

Steel Distribution Poles – Environmental Implications

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ABSTRACT

Steel poles are becoming popular in distribution powerline construction. Steel poles have a high strength to weight ratio and are resistant to insect, animal and bird damage. They are also recyclable and do not require treatment with chemical preservatives. Although steel distribution class poles offer some environmental advantages over wood poles, they can be extremely lethal to raptors and other large perching birds. Constructing distribution lines with metal poles in a traditional manner typically results in reduced phase to ground clearances. These reduced clearances can result in electrocuted raptors, which are protected by United States federal and state laws. Distribution steel pole construction requires alternative construction materials and framing to mitigate these potential electrocutions. Alternative construction methods including the use of fibreglass crossarms, pole-top pin extensions, perch guards and pole top insulating material are discussed.

INTRODUCTION

Traditional overhead construction is expanding to include the use of distribution steel poles. Utilities are increasingly employing steel poles in their new low voltage construction, partially because steel offers certain environmental advantages over wood. First, steel poles are not susceptible to woodpecker damage. In some regions of the United States, woodpecker damage to wood poles is the most significant cause of pole deterioration (Abbey *et al.* 1997). Second, steel poles are harder for animals such as Eastern Fox Squirrels *Sciurus niger*, Raccoons *Procyon lotor* and Opossums *Didelphis marsupialis* to climb and keeping animals off utility structures can help reduce outages. Although steel can rust, it is also not susceptible to fungal, bacterial, and insect damage. Lastly, steel is recyclable.

Despite these environmental benefits, steel poles can be extremely lethal to birds of prey. Distribution powerlines constructed with steel poles utilizing standard utility configurations can significantly reduce phase to ground clearances. These reduced clearances can result in electrocuted birds of prey.

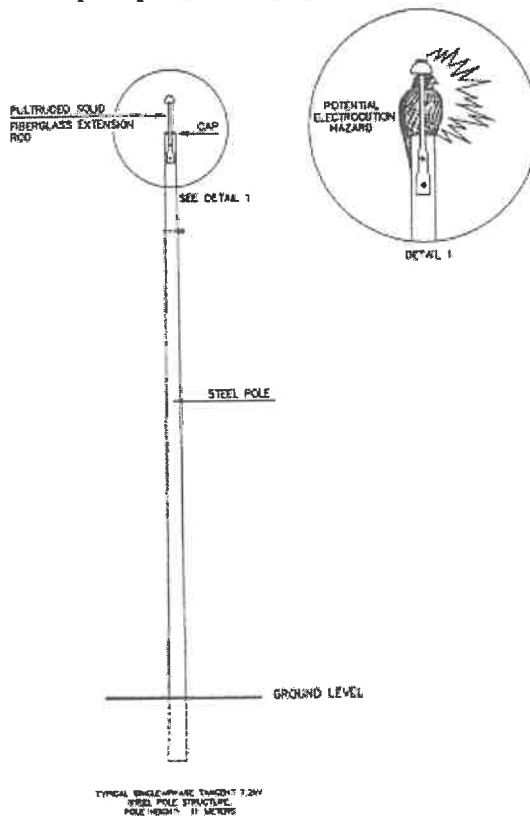
Raptors are especially vulnerable to electrocution when the birds are wet. Although dry feathers can withstand voltages up to 70 kV, wet feathers arc and burn at 5 kV (Nelson 1979). Most rural systems in the United States distribute power at 7.2 kV. Since a Golden Eagle's *Aquila chrysaetos* tail can extend 25 cms below its perch, large birds of prey can be electrocuted while perching on centre phase pins under wet conditions if tail feathers contact grounded surfaces, such as a steel pole.

MITIGATION MEASURES

The American industry standard for 15 kV Class construction at equipment locations is 95 kV Basic Impulse Insulation Level (BIL). The Rural Utilities Service (RUS) provides power in many rural areas and also adheres to this standard. Traditionally wood has been used as insulation between primary current and ground, using a wood impulse flashover value of approximately 80 kV per foot (Raytheon Engineers & Constructors 1994). Wood also has an arc quenching ability. The use of wood typically results in a BIL rating in excess of 350 kV BIL between primary conductors mounted on wood pole tops and crossarms, excluding equipment. The use of wood has proven to be a good design because values over 300 kV BIL reduce lightning flashovers. RUS advocates a minimum of 300 kV BIL on steel tangent poles to minimize these flashovers. RUS requires the 300 BIL at deadend steel structures (Rural Utilities Service 1996). The additional required insulation and air gap on steel poles is typically accomplished by adding longer deadend insulators and installing insulated pole top brackets. Fortunately this additional insulation and separation also increases clearances for birds.

