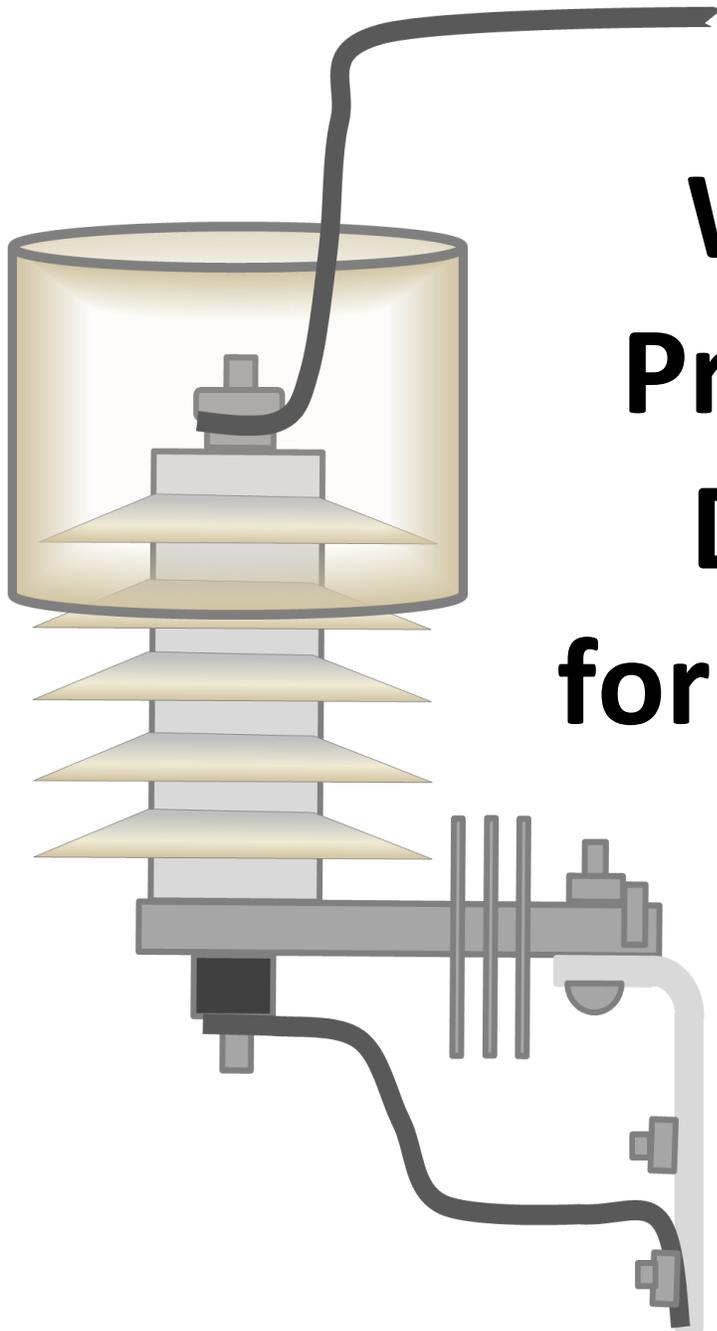


ArresterFacts 019



Wildlife Protective Devices for Arresters

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What is a Wildlife Protective Device

The term wildlife protective device (WPD) is relatively new to the industry and refers to any device that is used on power systems to reduce the effect of wildlife on system outages. Other terms often used to describe this device is animal guard, bird guard, bird deterrent to name a few. The device has been in existence for many decades and its earliest use is not identified. However old power system photos show some equipment covers that appear to be similar to wildlife protective devices.

Figure 1 is an example of a wildlife protective device (WPD) used on an arrester. However WPDs are not only used on arresters, they are used on all types of equipment where animal contact between earth and the high voltage side of an insulator is possible. Figure 2 shows WPDs on a distribution system recloser bushing as well as on the arresters. There are several other versions of WPD's that will be covered in a later section.

