



Retrofitting to Last – Selecting Optimal Wildlife Protection Products



**Birds of Prey and Energy
Workshop – September 2023
Almaty, Kazakhstan**

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ANIMAL CONTACTS – NOT JUST RAPTORS




Howler Monkey – Costa Rica



American White Ibis

You can save his Life!




help us!
sharing this information with other people

Many innocent animals die electrocuted every year.

With the purchase and installation of this Insulation Kit to Poletop Transformer, you can help save the wildlife in your community of dying in the energy networks. Where transformer leads and electric lines have been insulated, a drastic reduction of the electrocution of arboreal wildlife has been documented.

This kit includes:

- 1 Cover for transformer bushing.
- 2 Covers for the Cutout.
- 3 Meters (9.84 feet) of E/ Insulation for cover the conductor.
- 1 fusing tape to cover the low side of the transformer.
- This equipment must be installed by a professional only, otherwise, there is risk of death.



CFS Solutions en Energía Eléctrica
Tel: +506-2296-9061 www.cfsc.com

A joint effort with
nosara wildlife rescue
REFUGIO ANIMALES DE NOCORA AND SIEU SANCTUARY



Bobcat – USA



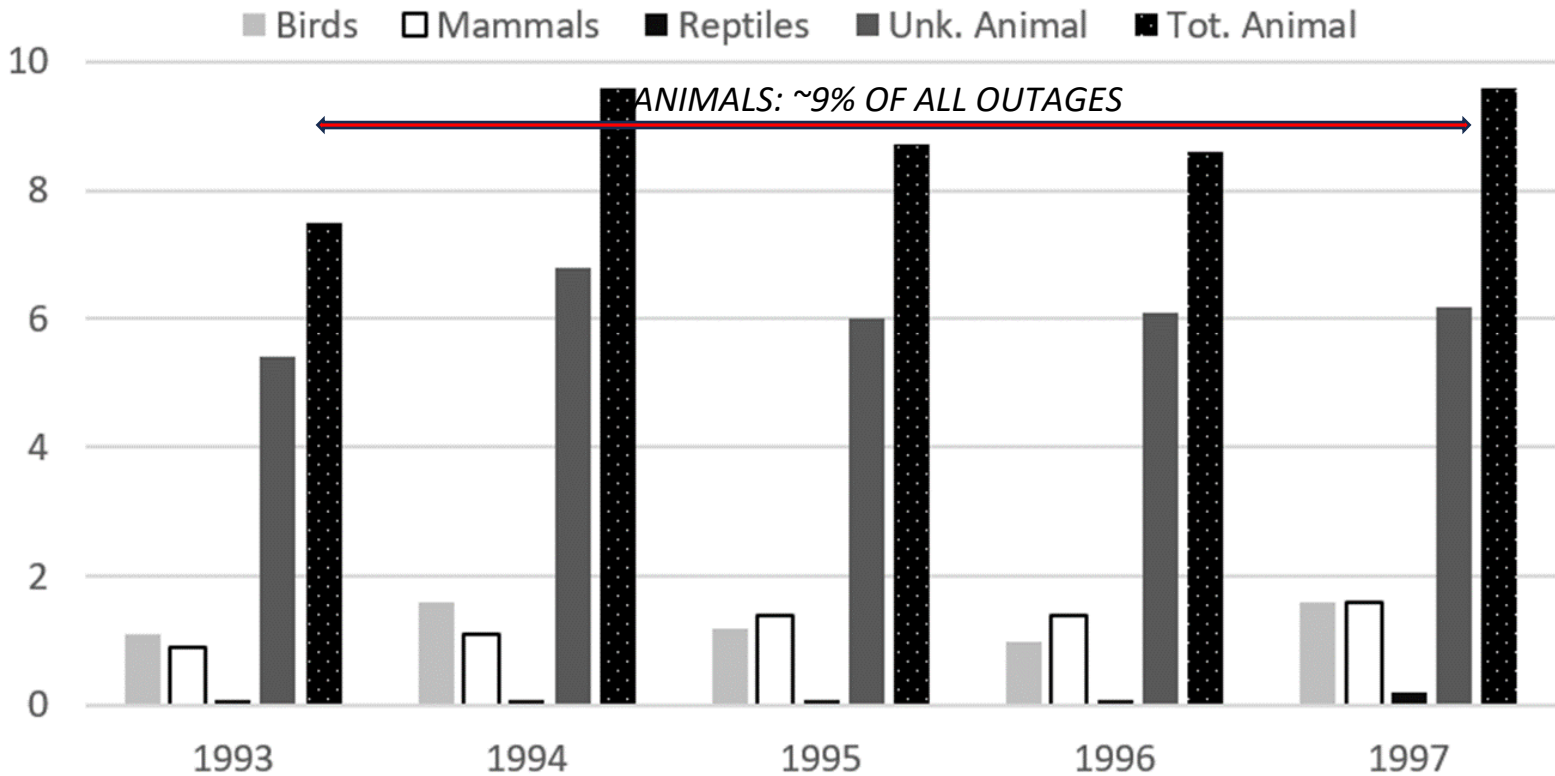
PROBLEMS: OUTAGES



ELECTRIC POWER
RESEARCH INSTITUTE

Percent of all Outages (Frequency)

Outage Frequency (%)
Percent of total annual outages
attributable to wildlife



ANIMAL CAUSE ~9% OF ALL OUTAGES - FREQUENCY

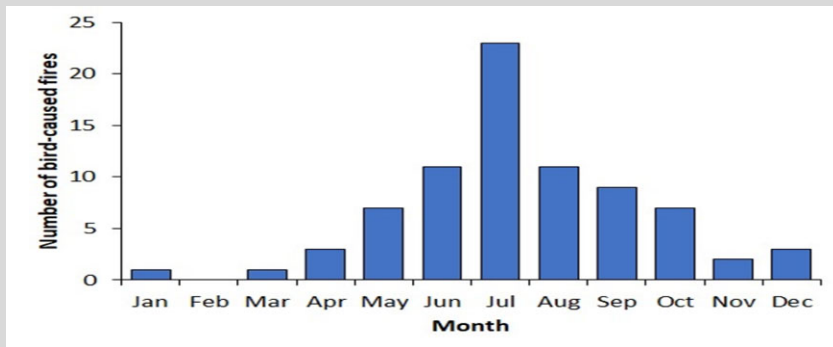
Plus, an Additional 9.5% of All Outages are Unknown!



PROBLEMS: FIRES



North America locations and time of year of bird-caused fires in electric utility Rights-of-Way from 1 January 2014 through 31 December 2017, as identified through Google Alerts (Barnes et al. 2022).



Barnes, T., J. F. Dwyer, E. K. Mojica, P. Petersen, and R. E. Harness. 2022. Wildland fires ignited by avian electrocutions. *Wildlife Society Bulletin*.