One solution currently employed to increase the centre phase separation from the top of the steel pole is the use of a poletop pin employing an insulated pultruded solid fibreglass rod (Fig. 1). Although the increased distance eliminates the possibility of electrocutions to birds perching on the pin insulator, the modification makes it possible for a raptor to perch directly below the phase wire on the grounded metal pole top. This new condition can be lethal to birds sufficiently large to bridge the gap between the steel pole top and centre phase wire (Detail 1, Fig. 1). Therefore, steel structures using extended pole top pins need additional modification to keep large birds off the pole top or away from the centre phase.

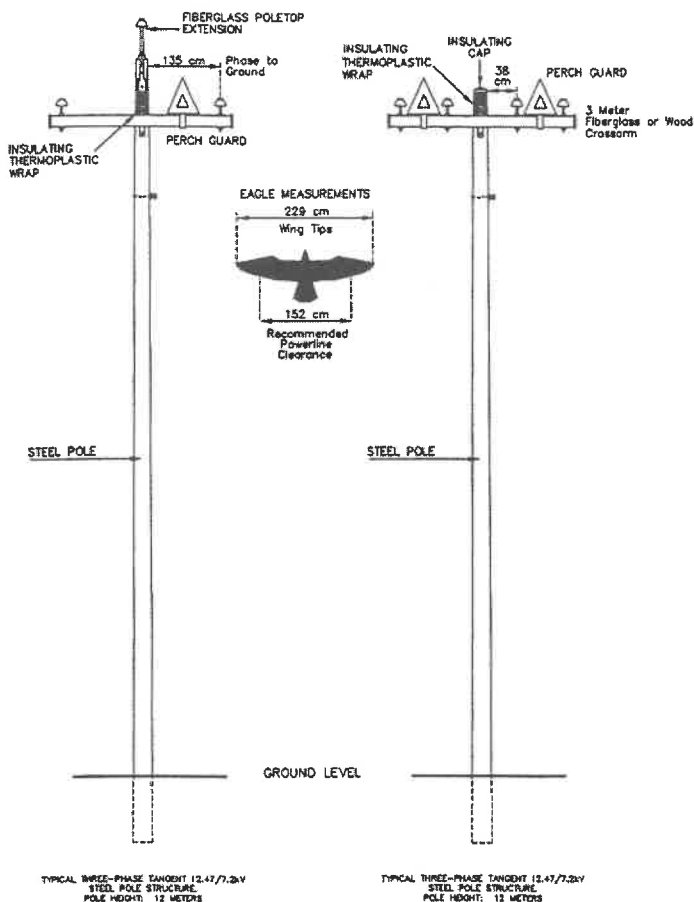
Figure 1. Increased centre pin separation using a pultruded solid fibreglass rod.



One solution to keep birds off the pole top is the use of plastic end caps. Steel poles are typically fitted with end caps to prevent small birds from nesting inside the structures. The caps also minimize noise from air blowing across the pole top. In preliminary tests utilizing captive raptors at the Rocky Mountain Raptor Center, these caps discouraged birds from perching on pole tops because of the caps' slick surface. It is uncertain however how these caps will perform long term in the field.

The Raptor Research Foundation recommends a minimum of 152 cm spacing between phases and phase to ground to minimize eagle electrocutions (APLIC 1996). A large female Golden Eagle can have a 229-cm wingspan, 137 cms between wrists. The 152-cm spacing was selected to minimize electrocutions of eagles when they begin or terminate a flight.

