Ironing Out Pole Problems

Using ductile iron utility poles are a textbook case of a new application for an age-old product.

By **Keith Kropf**, *Florida Keys Electric Cooperative*

At first blush, the idea of distributing a steady, reliable stream of electricity to the Florida Keys almost defies logic. There is one challenge after another. The chain of some 1700 islands off the tip of the Florida peninsula extends all the way to Key West, which represents the southernmost point in the continental United States. It is literally the end of the line — as far away from mainland power sources as one can get. Minuscule and surrounded by water, none of the islands are more than 20 ft (6.1 m) above sea level, so there is an ever-present risk of flooding. And, of course, the seasonal threat of devastating winds and storm surges from hurricanes is in the air with recurring regularity.

Nevertheless, the Keys are a haven for tourists, snowbirds and the loyal "Conch Republic" residents who live there year-round. But some of the same environmental conditions that contribute to the tropical atmosphere make power distribution all the more problematic. Intense sun, heat and continuous salt spray lead to ultraviolet damage and corrosion of most traditional types of equipment. Utility poles are no exception. Problems with wood, concrete and steel are exacerbated by virtually every aspect of the harsh environment, including sandy soil, coral rock, tidewater and the potential for triple-digit winds. Therefore, innovative, cost-effective solutions for improving the reliability and lifespan of poles are usually met with great interest in the Florida Keys.

This single-phase distribution pole is situated — as is most of the Florida Keys Electric Cooperative plant — within view of the water.

Ductile Iron

Such was the case when officials from the Florida Keys Electric Cooperative (FKEC) first heard about McWane ductile iron utility poles in early 2010. A distributor mentioned the poles in conversation one day with some members of FKEC's engineering department and happened to have one of McWane's brochures. The engineers, one of whom was also experienced in metallurgy, immediately grasped the concept. They knew that ductile iron was much more corrosion-resistant than other materials and were surprised no one had thought of using it for poles before.

Ductile iron has been the workhorse of the municipal water pipe industry for decades. It was developed as a lighter, stronger, more flexible, durable, corrosion-resistant and cost-effective alternative to cast iron. As an engineered material, the microstructure of ductile iron is controlled during production to create a product with a long list of superior properties. One of the most distinctive characteristics of ductile iron is that its graphite composition is manipulated into spherical nodules rather than flakes (as in cast iron). This gives the resulting material "ductility," which makes it slightly elastic and therefore resistant to cracking when under extreme force.

In 1955, ductile iron pipe became the standard of municipal water and sewer systems throughout the nation. And McWane Inc., based in Birmingham, Alabama since 1921, became one of leading producers of ductile iron pipe for the water infrastructure of cities across America. Highly adept at manufacturing products for use below the ground, McWane has now applied its knowledge and experience to developing utility poles that stand up to virtually all types of comparisons, as well as the most demanding environmental and economic conditions.

Pole Properties

Historically, FKEC had used three types of poles: concrete, steel and wood. All three materials have their advantages, but there's a significant downside to each, as well. Concrete has weight issues, steel is corrosive, and wood's durability is a weakness in the Keys environment.

Because of FKEC's wind loading strength requirements, wood poles have to be huge and all the more heavy to do the job. The fact that wood is treated with toxic preservatives is also a concern in environmentally sensitive communities such as the Keys. And, in spite of being treated, wood poles do still rot.

As for concrete, in addition to the weight issue (making transportation and installation both difficult and expensive), those poles have peculiarities in their design that make them prone to cracking. Once water and salt get into the pole, the rebar rusts and the concrete breaks away. That destroys the pole. Concrete is generally thought to be long lasting, and it is. But once it's flexed, it cracks; and that affects the life cycle.

Ductile iron poles are engineered and manufactured to solve those problems and then some. Ductile iron poles offer many beneficial features:

- Environmentally friendly, made from recycled material, and the poles themselves are 100% recyclable
- Combine the physical strength of steel with the corrosion resistance of cast iron

Pole installation. What is the black, ceramic epoxy coating? Is this during backfill?

- Weigh about 50% less than comparable wood poles — and far less than concrete
- Manufactured by centrifugal casting for consistent dimensional control and are engineered for consistent strength with a minimum yield strength of 42 ksi

What voltage construction? What's the orange stuff at the pole top?

- Cost effective versus steel and concrete
- Lightweight and easy to handle, making for low transport costs and easy installation
- Reduce maintenance, repairs and replacements because they are not affected by rot, cracking, insects, woodpeckers or temperature, and they are highly corrosion resistant
- Have an expected lifespan of more than 75 years.