Eccleston D.T., J. F. Dwyer, R. E. Harness, T Barnes, J Downie. 2023. Wildfire Risk Reduction Through Wildfire Risk Mitigation. *Proceedings of the IEEE Rural Electric Power Conference*.




PROBLEMS: PUBLIC RELATIONS

CNN World » Monkey causes nationwide blackout in Kenya Live TV U.S. Edition + menu

Marketplace AFRICA

Monkey causes nationwide blackout in Kenya

By **Tiffany Ap** and Lonzo Cook, CNN
 Updated 12:27 AM ET, Wed June 8, 2016



KenGen posted a photograph of what appears to be a vervet monkey crouching on top of electrical equipment.

Story highlights

(CNN) — Talk about monkey business.

NEW: "This is the first such disruption we've had by a monkey," utility says

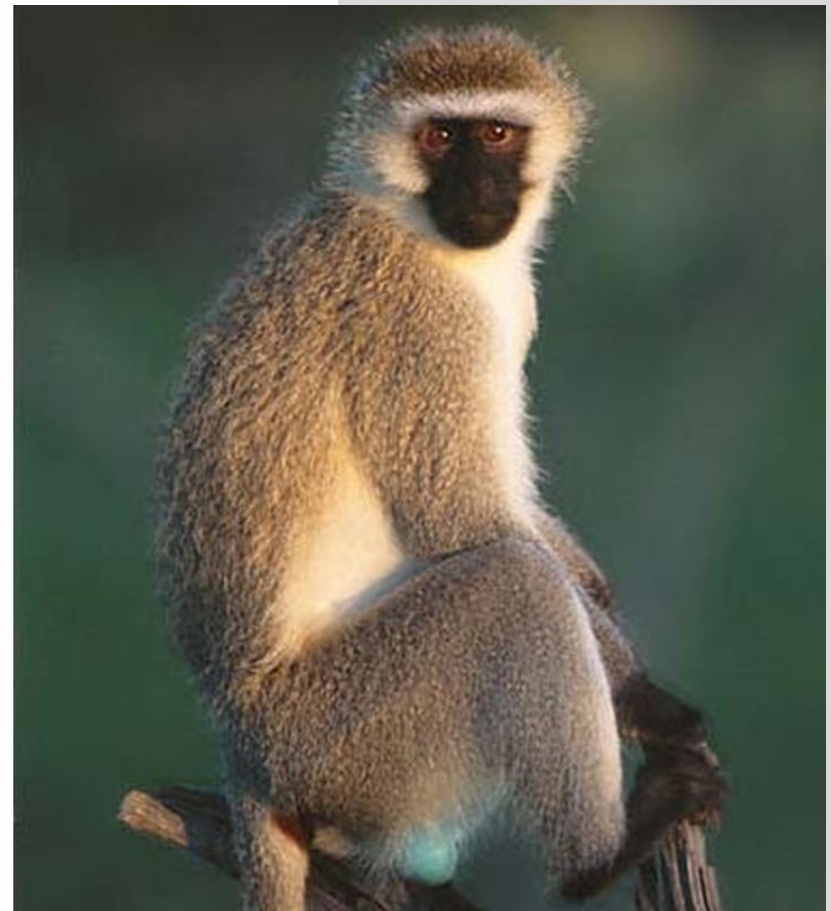
The monkey survived and was taken in by wildlife authorities

Kenya -- yes, the entire country -- was left without power for 15 minutes Tuesday after a rogue monkey got into a power station and triggered a blackout.

That's 4.7 million households and businesses.

The primate fell onto a transformer at the Gitaru hydroelectric power station, according to Kenya Electricity Generating Company, or KenGen, which owns the facility. The station is the largest generator in the country.

"This monkey tripped a transformer. This triggered a cascading effect on the other generators which ended up disrupting power generation and distribution in the whole country," Kenya Power



Story of a Vervet Monkey causing a countrywide outage Source: CNN

PROBLEMS: LEGAL LIABILITY

United States

Utility to pay for bird deaths

Fines, restitution, upgrades to electric equipment will cost \$10.5 million USD

By RUFFIN PREVOST

Gazette Wyoming Bureau Jul 11, 2009



U.S. Fish and Wildlife Service

Eagles electrocuted by power lines are seen in Wyoming.



Russia

Common Name	Scientific Name	Fine per Electrocution		
		Rubles	Dollar*	Euro*
Saker Falcon, Peregrine Falcon	<i>Falco cherrug, F. peregrinus</i>	₽ 600,000	\$ 8,160	€ 6,630,000
Golden Eagle	<i>Aquila chrysaetos</i>	₽ 300,000	\$ 4,080	€ 3,315,000
Eastern Imperial Eagle	<i>Aquila heliaca</i>	₽ 100,000	\$ 1,350	€ 1,105,000
White-Tailed Eagle	<i>Haliaeetus albicilla</i>	₽ 100,000	\$ 1,350	€ 1,105,000
Cinereous Vulture	<i>Aegypius monachus</i>	₽ 100,000	\$ 1,350	€ 1,105,000
Eagles to genus	<i>Aquila, Haliaeetus</i>	₽ 50,000	\$ 675	€ 553,000
Steppe Eagle	<i>Aquila nipalensis</i>	₽ 50,000	\$ 675	€ 553,000
Eurasian Eagle-Owl	<i>Bubo bubo</i>	₽ 50,000	\$ 675	€ 276,000
Great Grey Shrike	<i>Lanius excubitor</i>	₽ 10,000	\$ 135	€ 111,000
Crane species	<i>Gruiformes</i>	₽ 10,000	\$ 135	€ 111,000
Stork and Heron species	<i>Ciconiiformes</i>	₽ 10,000	\$ 135	€ 111,000
Hawks, Kites, Falcons	<i>Accipiter, Buteo, Milvus, Falco</i>	₽ 5,000	\$ 68	€ 55,000
Owls	<i>Asio, Strix</i>	₽ 5,000	\$ 68	€ 55,000
Great Spotted Woodpecker	<i>Dendrocopos major</i>	₽ 3,500	\$ 47	€ 39,000
Eurasian Nightjar	<i>Caprimulgus europaeus</i>	₽ 2,000	\$ 27	€ 22,000
Passerines	<i>Passeriformes, Corvidae</i>	₽ 1,000	\$ 14	€ 11,000



Avian Scope:

Total bird numbers globally lost to power line electrocutions are unknown, but it is believed between .9 million and 11.6 million birds are killed annually in the United States (Loss et al. (2014)).

Electrocutions are thought to be compensatory but there are impacts on declining species.



Saker Falcon - Mongolia

MITIGATION



Electrocution



Goals

The goal of wildlife mitigation product selection is to identify an optimal suite of products that will:

- a) minimize the possibility of an animal electrocution or related outage;
- b) be readily adopted by field staff; and
- c) provide a long service life!





