Growing Application of Protective Devices Aims to Reduce Outages Triggered by Wildlife

Photo: Courtesy of FortisBC

Midway through a morning this past June, about 7200 customers in Rock Hill, South Carolina suddenly found themselves without power for at least 45 minutes and some much more. According to the municipal utility, a squirrel had managed to get inside a substation near the local school and short-circuited the system while jumping over live connections. Only two weeks later, a bird was deemed responsible for the explosion of a transformer, leaving hundreds of residents of Hoboken, New Jersey without power. A spokesperson for Public Service Electric & Gas explained that nearly 800 customers were affected

for some time and that an unfortunate 50 of these remained in the dark even longer as crews worked to resolve the problem.

Such events are not isolated and, if anything, seem to be increasing in frequency.

Indeed, one of the most vulnerable links in many power networks are the points of interface between overhead line and substation equipment with the animal kingdom, specifically birds, reptiles and a host of predatory or scavenging carnivores. Taken together, these creatures present a persistent threat to the safe operation of key network assets. Anecdotes abound of rodents or feral cats being electrocuted and in the process 'blacking out' entire neighborhoods or regions, while also causing hundreds of thousands and even millions worth of damage to breakers and transformers. In the case of bushings, for example, the powerful shock waves emanating from a flashover sound like a bomb and can blow the porcelain housings into shards that cause even more damage.

Given such risks, a growing range of protective devices has now been developed in an effort to reduce the scale of the problem. INMR talks with some of the key suppliers in this business to look at the factors which determine the long-term effectiveness of such products.

Photos: INMR ©

Photo: Courtesy of FortisBC

Photo: Courtesy of TE Connectivity

In the U.S. alone, economic losses attributed to wildlife interaction with the electrical grid are thought to cost from $20 to 30 billion each year.

Photo: Courtesy of TE Connectivity

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Examples of damage to network assets directly linked to wildlife.

Statistics compiled by the U.S. Department of Energy indicate that the American economy suffers some $ 150 billion worth of losses each year due to unexpected outages and other disruptions to electricity supply. Moreover, data gathered by EPRI during the late 1990s suggests that a distinct proportion of these problems – estimated at about 12 percent – result from interaction of wildlife with energized lines and equipment. If outages classified as 'source unknown' are factored in (some two-thirds of which are thought to be wildlife related), the annual impact of such events probably ends up costing between $20 and 30 billion. That's just in one country.

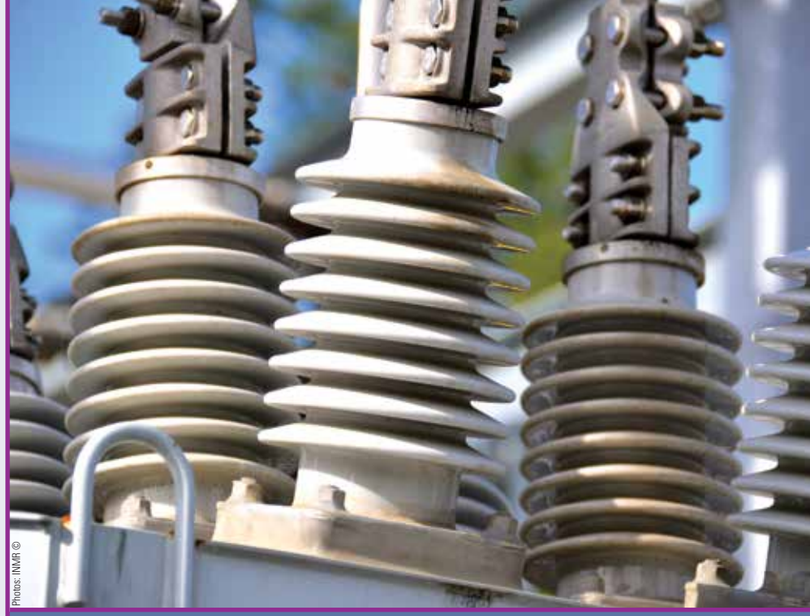
Indeed, few lines workers or substation maintenance staff anywhere have not observed firsthand the results of such unfortunate interactions, which many in the industry believe represent one the leading causes of unplanned power interruptions (the others being severe weather and accidents). For example, in one year alone, a large electricity supplier in the State of Mississippi documented more than 1100 wildlife-induced outages, resulting in 565,000 customer-minutes of interrupted service.

Moreover, the risk of these types of outages is apparently growing as more power infrastructure shifts away from population centers due to public

pressure and is sited in areas where wildlife are more abundant. On top of this, industry efforts to reduce costs, save space and make electrical infrastructure less visible through compaction only contribute to the problem by reducing the distances that need to be breached to create faults. Large birds preparing for take-off can have wingspans of well over a meter while snakes in places such as Texas easily reach similar lengths.