Which to Use

FKEC began actively researching alternative types of poles after the 2004 hurricane season. Many utilities just keep doing what they have always done — over and over — and accept their particular weather as a fact of life. FKEC, of course, knew it could not change its weather and environmental conditions. But since the Keys are in the highest wind area in the country, there was an urgent need to find a better pole solution. So the utility explored and tested as many options as possible.

The utility designs its system for 150-mph (241-kmph) winds, which requires a pole with the strength of concrete. The weight of concrete, however, drives up the installation cost dramatically. Finding a high-strength alternative with a lot less weight was initially the focus of the search. One of the options FKEC looked into was fiberglass poles. The extreme flexibility of fiberglass in high winds was a problem. Obviously, other performance characteristics, in addition to strength and weight, had to come into play in FKEC's search.

After hearing about and looking into ductile iron poles, FKEC engineers consulted with a local company that has actually had ductile iron in the ground since 1980. The engineers were able to look at some sections of pipe that had been underground for 30 years, and there was very little corrosion. That was significant because wood poles typically rot off in the Keys just below the groundline. There was no evidence ductile iron would pose such a problem. Based on the condition of the 30-year-old product that was examined, it was estimated the ductile iron would be good for at least another 30 years, if not more.

The economic implications of ductile iron's longevity are huge in terms of fewer repairs and replacements. Even though the initial purchase price of ductile iron is more than wood, life-cycle cost comparisons, which include items such as reduced maintenance over all those years as well as lower shipping and installation costs, can more than make up the initial cost difference. When it came to actually making the decision to put ductile iron poles into service, the choice was clear. FKEC had done its research, and, based on all the facts and figures, ductile iron poles came out clearly on top.

The Transition

The utility's transition to ductile iron poles is occurring on a gradual, as-needed basis. Two sites were initially selected for test installations on Key Largo and in the city of Marathon. The test poles were installed within two days, and a crew from McWane was on-site to oversee and assist.

Strategically, FKEC wanted to install several poles in different locations to see if any problems could be uncovered. Two sites that were easily accessible and not on busy roads, where the utility already had crews, were selected. Poles at both sites were scheduled for replacement anyway, so it made sense to go there.

The reaction of field personnel to the ease of handling and maneuverability of ductile iron poles was a big additional benefit. With concrete, line crews have to take extra safety precau-

tions for installation, and it takes bigger equipment. Crews are now replacing 15,000-lb (6,804-kg) concrete poles with 1,400-lb (635-kg) ductile iron poles.

Installation went faster and easier than anyone expected, in large part because of the relative ease of handling of the lightweight poles and the simplicity of grounding. They took far fewer hours of labor to install, including what may have been overkill in the area of corrosion protection. The poles FKEC ordered have an arc-applied zinc coating above ground and a ceramic epoxy coating — inside and out — on the embed section.

Because of the extreme environmental conditions, McWane also recommended putting two polyethylene bags over the end of each pole before it went in the ground. The linemen thought that was a little strange, but it has been proven to add tremendous corrosion protection by slowing the migration of water and salt. There are a lot of situations where, when holes are dug, the crew hits tidewater. The Keys are on coral rock, which is like a big sponge, so it is not uncommon for saltwater to fill a hole. That, of course, can be a real problem for poles. So the idea of extra insurance made sense.

Having a crew from McWane on-site during those first several installations also proved very helpful. They bent over backward to ensure the installations went smoothly. When there was an issue with drilling the poles, they were quick to help solve the problem. The solution was simply a matter of setting the drill speed properly to avoid buildup of too much heat.

Now it is Routine

The test has gone so well, FKEC has since ordered and received several more truckloads of ductile iron poles. The utility's management team has agreed the poles will now be the new standard for heavy-duty applications. The ductile iron poles come in seven classes and lengths, ranging from 30 ft to 70 ft (9.1 m to 21.3 m). Most of the FKEC poles are 40 ft to 45 ft (12.2 m to 13.7 m) with a one-third-inch wall thickness for extra strength due to the potential for hurricane-force winds. Area residents seem to like the looks of the poles. They are straight and uniform, and have a light gray coating, which is barely noticeable.

Best of all, however, is the fact that ductile iron poles offer a unique combination of high value, incredible strength, light weight, durability and flexibility. They can be loaded to yield strength without any damage to the pole. And, they will not deteriorate like wood or concrete. Replacing a pole is very expensive, and the labor outweighs the cost of the pole. Ductile iron poles are still new to FKEC, and the industry, but they are more cost effective and do the job better than anything else the utility has come across. FKEC expects them to last a long, long time. TDW

Replacing an end of useful service life wood pole with a ductile iron pole.

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Companies mentioned:
FKEC **www.fkec.com**
McWane **www.mcwanepoles.com**