Different Challenges Globally

Material Types

Phase to Phase
North America

Wood Pole & Arm

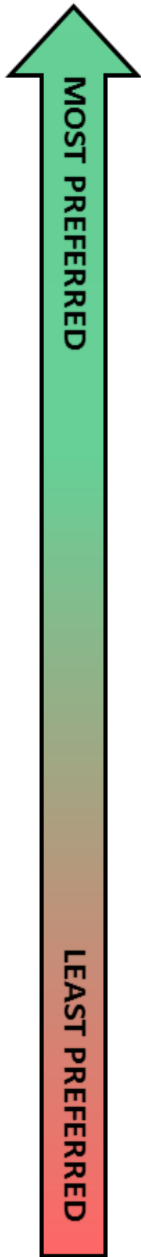


Phase to Ground
Europe and Asia

Grounded Pylon & Arm



Wood versus Reinforced Concrete and Steel



Wood Pole & Arm



Grounded Pylon & Arm



<p>INSULATION ✓</p> <p>Avian-friendly</p> <p>2.4 m arm with conductor cover</p>	<p>INSULATION ✓</p> <p>Avian-friendly</p> <p>3 conductor covers</p>
<p>REDIRECTION ⚠</p> <p>Reduced Hazard</p> <p>2.4 m arm with perch discouragers</p>	<p>REDIRECTION ⚠</p> <p>Reduced Hazard</p> <p>Discouragers</p>
<p>NO MITIGATION ✗</p> <p>Avian Hazard</p> <p>2.4 m arm</p>	<p>NO MITIGATION ✗</p> <p>Minimal Separation</p>

NEW CONSTRUCTION

1. Build in Clearances



Wildlife and power lines

Guidelines for preventing and mitigating wildlife mortality associated with electricity distribution networks

Editors: Justo Martín Martín, José Rafael Garrido López, Helena Clavero Sousa and Violeta Barrios



INTERNATIONAL UNION FOR CONSERVATION OF NATURE

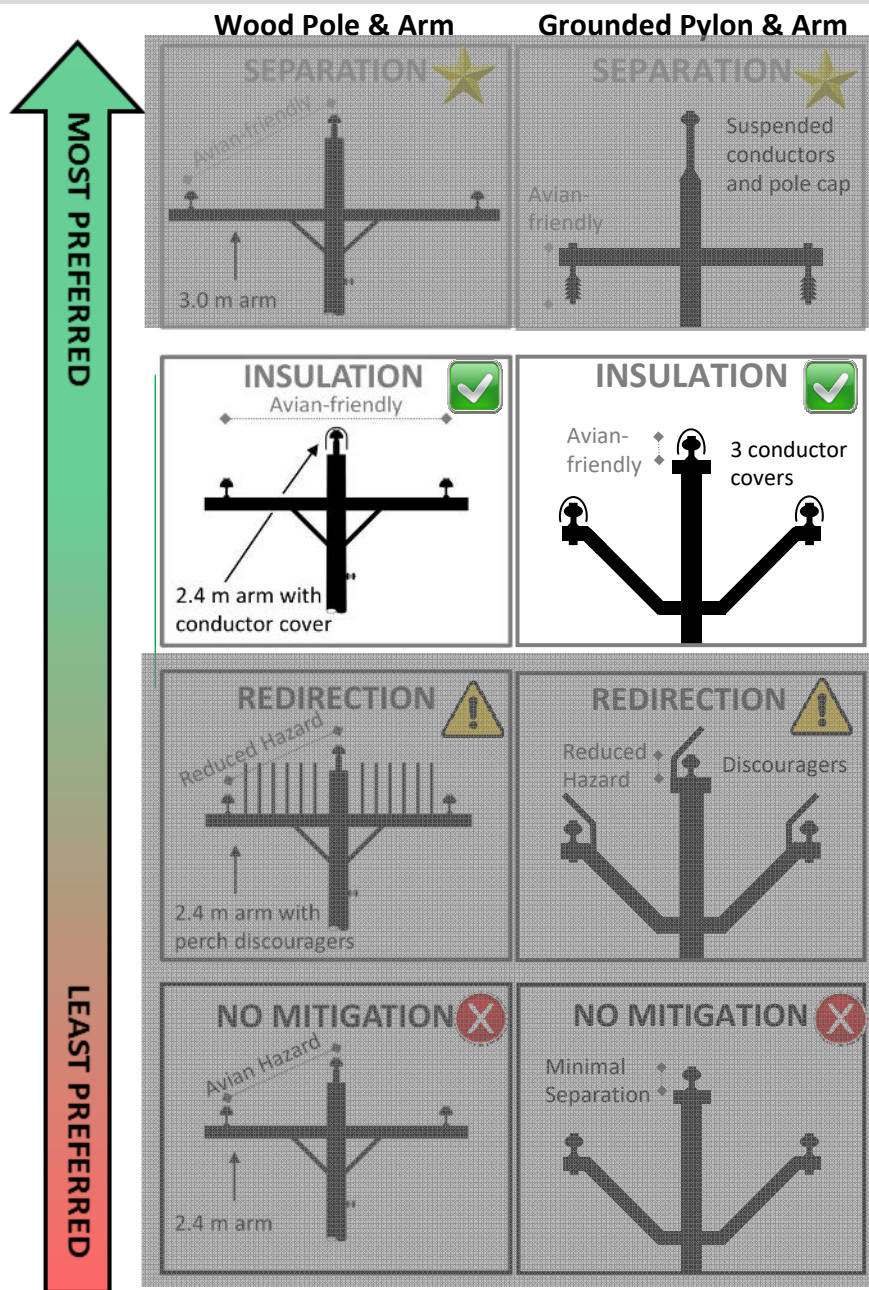


(Dwyer et al. 2017)



Avian Interactions with Power Infrastructure





MOST PREFERRED

LEAST PREFERRED

(Eccleston & Harness 2018)

EXISTING CONSTRUCTION

Existing Pylons are Typically Retrofitted with a Variety of After Market Products

2. Retrofitting: Insulation

! *Caution: Raptor-protection measures using insulation are not designed to protect linemen. Many products are not rated for the full line voltage and are designed to protect birds from incidental contact only. All raptor-protection products should be reviewed and formally adopted by Engineering and Operations prior to deployment.*



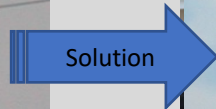
Retrofitting – Insulation

Wood Poles and Crossarms

Problem:



Golden Eagle – Wyoming USA



Retrofit:



Golden Eagle – Wyoming USA

Conductor Guard (1)