Standards and Guides

IEEE 1656 is a Testing Guide for WPDs has been published, this guide defines WPDs as "A device, guard or structure providing electrical isolation from high voltage equipment that is intended to prevent contact by wildlife that would result in a momentary flashover or short circuit of the electrical system. Contact by wildlife should not produce physical harm to either the equipment or wildlife." This guide is the first ever guide on how to test WPDs to verify their quality, effectiveness, capabilities and environmental withstand. It is the only document worldwide that covers this important subject. The guide was initiated in an attempt to

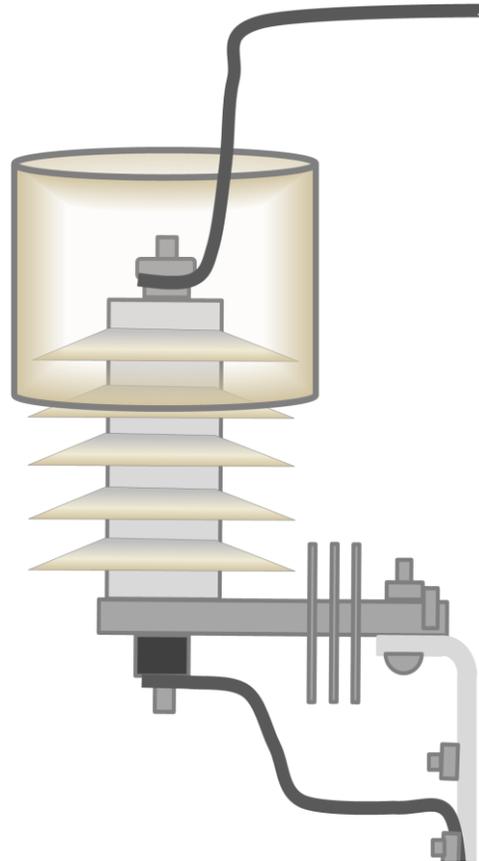


Figure 1: Cover Type Wildlife Protective Device on an Arrester



Figure 2: Cover Type Wildlife Protective Devices on the bushings of a recloser and arresters

eliminate ineffective WPD designs. This guide only discusses and applies to wildlife guards up to 38kV which is very appropriate for this type of device. Equipment in this voltage range is short enough where the potential of wildlife contact between the high voltage end of an insulator or bushing to the earth is quite high. For voltage above these levels the insulators length and insulator spacing is high enough to make this



Figure 3: Cover Type Wildlife Protective Devices on Duke Power system.

product less effective.

A second and equally well done IEEE document is IEEE 1651 titled “Draft Guide for Reducing Bird Related Outages.” This guide is also in final balloting stages and not yet published as a guide. This guide is focused on avian issues and contact with power systems. It is not a testing guide as in the last document discussed, but almost an application guide. When it is published, it will be an excellent overview for transmission system operators on how to deal with all bird contact issues. The WPD discussed in detail in this guide is the bird deterrent. Bird streamers caused by defecating birds is discussed in detail in this guide.

To date this author has not been able to find any IEC documents that deal with WPDs. I’m sure this lack of concern is short lived.

The [Edison Electric Institute](#) has published a comprehensive guide relative to this subject. It is titled “[Suggested Practices for Avian Protection on Power Lines – The State of the Art 2006](#)”. The [Avian Power Line Interaction Committee](#) which is a 30 member organization that are dedicated to the reduction in avian and power line interaction has also published an excellent Guideline a utility can use to develop an [Avian Protection Plan](#).

Benefits of Wildlife Protective Devices

There are several major benefits of applying WPDs on power systems. The first is that effective installations will result in lower outage rates due to animal contact. According to a National Rural Electric Cooperative Association (NRECA) survey in the US, animals are the third leading identifiable cause of power outages and birds cause more transmission line outages than any other animal. At Duke Power a major utility in the US, a wildlife protective device improvement program was initiated more than 15 years ago. Since that time, their outage rate due to animals has been reduced significantly. They use very robust guards what appear to be larger than necessary as it can be seen in Figure 3, but often times carrying only one size for all applications is more cost effective than inventorying several sizes. In T&D World (Sept 2004), author Joe Kysely at WE Energies in the US claims a 27000USD savings per year by eliminating wildlife flashover of arresters alone with the use of effective WPDs.

A second benefit is to reduce the electrocution of animals. This is particularly important for species that are on protected species lists such as certain vultures and raptors. In the US, it is illegal to cause the death of an eagle; however power systems that are not well equipped with WPDs can do just that.