Given the above, one might well expect that the majority of installations in the voltage range where clearances are most at threat, i.e. 5 kV to 38 kV and in areas where wildlife are present, would be equipped with added protection. Yet, according to companies supplying such devices, the incidence of their application is estimated at less than 20 percent – representing a relatively modest annual world market of only some US$ 50 to 100 million. Says Steve Parker, who manages business development in this sector for TE Connectivity's Raychem line of wildlife insulation products, "many substations I've seen are basically accidents just waiting to happen."

In spite of the relatively low level of market penetration of these devices, Parker reports that three factors are now driving buoyant sales growth, especially in North America. Foremost among these are



Photos: INMR ©

Bushings, such as these unprotected units on distribution equipment up to about 38 kV are most at risk of wildlife-induced damage.

"Many substations I've seen are basically still accidents just waiting to happen."

consistent efforts to improve system reliability in order to justify proposed rate increases that must be reviewed and approved by public utility commissions. "In these situations," says Parker, "those who evaluate these proposals do not want to hear stories that a squirrel was able to 'take out' an entire substation."

A second factor, whose importance varies by country and region, relates to the potential for costly lawsuits and penalties should protected

Photos: INMR ©

Electrocution of protected species of large birds is potentially a financial and public relations threat to power utilities.

It is estimated that risk of damage at substations could be reduced by 60 to 80 per cent through application of well-designed wildlife protection products.

Loose-fitting protective cap on this arrester in Thailand offers no real protection against local wildlife, which include monkeys.

Good fit is seen as key to effective long-term performance (bottom photos)

Photo: Courtesy of Cantega Technologies

Bird nesting on this structure attracted scavenger, whose skull on ground below tells how it met its fate.

species be electrocuted during phase-to-phase or phase-to-ground contact. In the western USA, for example, one of the largest electric utilities pleaded guilty several years ago to illegally killing golden eagles and other migratory birds, resulting from accidental electrocutions in proximity to some of its rural lines. The utility was ordered to invest over $ 10 million in system upgrades intended to protect these birds. Indeed, limiting such problems was the goal behind the setting up of a group called the Avian Power Line Interaction Committee (APLIC) that travels the country to provide information on reducing bird electrocutions and in this case provided guidance to the utility doing the work.

Finally, the basics of asset management suggest that the consequences of animal interactions with energized structures are not just power interruptions and potential fines but also costly damage to equipment. For example, Parker estimates that risk of such damage at substations could be reduced by from 60 to 80 per cent through selective application of well-designed wildlife protection products. This, he says, makes any cost-benefit analysis tip heavily in their favor.

The various wildlife protection devices that are offered on the market have different designs and are made of different materials, often with different colors. According to Marty Niles, founder of Canadian-based Cantega Technologies, one of the keys to high performance in wildlife protection products is good fit. This, he claims, can only be achieved if they are customized to the exact shape and dimensions of the equipment to which they are being applied. “Precise fit is essential in this business,” says Niles. “Power arcs travel through air, meaning that the gap between the creature and the live fitting is critical. Any crack or seam in a protective covering can allow the arc through and the higher the voltage the greater this risk.”

Niles, who witnessed numerous such problems over two decades as a former lineman in Alberta, goes on to say that wildlife behavior also requires a tight fit to achieve best long-term results. “Bird nesting on lines and at substations attracts predators,” he notes. “These animals, including cats, snakes, iguanas and possums, can easily dislodge or remove any loose-fitting cover as they push their way toward a nest.”

The materials themselves are also important. Says Robert Vojtila, Principal of Midsun Group, “long term, you need a high quality product that will last. Ease of application and availability are also important

Photo: Courtesy of TE Connectivity

Materials used in wildlife protection covers for bushings must be engineered for reliable performance for many years exposed to UV, weathering and tracking.

Photo: Courtesy of Midsun Specialty Products

Silicone sheets and tape applied to bus while pre-molded cover designed for bushings.

considerations." Vojtila also explains that one of the goals behind recently issued IEEE guidelines for application of these products was to assure that wildlife protection devices would not create new problems over the long-term.

TE Connectivity's Parker points out that one of the key considerations when it comes to composition of the materials used in wildlife protection devices is suitability to an outdoor environment of electric field combined with persistent UV. He notes that one of the methods to produce a reliable material able to perform under such conditions has been irradiating them after molding to ensure full cross-linking of the polymer.

Difficulty in scheduling outages has been one of the major reasons why so many existing substations are still unprotected against wildlife intrusion.