Tangent Unit - Wood



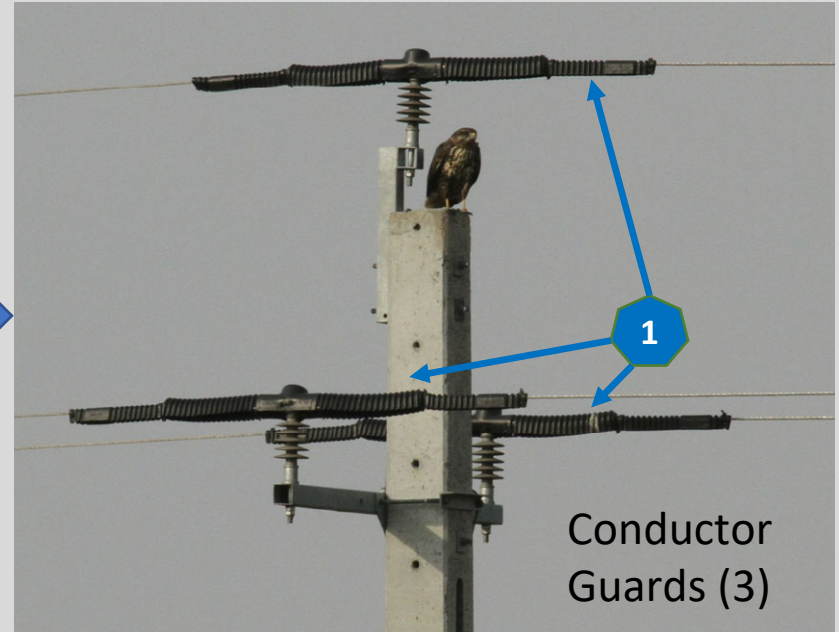
Retrofitting – Insulation

Concrete Poles and Metal Crossarms

Problem:



Retrofit:



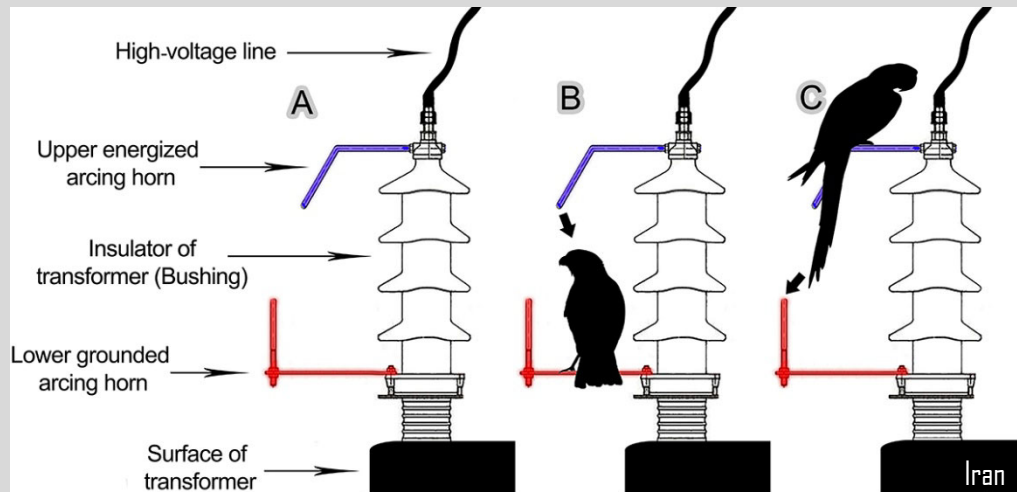
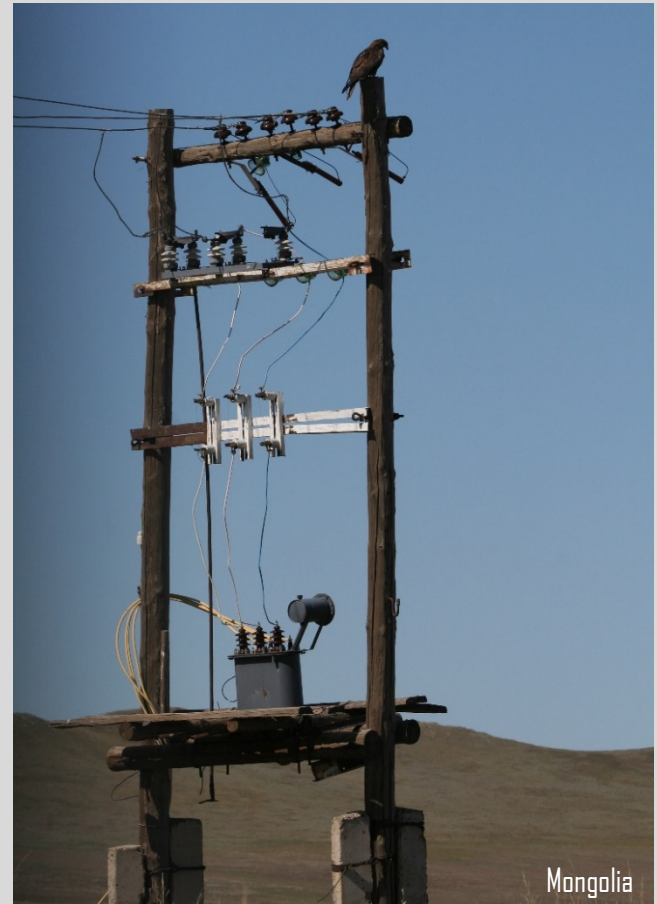
Saker Falcon – Hungary

Tangent Unit – Concrete and Steel



New AND Retrofitting – Insulation

REGARDLESS: ALL Equipment Must be Insulated!



Transformer Units



Retrofitting – Insulation

ALL Equipment Must be Insulated!

Install Transformer Bushing Covers (3)



Insulate ALL Jumpers – Leaving NO gaps



Install Surge Arrester Caps (3)