Types of Wildlife Protective Device Designs and Installation Considerations

Cover Type: This device is designed to cover the high voltage end of an insulator as seen in Figures 1 and 2. This is by far the most common type of WPD and one of the most difficult to install. The issue with this device is the simple fact the critical flash area is easily compromised. A universal misconception is that if it is covered it

is wildlife proof. This is just not true by any means. Figure 4 demonstrates the issue. The

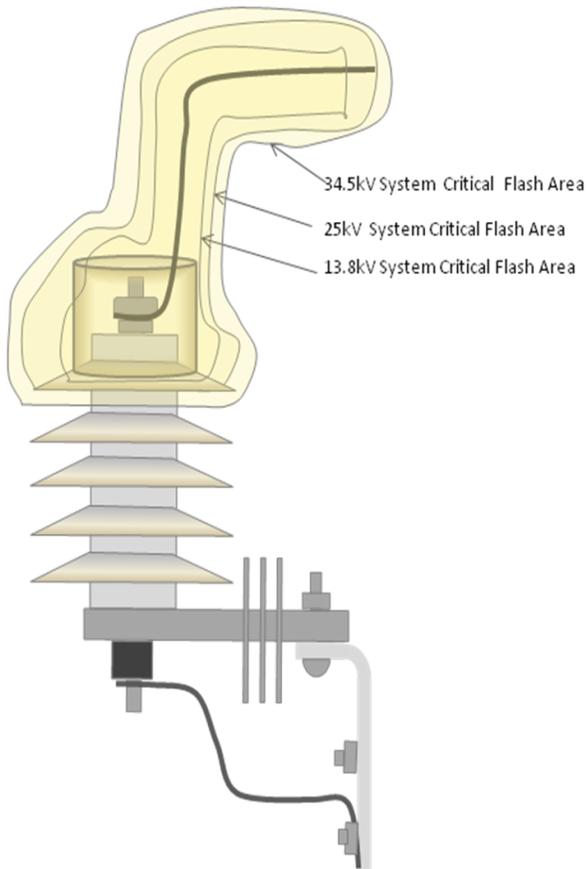


Figure 4 Concept sketch of a cover type WPD showing Critical Flash Area

electrical field can easily extend beyond the physical limits of the cover. Figure 4 is a concept sketch and not to be taken as exact. The field does not usually extend beyond solid insulating material; however it easily extends out between seams and around ends of the barrier material. Any animal perched or sitting on the mounting bolt that encroaches the Critical Flash Area will cause a power frequency arc and flashover of the arrester. The animal does not need to actually touch the high voltage end of the arrester, just get near to it while sitting at earth potential.

A second major oversight by users, manufactures and designers of this type of WPD has to do with the leads. If a conductor must pass into the covered area, it too must be covered and covered

for full voltage. Again just because a lead is covered, doesn't mean it is insulated for full voltage. Also note in Figure 4 that the critical flash area extends beyond the insulation of the wires. It is always advantageous from a WPD perspective for leads to enter and exit at the top of the cover. Since this is not always possible, other means need to be employed to account for potential lead mismanagement.

Based on the above consideration, it is then more obvious that the optimum design for a cover type WPD is one that does not allow for encroachment of the critical flash area. There appears to only be one way to insure that the critical flash area is avoided and that is to use a cover that is large. It is simple and effective, but generally does not have much eye appeal. Ignoring installation issues, a cover type WPD as shown in Figure 5 is an optimum arrangement.

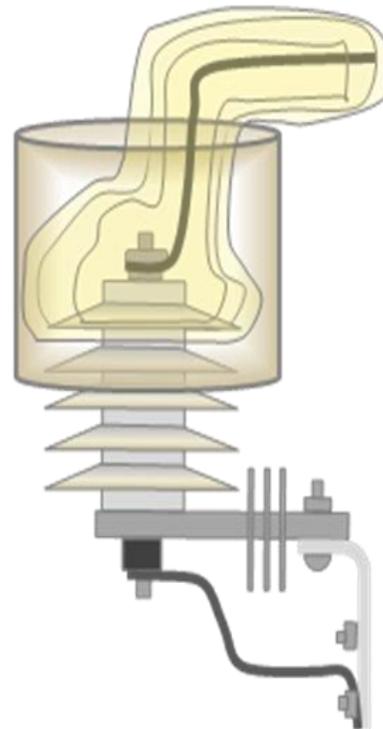


Figure 5: Preferred Cover type design to reduce encroachment in Critical Flash Area

Once the size of the cover type WPD is resolved, then lead management becomes the next major

challenge for the designer and user. As stated above, leads entering and exiting directly out the top is preferred, but this results in impossible installation without de-energization. Retrofitting a WPD is very high on the design priority list so

