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Reliability Begins with a Strong Foundation

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Spacer Cables Revisited

Consumers Energy develops new standards to improve overhead distribution circuit reliability in problem areas.

By Terry J. Orban, Consumers Energy

Utilities have always tackled the need to improve system reliability. Now, due to factors such as regulatory demands, competitive markets and customer demands, maintaining system reliability is more than a challenge, it is a requirement. Increasingly, utility commissions are providing financial incentives for increased performance, while applying penalties for poor reliability.

To address future reliability needs, Consumers Energy (Jackson, Michigan, U.S.) evaluated the field problems affecting its distribution system performance and decided to enhance its construction and material standards.

Consumers observed and addressed the following field situations. With bare-wire overhead distribution systems, trees are one of the major contributing factors of system outages. Michigan has a large population of trees affected by high winds and rain in the summer months, and ice and snow in the winter months. In that Consumers Energy has 1.7 million electric customers served from 70,000 miles (112,650 km) of mainly bare-wire overhead primary distribution circuits, the utility had to address the tree problems from a construction standards approach.



A typical example of aerial spacer cable construction involving multiple paralleled circuits.

While trees have a major impact on circuit performance, it is usually the same isolated areas that contribute to most of the tree-caused circuit outages. Therefore, these are the areas that need special attention.

Although tree trimming is the normal option for correcting these problems, utility budget constraints can limit the amount of dollars available for tree

work. Tree trimming is also a temporary solution, which, in most cases, accelerates tree growth, therefore increasing trimming cycles. Additionally, the attitude of the general public is “don’t touch my trees” and it is going to get worse. In Michigan, the public sector has petitioned some township and city governments to enact laws requiring any tree maintenance in

Spacer Cable Pilot Project

The field-proven reliability of aerial spacer cable systems can be a competitive edge for economic development. Five years ago, the following scenario occurred. A large auto parts manufacturer approached Consumers Energy about the possibility of locating its new facility within Consumers Energy’s service territory. The location was close enough to an adjoining utilities area that both utilities were asked for competitive contracts to see who could provide the most reliable service. The location of the new facility was in an area where Consumers Energy’s bare-wire system did not

have a good reliability history. Consumers Energy put together a competitive package that included building a 3-mile (5-km) dedicated (only customer) 795 kcmil aerial spacer cable circuit. The manufacturer, aware of the service reliability of an aerial spacer system, accepted Consumers Energy as its service provider, and there has not been one interruption to its facility.

The construction of this job was Consumers Energy’s first use of the new 25-kV-rated aerial spacer cable standards.



A typical aerial spacer cable system with tree-tolerance capabilities.

public right of ways (R/Ws) to have issued permits with regulations or controls on how and where tree work can be done.

The standards and material group developed an optional construction standard that would improve of circuit reliability, while being more customer-tree friendly and saving tree-trimming dollars. After evaluating different construction methods, the group decided the aerial spacer cable design could address all these concerns. Cost studies revealed initial construction costs to be about 25% more than an equivalent bare-wire system. Savings in initial tree clearing, tree-trimming maintenance dollars, reduced momentaries and outages, and improved customer satisfaction offset these increased costs. Line crews becoming more familiar with construction methods for aerial spacer cable versus bare-wire construction also helps to reduce costs.

While Consumers Energy had some past experience with aerial spacer cable, standards were outdated and the utility's present design personnel and line crews were not familiar with this type of construction. Therefore, the utility decided to improve the aerial spacer cable design. While bare-wire construction would remain Consumers Energy's main type of circuit construction, it would use aerial spacer cable in special circumstances. This included heavily wooded areas, areas with trimming limitations or restrictions, narrow R/Ws, and

Spacer cable has the mechanical strength to weather severe storms and the electrical strength to prevent faults due to phase- to-ground or phase-to-phase contact, tree contact or animal contact.

high-reliability circuits for industrial or commercial customers where momentary outages are not tolerated. Consumers Energy developed a new aerial spacer cable standard with cost-effective reliability as the main goal.