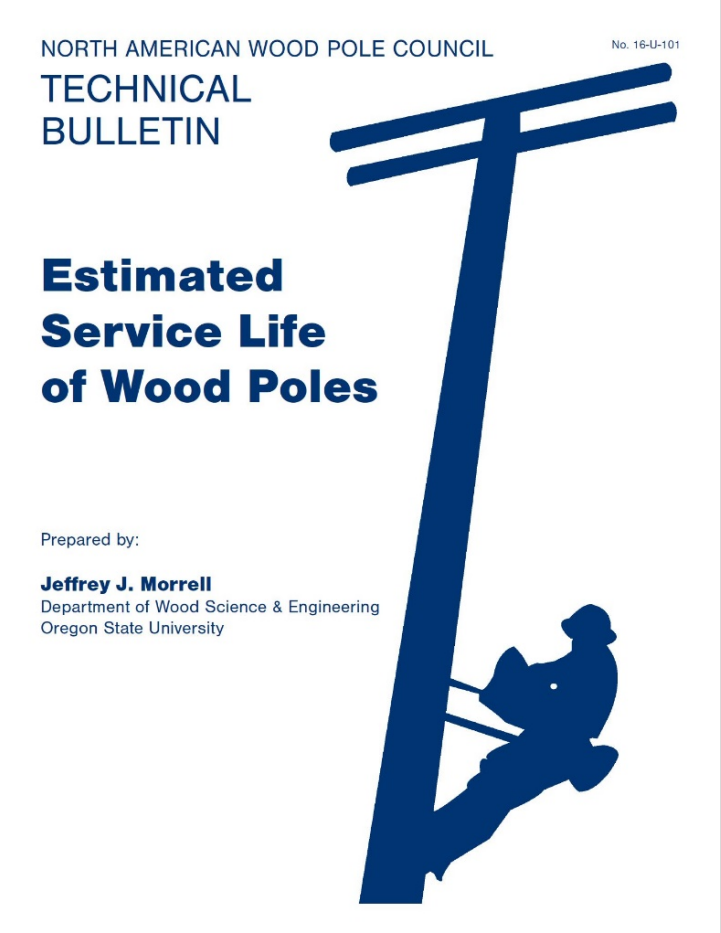


Transformer Unit



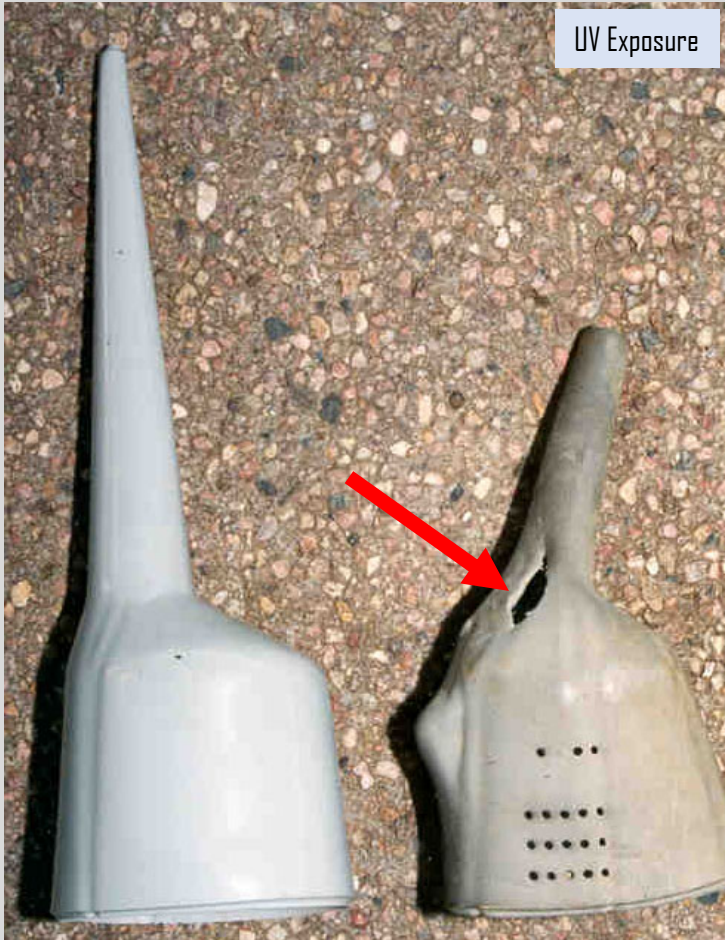
Durability is VERY Important

Many distribution utility structures will last 50+ Years! Thus, engineering should select retrofitting materials which fit properly, are effective and will last for decades.





Products Must Withstand Harsh Factors

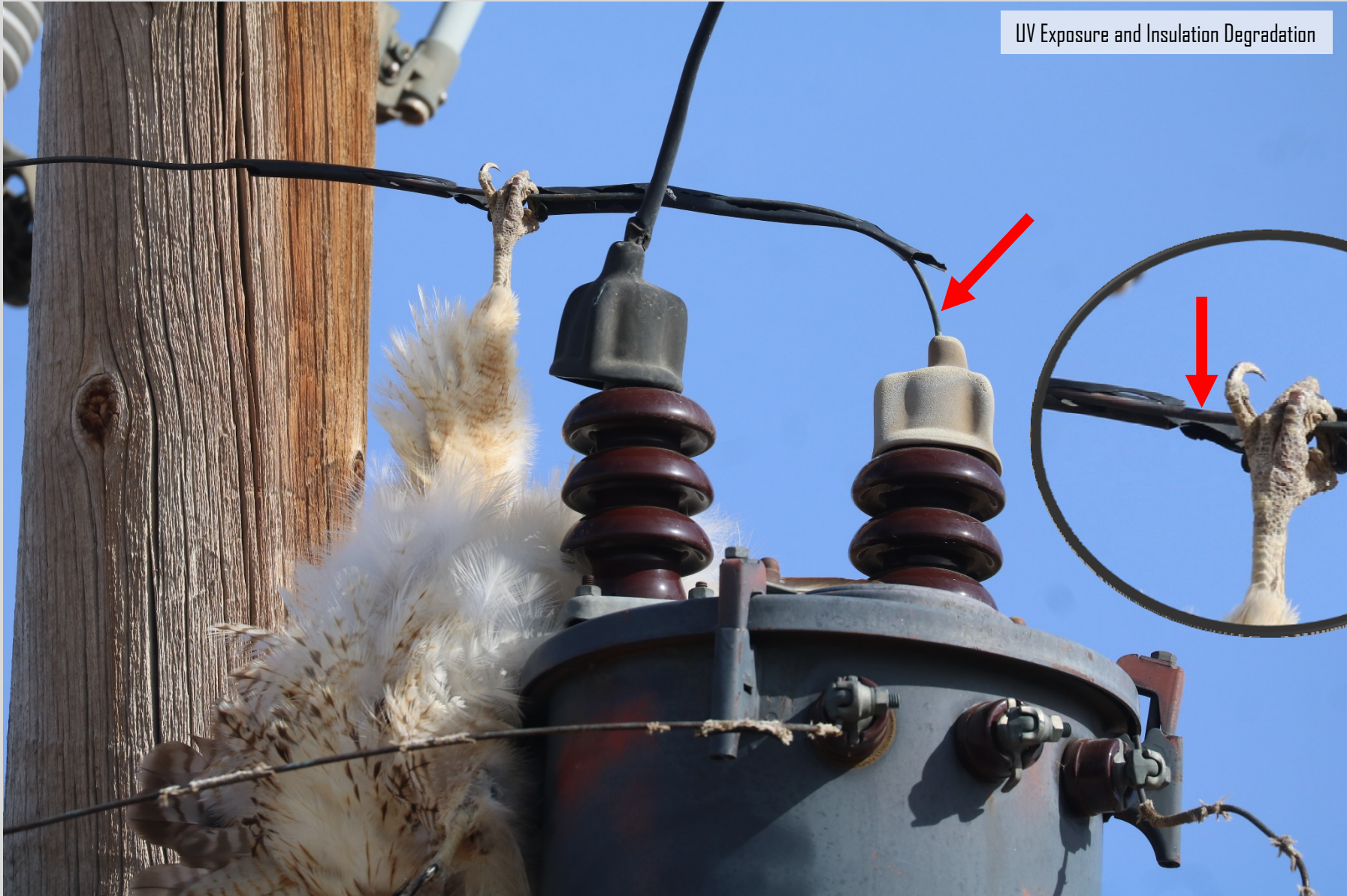


Installed on equipment which can operate at 140 °C (284 °F) or more!