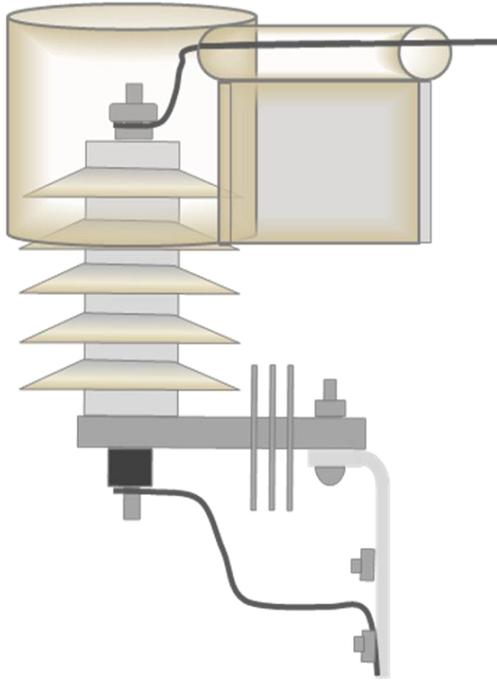


Figure 6: Preferred cover design that accommodates side leads and retrofitting

other accommodations for leads exiting the side have been developed. At first sight, it is not obvious why there is so much extra material used but after a closer examination, it is clearer. Several manufacturers of cover type WPDs had used a split wing addition to a large cover that allows the lead to be slipped between two sheets of polymer along a slit in the side of the cover. The sheets insure that the critical flash area stays within the cover along the slit and at the same time insures that the wildlife cannot easily reach the lead while perched or sitting on earth.



Figure 7 Large arrester cover with poor lead management

WPD mounted over a horizontally mounted arrester with poorly managed leads. The lead extends out the side of the arrester cover and is only a few inches from metal structure in the substation. A squirrel or large bird could easily span the distance from points A to B.

Barrier Type Wildlife Protective Device

The barrier type WPD is another common device. Figure 8 shows the basic form of this type of WPD.

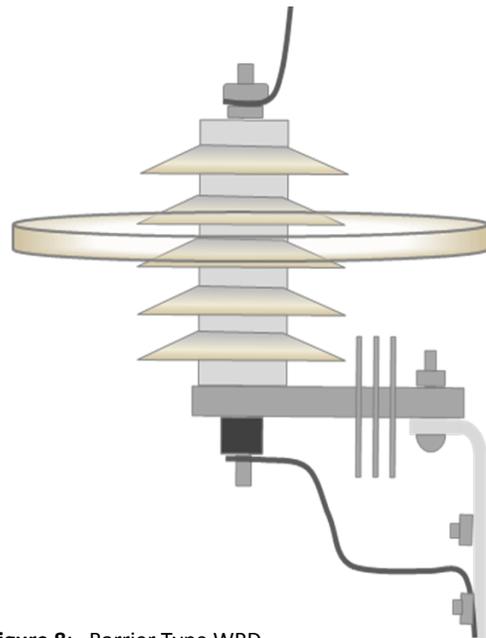


Figure 8: Barrier Type WPD

The strategy of this device is to insert a fence between the high voltage side of an insulator and

earth so that wildlife cannot touch both voltages at the same time. If there is space in the equipment layout, this is a very effective means to provide wildlife protection. This form of protections makes it much easier to manage leads or bus work on an insulator. There is no attempt to cover anything, just put a barrier between critical parts.



Figure 9 Barrier type WPD mounted too close to the high voltage

There is probably more than one way to install this protector incorrectly, but the most common is to install the barrier so close to the high voltage end that it allows for encroachment of the critical flash area such as in Figure 9. In the case of Figure 9, if the animal is resting on earth and extends a wing or paw near the top of the insulator, a flash could still occur.

As with all high voltage equipment, even the best efforts can be compromised by animals. In the case shown in Figure 10, a substation well equipped with WPDs still experienced a fault due to a bird. In this case a Mourning Dove nested on a correctly mounted barrier type WPD on a slanted insulator. The nesting material contained conductive wires from a nearby pile of wire thus making the nest even more of an



Figure 10 Barrier type WPD compromised by a bird nest

issue. The lesson here is beware of slanted insulators and Mourning Doves.

