materials

Like most utilities, Tucson Electric Power has historically used wood poles for its distribution system. Most of its 125,000 distribution poles are wood, but the utility has been using steel poles for higher-voltage installations since the late 1960s. More recently, the utility evaluated the benefits of switching to steel distribution poles from Valmont Industries for the 700 to 900 distribution poles it replaces each year through routine maintenance.

Tucson Electric Power set up a team to study several issues in depth to develop a clear understanding of how wood poles compare to those made of steel. The team included employees from engineering, standards, construction, environmental, safety and purchasing.

The utility's transmission and distribution crews already

recognized that steel poles could be engineered to a strength that made them useful as "stoppers," poles that resist being pulled down by nearby facilities during a heavy storm. A life-cycle study uncovered a cost advantage as well: With a life expectancy of 60 years — twice that of comparable wood poles — steel poles can provide good value despite their higher initial cost.

Steel poles can be fabricated with uniform dimensions and conformance to ASTM specifications and tolerances. They can be designed as direct replacements for wood poles or engineered to meet any specific loading criteria — a level of flexibility Tucson Electric Power has come to appreciate.

The Importance of Training

At first, Tucson Electric Power's use of steel poles was met with internal resistance and skepticism. Those attitudes eased as employees grew more familiar with the poles. Tucson Electric Power developed its own specific work procedures for steel poles and gave crews the tools and equipment they needed to work with all types of distribution facilities.

Tucson Electric Power's experience shows the value of training. As engineers and linemen began to understand the benefits of steel poles in terms of installation, life span and reliability, the acceptance of steel as a material for distribution poles increased. This understanding has been facilitated with training materials. As with wood poles, safety requirements and best practices for steel poles are clearly defined and integrated into existing training and maintenance programs.

Best Practices

As Tucson Electric Power crews have gained confidence in working with steel poles, the speed of installation has increased. On average, one of the utility's four-man crews can set a steel pole in a little more than an hour — slightly longer than it takes to install a comparable wood pole. But the steel pole's extended service life more than offsets the slightly longer installation time.

Tucson Electric Power also has developed best practices for working with steel poles. The utility avoids using wood crossarms on metal poles, for example, since manufactured products are expected to provide greater long-term value. Fiberglass crossarms are used on steel poles and wood crossarms on wood poles. This allows wood poles and crossarms to be integrated in appearance and material characteristics. Depending on where the poles are being used, it is sometimes necessary to replace wood crossarms before the wood poles are replaced.

With both steel and wood poles, drilling and preparation for hardware and crossarms can be done off site or at the time of installation. However, most drilling and other preparation of the poles used by the utility is done at the Valmont manufacturing plant. Whether at the fabrication facility or on the job site, some special equipment is required, such as dedicated drill bits and hand tools designed for use with wood or steel and fiberglass. In general, drilling in the field is not a problem.

Also, the center-phase insulator commonly used on wood

Crews relocate a line because of a road improvement project and use steel for the new poles.

Hendrix polymer vise-top center-phase insulator (shown prior to the raptor hood being installed) is the Tucson Electric Power standard.

poles has been replaced with a Hendrix polymer vise-top design on the steel distribution poles of Tucson Electric Power. This newer design eliminates the need to spin a preformed tie wire when the insulator is near the steel pole on under-built or crossarm construction — a best practice for safety. Tucson Electric Power crews use short-pole guards and rubber blankets to cover steel poles when transferring phases. And since linemen do not climb the steel poles, the poles are not used in areas with limited access.

Optimal Use of Coatings for Underground Protection

Tucson Electric Power originally left the bottom 4-ft (1.2-m) section of its weathering steel poles uncoated to provide a better earth ground. After consulting with other regional utilities and testing a few of its own poles, the utility discovered the uncoated poles were prone to underground corrosion.