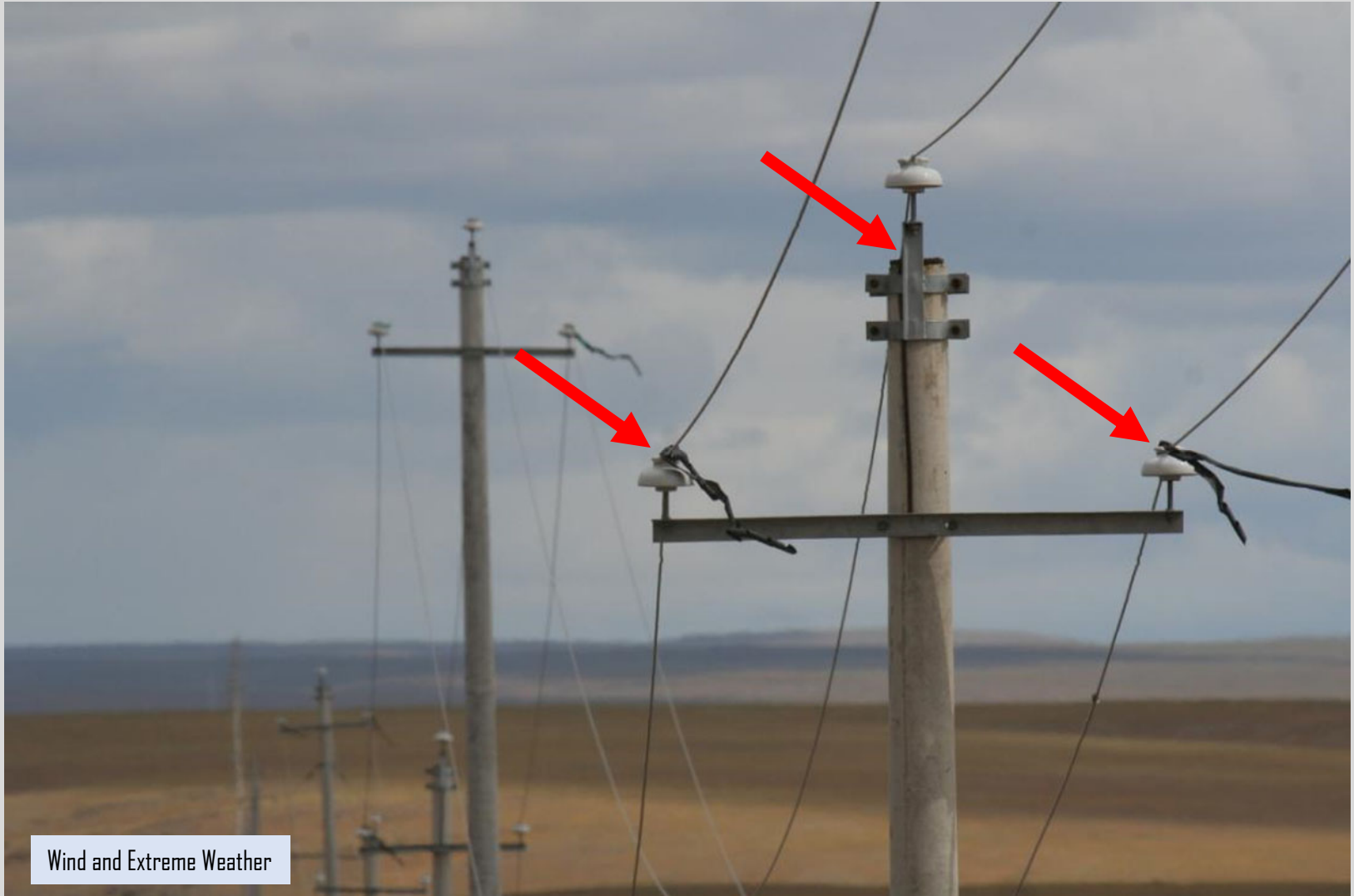
Products Must Withstand Harsh Factors

UV Exposure and Insulation Degradation





Products Must Withstand Harsh Factors

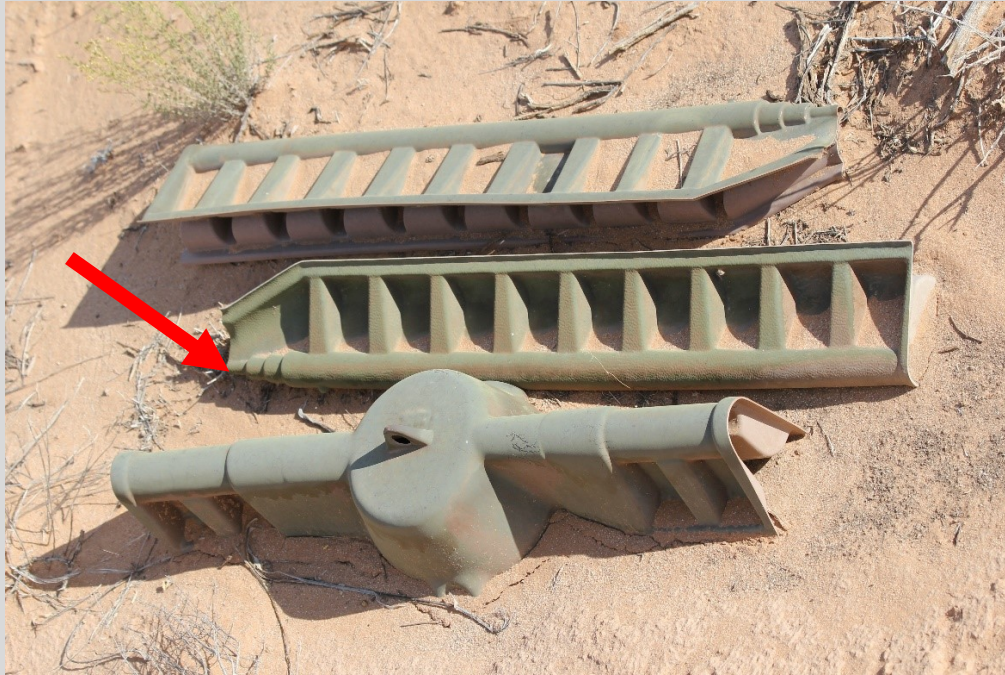


Wind and Extreme Weather

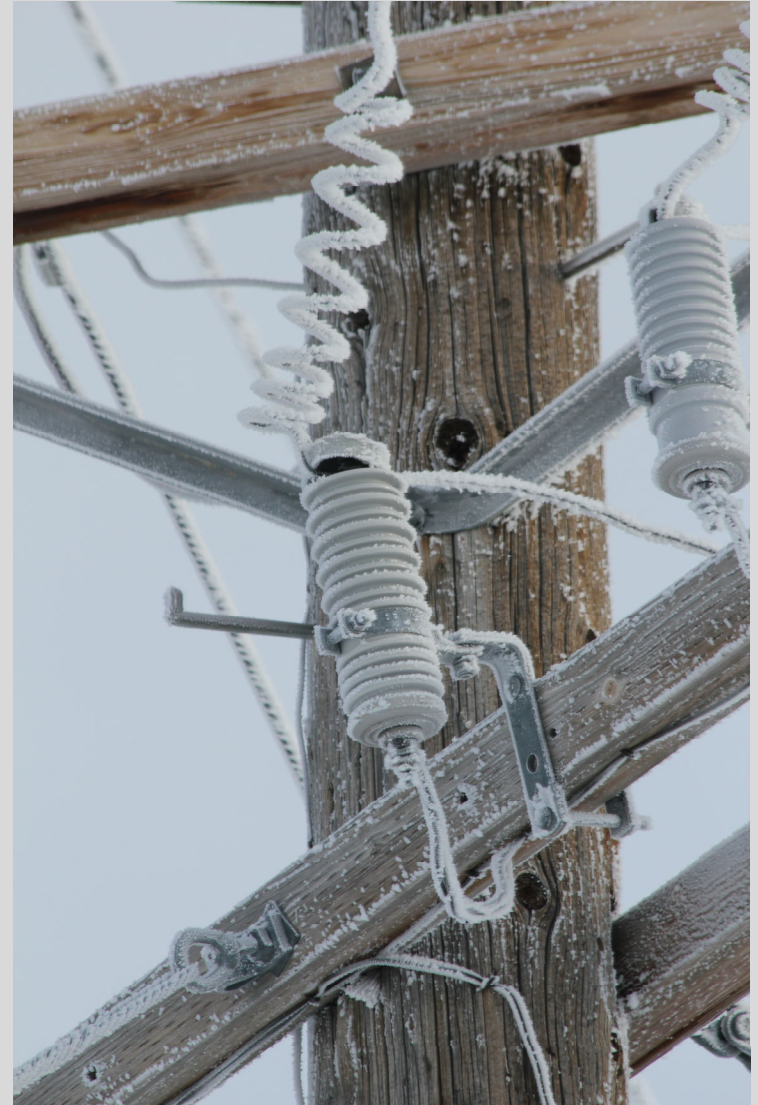
Mongolia



Products Must Withstand Harsh Factors



Hot and Cold Extremes – Devices Coming Off Due to Contraction and Expansion





Products Must Withstand Harsh Factors





Numerous Available Products

EPRI | ELECTRIC POWER
RESEARCH INSTITUTE

Compendium of Animal Caused Outage Prevention Products

Single Source of Mitigation Products:

- Product Name
- Manufacturer Name
- Contact Information