Figure 2. Three-phase clearances and mitigating measures



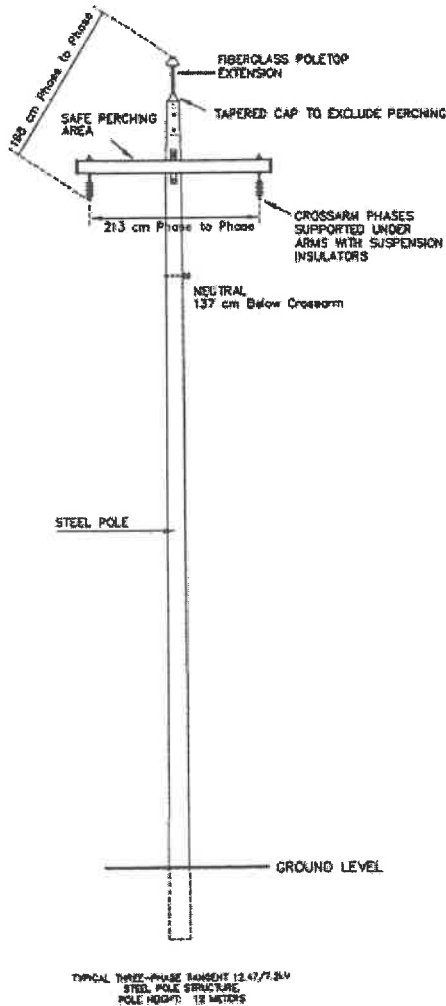
A typical RUS three-phase pole constructed with 3 metre wood crossarms provides the required 152 cms of clearance. However, when a steel pole is substituted the wire to ground (steel pole) separation becomes the critical distance, not the wire to wire separation. The steel pole to energized wire separation is often reduced to 135 cms or less (Fig. 2). If all the conductors are supported on a single crossarm, the horizontal clearances can be further reduced to 38 cms (Fig. 2), clearly placing both small and large birds at electrocution risk. The reduced phase to ground clearances on steel poles can be mitigated by wrapping the pole with a band of thermoplastic wrap above the crossarm

(Figure 2). The wrap consists of a 40-mil thermoplastic polymer membrane backed with a pressure sensitive adhesive. The thermoplastic wrap is produced by Valmont as a below grade corrosive protective system. Carbon Power and Light Company, Inc., performed a dielectric test of the pole wrap, determining that a 46-cm x 167-cm piece allows no appreciable current leakage at 35 kV for a three-minute duration. The thermoplastic wrap can also effectively reduce phase to ground clearances in narrow profile construction.

Perch guards can also be mounted on crossarms (Fig. 2) to keep raptors away from unsafe areas (APLIC 1996). The required clearances can also be obtained by snapping insulating Kaddas Bird Guards* over problem phase wires and insulators. Additionally, nonconducting wood or fibreglass crossarms should always be used. Steel crossarms mounted on steel poles are extremely hazardous due to minimal phase to ground clearances and should always be avoided. Raptors landing on steel arms are grounded and need only touch one energized conductor to become electrocuted.

An alternative to constructing lines in a traditional manner is to frame them in a form that allows safe perching. This can be accomplished by suspending two of the energized conductors under the

Figure 3. Three-phase suspension structure designed to allow perching on cross-arms



crossarm, instead of supporting them on the arm (Fig. 3). Suspending the conductors allows birds to perch on the crossarm without coming in close proximity to energized conductors. A poletop cap must still be employed to discourage perching on the top of the pole. Suspending the insulators and conductors will also allow utilities to achieve the Raptor Research Foundation's recommended 152 cms with shorter crossarms. Constructing new lines in a manner that allows raptors to safely utilize utility structures is preferable to retrofitting structures after a problem is detected.

CONCLUSION

A reduced Basic Impulse Insulation Level can result in electrocuted raptors, which are protected by State and Federal laws. All migratory birds are protected by the Migratory Bird Treaty Act (MBTA) and electrocutions can result in \$10,000 (U.S.) fines per incident per organization. Both Bald *Haliaeetus leucocephalus* and Golden Eagles are additionally protected under the Eagle Protection Act. Eagle electrocutions can result in felony charges resulting in a \$500,000 fine and up to 2 years in prison. The Endangered Species Act (ESA) also protects rare birds such as the Peregrine Falcon *Falco peregrinus*, Northern Spotted Owl *Strix occidentalis*, and Bald Eagles. Utilities killing birds will also usually be required by the U. S. Fish and Wildlife Service to reconstruct lethal poles in a manner that eliminates the electrocution hazard.

Utilities using non-traditional materials should review design tolerances to ensure that there are adequate clearances for birds and animals that traditionally use utility structures. Incorporating new designs before construction is preferable to costly fines and retrofits. This process will also avoid a negative impact on consumer relations.

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