The utility began experimenting with different coating applications and found that a 40-mil polyurethane coating extending up from the base of the pole to 18 inches (457 mm) above ground level provides optimal protection against corrosion. Because of the minimal cost of coating, Tucson Electric Power now orders fully coated poles to safeguard against chipping during delivery and installation. Standard ground rods are used, and the ground is attached to the steel pole using a tank ground connector bolted to a factory-welded 0.5-inch (13-mm) nut.

Environmental Issues

Metal poles are well suited to the protective measures employed by Tucson Electric Power and other utilities to prevent the electrocution of large birds. In areas where avian protection is an issue, poles are retrofitted with avian covers. Typically, new installations are protected. The modification on three-phase construction usually consists of using raptor hoods over the center-phase conductor. In addition, Tucson Electric Power uses cover-ups on equipment attached to the

pole and insulated jumper wires for wildlife protection. This design feature is not intended to protect utility personnel during energized line work.

Avian protection can be achieved in locations where wood or steel poles are used by establishing standardized practices and equipment. Another alternative is to engineer clearances between lines to provide adequate space and reduce the risk of avian injury.

Another environmental factor relating to the use of steel poles is the material itself. Steel poles incorporate a high percentage of recycled material, and the entire pole can be recycled at the end of its useful life. Some preservative treatments applied to wood poles can limit recycling options, although Tucson Electric Power finds safe, recycled uses for most of the wood poles it takes out of service.

Crew installs cover-up over the steel to provide protection in case of accidental contact with an energized line.

Steel poles are typically available with two finish choices: galvanized or weathering steel. Galvanized poles are coated with a layer of zinc to protect against corrosion, leaving them with a metallic appearance. Weathering steel, generally reddish brown in color, has a protective layer that prevents corrosion. Its color also makes it aesthetically compatible with wood poles. The vast majority of the steel distribution poles at Tucson Electric Power use the weathering finish.

Pole Reliability

The advantages of steel poles would not mean much if they did not also provide solid reliability. For Tucson Electric Power, wind is the most serious source of service interruptions. Severe storms with heavy wind gusts or intense microbursts can knock down poles, particularly during Tucson's summer monsoon season.

In theory, a wood pole of equivalent strength should function the same as a steel pole. In reality, the consistency achieved through the use of steel cannot be duplicated when using wood. Therefore, wood poles require higher strength factors as specified by the National Electrical Safety Code.

Wood poles also can experience loss of strength due to aging and can be weakened by natural causes such as infestation, leading to sudden failures. Steel is a ductile material subject to a different mode of failure. Whereas wood poles often completely break, steel poles tend to bend, leaving lines intact. This feature also helps prevent the wires from pulling down adjacent poles, a situation known as cascading.

Tucson Electric Power will continue to study how the use of steel poles impacts the reliability of its service. The utility is pleased with the performance of steel poles so far, and it seems clear these poles will play an important role in the future operations of the distribution system. TDW

Roger Hall (RHall@TEP.com) began work at Tucson Electric Power's electric repair and test facility in 1986. He now supervises Tucson Electric Power's standards department, where he oversees manuals on distribution materials, distribution construction, tool crib and supply catalogs, electric service requirements and distribution technology. His work helps ensure Tucson Electric Power's system is built and maintained in accordance with the utility's high standards for safety and reliability.

Ron Runion (RRunion@TEP.com) has been in line construction at Tucson Electric Power since 1977. He has worked in all areas of transmission and distribution construction, from apprentice to cableman to crew leader. In 2001, he was appointed to the utility's distribution standards committee and earned the position of T&D group leader for emergency response. Runion is currently focused on improving Tucson Electric Power's apprenticeship program and overseeing the protection of its overhead and underground facilities. He also volunteers with Habitat for Humanity and numerous other local causes.

Companies mentioned:
Hendrix Wire & Cable Inc.
www.hendrix-wc.com
Tucson Electric Power
www.tucsonelectric.com
Unisource Energy Corp.
www.uns.com
Valmont Industries
www.valmont.com