- Description
- Application
- Device Property and Material

Description: Dead-end shoe cover. Custom designed parts available.

Voltage Rating: 72kV

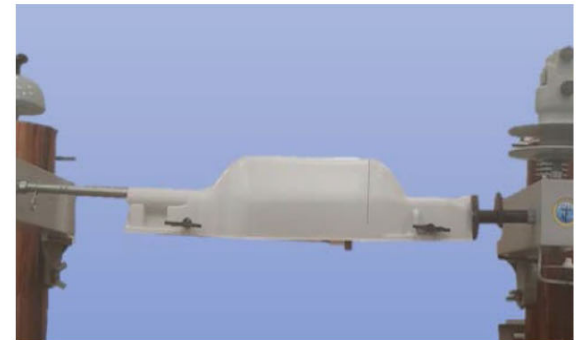
Installation Techniques: Hotstick; Gloved

Material: Proprietary Blend/Plastic: Thermoform

Cost: Contact for pricing

Self-Reported IEEE 1656 Testing: Testing in progress

Flammability Testing: V0





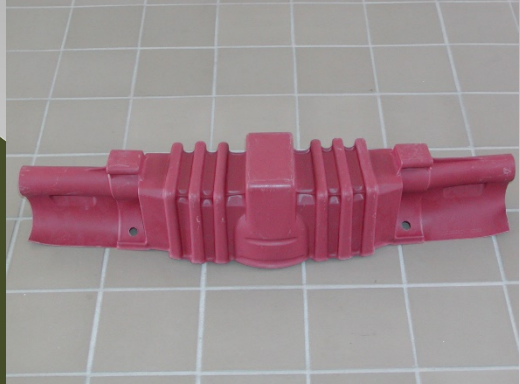
Numerous Materials



N=35
Bushings Covers

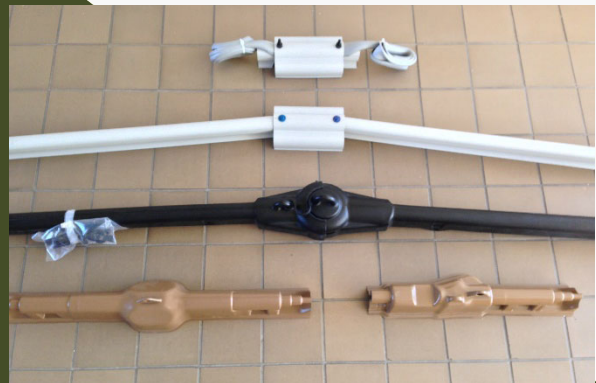


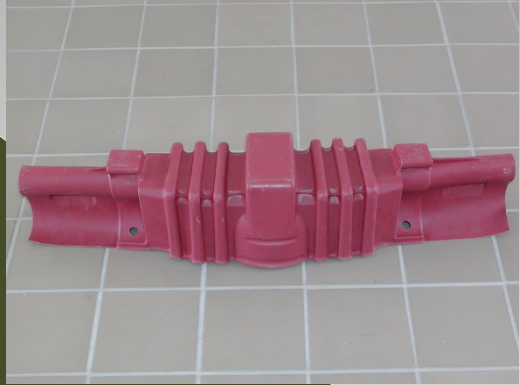
Similar Looking Products May Have Very Different Formulations and Thus VERY Different Performance and COST!