Reliability Design

Aerial spacer cable construction consists of high-strength messenger-supporting covered conductors in a close triangular configuration. Spacer cable has the mechanical strength to weather severe storms and the electrical strength to prevent faults caused by phase-to-ground or phase-to-phase contact, tree contact or animal contact. The compact configuration and covered conductors can tolerate momentary tree contact, which allows trees to grow much closer to the circuit before tree maintenance is required. When

wind, ice or storms down branches on the system, the messenger either deflects them away from the covered conductors or supports them. If the messenger continues to support downed limbs or branches, the covered conductors prevent a phase-to-phase or phase-to-ground fault, and the subsequent operation of sectionalizing devices so that no outages occur. This eliminates momentary "blinks" on the circuits caused by incidental tree limb contact and defers branch removal, allowing crews to perform restoration work at outage locations.

The messenger also acts as a shield wire for lightning protection. The compact design enables the installation of multiple circuits at the same level or stacked vertically, thus allowing for better use of pole space. Two spacer cable circuits use the same space as one bare-wire circuit on crossarms.

Material Design

To obtain technical support on aerial spacer cable, Consumers Energy contacted C.L. Somes Co. Inc. (Grand Ledge, Michigan), the area sales representative for Hendrix (Milford, New Hampshire, U.S.). Hendrix developed the aerial spacer cable bundled construction design more than 50 years ago and has the field experience and technical support staff to provide assistance in developing material specifications. Hendrix also has the capability to supply required cable, hardware and installation equipment, so Consumers Energy entered into a partnership with Hendrix to provide a complete package.

Consumers Energy's primary distribution system includes both 15- and 25-kV voltages. The previous standards predated the 25-kV distribution system. Therefore, all existing spacer cable was rated at 15 kV. Voltage conversion or partial load transfers to 25-kV circuits might require rebuilding the aerial spacer cable portions to 25-kV rated cable. As a result, the conductors approved for the new standard are 25-kV rated. Conductor sizes are 1/0 AWG (7 str), 336.4 kcmil (19 str) and 795.0 kcmil (19 str).

These conductors consist of compact stranded hard-drawn aluminum conductors with three extruded layers of covering. The outer layer can be black or gray. Consumers selected the gray covering to give field personnel a visual identification of the conductor

rating. The existing 15-kV conductor has a black covering. The gray covering blends better with the sky, providing a more aesthetic design. The conductors triple-pass covering consists of an inner layer 0.015-inch (0.038-cm) semiconducting polyethylene (0.020 for 795 kcmil), a middle layer of 0.075-inch (0.019-cm) low-density polyethylene and an outer layer of 0.075 track-resistant high-density polyethylene, which prevents faults due to contact, resists abrasion and electrical tracking. The covered conductors have a high-impulse strength allowing closer spacing of phase conductors. Field experience shows that the basic insulation level (BIL) of an aerial spacer cable system is key to its reliable design. To achieve the BIL, Hendrix manufactures the spacers, insulators, anti-sway brackets and outer conductor covering from the same materials. These items also can be purchased from other manufactures.

Successful Implementation

Because an aerial spacer cable system requires completely different materials and installation methods than bare-wire construction, Consumers En-

ergy realized field acceptance would be a critical factor in implementing the new aerial spacer standards. To address this concern, the utility assembled a team made up of Consumers Energy standards and material section, purchasing department, tools and work methods group, and field design and construction personnel as well as representatives from Hendrix and the C.L. Simes Co.

The key decisions were:

- To simplify design and construction needs, completely separating the new standards in a special section from bare-wire construction in the design and construction manuals.

- To establish a "one contact" purchasing point for all aerial spacer cable material and tool orders between Consumers Energy and Hendrix.

- Hendrix to provide technical support for standards development.

- To provide training for field personnel prior to field construction. This was accomplished by employing a retired line foreman (Don Gailey of Michigan who had more than 15 years of experience in constructing aerial spacer cable systems) to assist the tool and work methods group in

learning the new construction procedures and supervising the first aerial spacer cable jobs. This was one of the best steps in gaining field acceptance of the new construction standard and ensuring the quality of the jobs being constructed.

The use of aerial spacer cable construction on the Consumers Energy electric distribution system has far-exceeded expectations. While the utility has constructed many jobs in areas that were prone to bare-wire outages, it has not attributed any outages to the aerial spacer performance.

The keys to successfully implementing the new construction standard were providing cross-functional support and giving proper attention to gain acceptance from field personnel. ▀

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