Electrostatic Type

This type of WPD is relatively new to the industry. It can be described as an advanced barrier type device because it does in fact act as a barrier, but with an added feature. The floating conductors can pick up a charge and will discharge a very small amount of

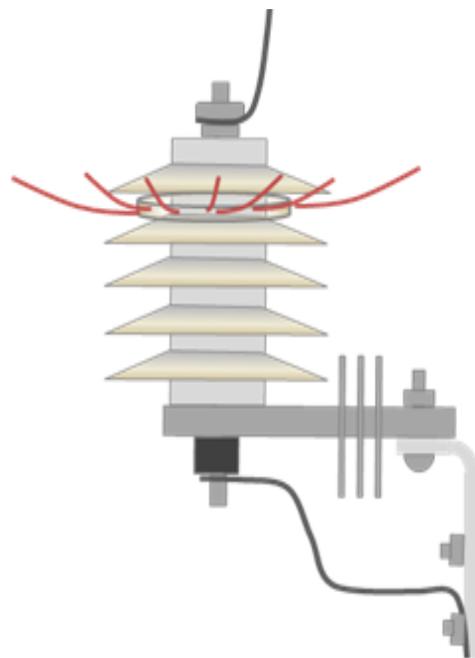


Figure 11 Electrostatic Barrier type WPD

energy if contact is made by an animal. This discharge can be compared to that received when touching a door knob after walking on synthetic carpet. Figure 11 shows the details of this device.

surfaces on the protected side of the WPD there is no flashover then the device is considered to have passed the test. A may be a very simple test but it is a very revealing test. It is through this test that one