"It's all about materials science," he says, "and the materials themselves must be inert and resistant to tracking and erosion. That's because they face much the same issues as insulators, including dry band formation that can leave carbonized dots on the surface and cause tracking. We advise customers that they must look at the tracking and erosion performance as well as UV test data for any wildlife protection device they consider installing. There's a lot of bad material out there, sometimes even made from recycled plastic bottles."

Parker goes on to also emphasize that it is essential to ensure that whatever latches attach these devices to the equipment they protect must not become brittle, rotted or eaten up over the years. If that happens, the devices will simply break off under wind.

Vojtila and General Manager Brad Macculloch explain that in the past many wildlife protection devices tended to be made from PVC or EPDM but that Midsun decided to develop their own growing line using custom silicone rubber blends that they claim offer ozone, fire resistant and environmental stability better suited for power industry applications. These are offered as extruded sheets that can be 'templated' to fit whatever equipment is being protected or, if volumes justify, pre-molded in the factory to specific shapes. Silicone rubber tape is also available in a thickness allowing an equivalent 15 kV insulation per layer. "The material is critical," says Macculloch, "since users need to know that the product will last many years in a potentially demanding service environment."

Niles indicates that, for its part, Cantega Technologies relies on a polyurea formulation which he claims is more robust as well as more flexible for good fit than alternatives such as polypropylene and which has already proven itself as a pipeline coating in the oil and gas sector. He adds that the material has been 'tweaked' for a high voltage environment and to ensure fire-resistance.

Apart from material, which has to be durable enough to last at least 5 to 10 years on distribution line applications and more than twice that in the case of substations, another key element of wildlife protection devices from the user perspective is speed and effectiveness of application. The former factor is especially important if an outage is needed to install them.

For example, Niles indicates that designing protective devices for precise fit not only maximizes performance but also translates into typically lower installation times. Still, he notes that new hotsticks have now been developed that allow wildlife protection covers to be installed with the equipment still energized. Indeed, he feels that the growing difficulty scheduling outages is one of the main reasons why so many existing substations are left unprotected against wildlife intrusion. New live installation techniques are therefore likely to translate into higher market penetration levels for such devices.

Niles also remarks that suppliers must ideally co-operate with the customer in developing what he calls a 'site protection plan', intended to identify potential problem areas and customize the solution for these different applications. "In our case, he explains, "we also offer on-line training as part of our service package, over and above an itemized list of the parts we supply and where they are intended to be installed."

Parker agrees that the clear trend in wildlife protection is toward devices that can be installed without de-energizing the equipment. "The hardest part up to now," he explains, "has been scheduling an outage and then waiting around. Putting these devices up live can therefore

Photos: INMR ©

Wildlife protection devices on lines and at substations must be durable enough to endure temperature changes, wind loads and persistent UV.

Worker uses hot stick to take precise measurements of equipment to which wildlife protection devices will be attached.

Installation live using hot sticks (inset) expected to enlarge market for wildlife protection devices.

help cut up to two-thirds off total installation time." At the same time, Midsun's Todd Tremeglio points out that energized application depends on the policies of individual users, some of whom prefer taking an outage. By contrast, he notes that industrial customers almost never accept a planned outage so that wildlife protection devices for this market segment must generally be installed live.

Another trend in the business is growing sales of wildlife protection devices directly to electrical OEMs, e.g. manufacturers of transformers, arresters, reclosers, etc., so that such equipment is already equipped with these at time of purchase. Management at Midsun, for example, report that they are seeing an increase in the level of OEM requests for such items. There is a word of caution, however,

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from Vojtila who says that OEMs these days are more focused on cutting costs than on wildlife protection. As a result, plastic caps supplied factory-installed on their equipment can sometimes be sourced from companies with little experience in wildlife protection devices and that will not stand up over the long-term.

Parker takes a similar view but notes that the OEM market is one that TE Connectivity is now actively trying to grow through sales efforts directed at end users. "The OEM's real business is selling equipment, not the wildlife covers," he points out. "Therefore they will probably source these based mostly on what customers specify."

Looking to the future, most in the wildlife protection business discount alternative techniques such as sonic emitters or other electronic devices intended to discourage birds and animals from entering electrical installations. Says Parker, "a device that can somehow keep wildlife away has always been our industry's 'holy grail' – but the fact is that creatures soon become conditioned to and ignore them." To illustrate, he cites cases where squirrels have eaten through plastic owls put up at substations with the goal of keeping them away.

The real alternatives to improved wildlife protection of equipment rely instead on restoration schemes and relays or reconfiguring structures to achieve extra spacing between the phases and phase-to-ground. But the latter approach to the problem is very costly.

"Solving the wildlife interaction problem," concludes Parker, "can only be accomplished by fully covering substations – new and existing – with specialized protection products. Where there's a will there's a way and that means animals always find some way to get in." ☒

Transformer and arrester equipped with protective covers in place at time of shipment to customer.