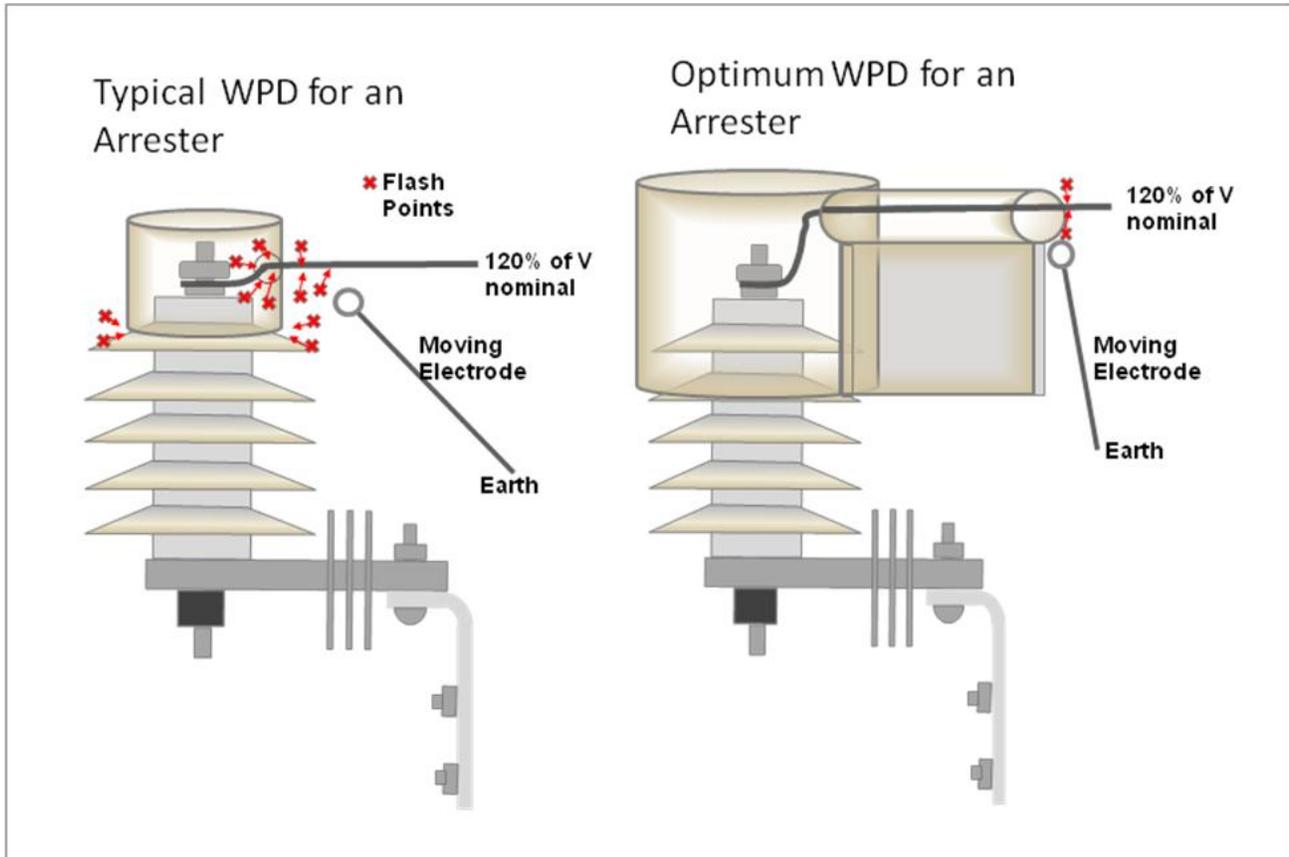


Figure 12 Results of Moving Electrode Test

Testing Considerations

Presented for the first time in the IEEE 1556 Guide to Testing Wildlife Protective Devices is a very effective method of determining the withstand level of electrical equipment equipped with wildlife protectors. The purpose of the test is to determine if the WPD meets the claimed capability of the protector. The test technique disclosed is called the moving electrode method. The WPD is assembled on a test fixture or actual product and energized. The power frequency voltage on the high voltage side is raised to 120% of that expected while in service. (Note this is not an impulse test, but only an AC test) A grounded contact is then moved around the protected side of the WLD. If after covering all

realizes the effect a small seam in a product can make. It also proves immediately the misconception; if it is covered it is protected. Figure 12 shows the results of a moving electrode test at 15.3kV rms. It can be seen that even with a covered high voltage end of the arrester, there are flashes to the moving electrode outside the WPD. With the large design, the only flash points were at a much farther distance from the earth end of the arrester.

Other New Tests

Also introduced in this guide is a retention test. This test requires that the WPD withstand a 60 MPH continuous wind and remain attached to the insulator it is protecting. For some designs this will be an onerous requirement and for other designs it will not

be an issue. Testing is the easiest way to determine the results.

A surprise in the new test sequence with regard to cover type WPDs is the salt fog test. I'm sure the folks writing the guide added this requirement to insure that WPD could withstand the rigors of a sea shore environment. However the results show that there can be significant interaction between the polymer insulators and the WPD over long and continuous periods of salt spray. The key factor is how much partial discharge between the WPD and the insulator takes place during the test. If there is significant partial discharge between the two components, damage to one or the other will take place during the test. The means of mitigating this issue is to not cover too much of the insulator with the WPD, and to make sure there is as much contact between the two components as possible.

Installation Considerations

Key points to remember when installing a WPD are:

1. If using a cover type protector, it must be sized and mounted to ensure that the critical flash area falls within the cover. If a barrier type protector is used, it must be located between the second and third shed down from the top of an arrester on the 34.5kV system and between the first and second sheds for systems less than 34.5kV
2. Insure that the arrester lead is outside the reach limit of the wildlife. It is generally best to direct the line lead out the top of the guard if it is a cover type and up and away from the barrier type guards.
3. Insure that the WPD is secure and does not change position in the wind.
4. Insure that seams are located where they are not allowing the flash area to leak out.
5. Always step back and take a second look. You want to make sure that ALL potential flash points are protected, not just half of them. Refer back to Figure 2 and not how much effort was put into an

effective recloser bushing cover and then an ineffective cover is applied to the arrester.



Figure 13 Bad Example of Animal Proofing a Substation

A Great Example of How Not to Do It

This example came from a 25kV side of a 115kV transformer in a substation.

1. Exposed Metal
2. Metal near exit hole
3. Exposed Metal
4. Exposed Metal

Summary and Conclusions

As you can see, what may seem to be a simple device and a simple installation is in actuality not so simple. Proper application and use of this device is not obvious. If we want to reduce outages caused by wildlife, we need to take a better look at the options and the opportunities. Good luck in this endeavor.

Please send questions and comments to Jonathan.Woodworth@arresterworks.com at any time.

Other ArresterFacts Available[Arrester Lead Length](#)[Field Testing Arresters](#)[Infrared Thermometer](#)[Guide for Selecting an Arrester Field Test Method](#)[VI Characteristics](#)[The Externally Gapped Arrester \(EGLA\)](#)[The Disconnecter](#)[Understanding Mechanical Tests of Arresters](#)[What is a Lightning Arrester?](#)[The Switching Surge and Arresters](#)[The Lightning Surge and Arresters](#)[Understanding the Arrester Energy Handling](#)[Issue](#)[Understanding Discharge Voltage](#)[What is a Riser Pole Arrester?](#)[Selecting Arrester MCOV and Uc](#)[Arrester Selection Flow Diagram](#)[What is a Transmission Line Arrester](#)**ArresterFacts Usage**

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