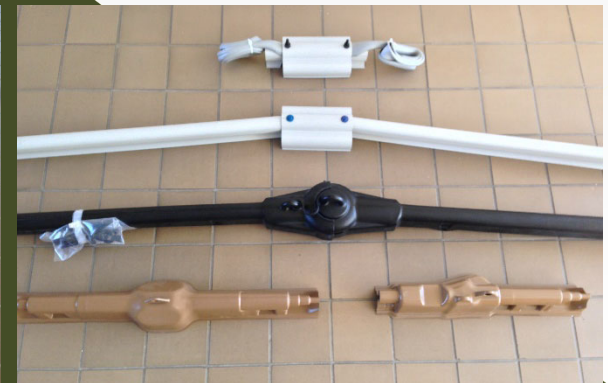
The goal of wildlife mitigation product selection is to identify optimal products that will:

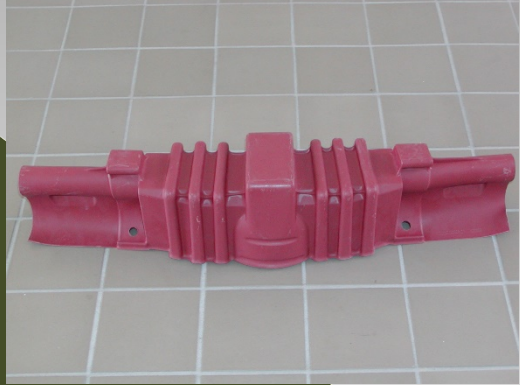
1. Minimize the possibility of an animal electrocution or related outage (effective) NEXT Presentation by Dwyer
2. Be readily adopted by field staff (easy to install) NEXT Presentation by Dwyer
3. Provide a long service life!



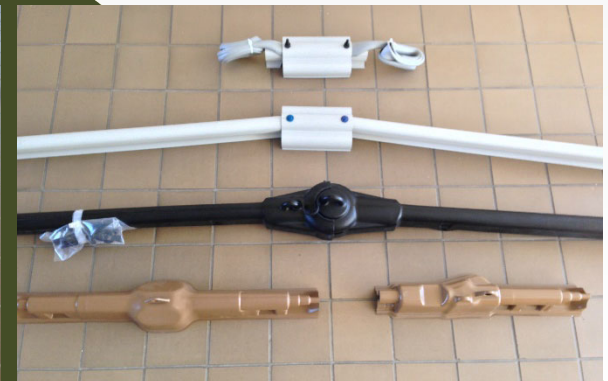


To maximize mitigation success, utility engineers should consider specific environmental stresses that may affect product longevity and effectiveness in their service area.





UV Stable + Non-Tracking +
Hydrophobic + Fire
Resistant + Other?





IEEE Guide for Animal Deterrents

IEEE STANDARDS ASSOCIATION



IEEE Guide for Testing the Electrical, Mechanical, and Durability Performance of Wildlife Protective Devices on Overhead Power Distribution Systems Rated up to 38 kV

IEEE Power & Energy Society

Sponsored by the
Transmission and Distribution Committee

IEEE
3 Park Avenue
New York, NY 10016-5997
USA

IEEE Std 1656™-2010

IEEE 1656-2010 - IEEE Guide for Testing the Electrical, Mechanical, and Durability Performance of Wildlife Protective Devices on Overhead Power Distribution Systems Rated up to 38 kV **recommends sequential test procedures to ensure products will not compromise system performance and products will be effective and durable despite long-term exposure to UV, extreme temperatures, high winds, and/or salt fog.**

The sequential format is:

- a) baseline dielectric testing
- b) environmental stress exposure,
- c) repeat dielectric testing.

To PASS: Individual samples must show ongoing dielectric effectiveness!



Table 1—Design test sequences

Design test	Clause	Wildlife protective device type (See NOTE 1 and NOTE 2)	
		Bushing, cutout, surge arrester, and conductor/insulator guards (See NOTE 3)	Deterrents, perches, and manufactured nests (See NOTE 4)
Cold temperature	5.5	<input type="checkbox"/>	<input type="checkbox"/>
Flammability – when required	5.9	<input type="checkbox"/>	<input type="checkbox"/>
Retention – when required	5.8	<input type="checkbox"/>	<input type="checkbox"/>
Radio-influence voltage	5.10	—	<input type="checkbox"/> ↴
Wet withstand	5.2	<input type="checkbox"/> ↴	<input type="checkbox"/> ↴
Wet power frequency flashover (See NOTE 5)	5.3	<input type="checkbox"/> ↴	<input type="checkbox"/> ↴
Lightning impulse withstand	5.4	—	<input type="checkbox"/> ↴
Ultraviolet aging	5.6	<input type="checkbox"/> ↴	<input type="checkbox"/> ↴
Radio-influence voltage	5.10	—	<input type="checkbox"/> ↴
Wet withstand	5.2	<input type="checkbox"/> ↴	<input type="checkbox"/> ↴
Wet power frequency flashover (See NOTE 5)	5.3	<input type="checkbox"/> ↴	<input type="checkbox"/> ↴
Lightning impulse withstand	5.4	—	<input type="checkbox"/> ↴
Salt fog aging – for unusual service conditions – when required	5.7	<input type="checkbox"/> ↴	<input type="checkbox"/> ↴
Radio-influence voltage	5.10	—	<input type="checkbox"/> ↴
Wet withstand	5.2	<input type="checkbox"/> ↴	<input type="checkbox"/> ↴
Wet power frequency flashover (See NOTE 5)	5.3	<input type="checkbox"/>	<input type="checkbox"/> ↴
Lightning impulse withstand	5.4	—	<input type="checkbox"/>

NOTE 1—A minimum number of three samples is required for each design test.

NOTE 2— = test applicable to sequence; ↴ = each specimen proceeds to following test; — = the test is not required for devices not containing metallic components and is omitted from the test sequence.

NOTE 3—If the device contains metallic components, the test sequence for deterrents, perches, and manufactured nests should be completed.

NOTE 4—For electrostatic guards, the wet withstand test (see 5.2) should not be performed.

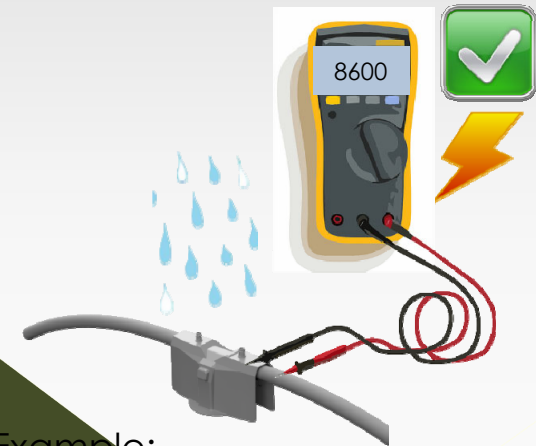
NOTE 5—For surge arrester guards, the wet power frequency flashover test (see 5.3) should not be performed.



IEEE Guide for Animal Deterrents

Primary Test #1:

Wet withstand: The test is a means to qualify a device's ability to operate safely during rated electrical conditions. A wildlife guard or deterrent passes the wet withstand test if samples do not puncture or flashover when exposed to 120% of the rated phase-to-ground voltage with either a moving or fixed electrode.

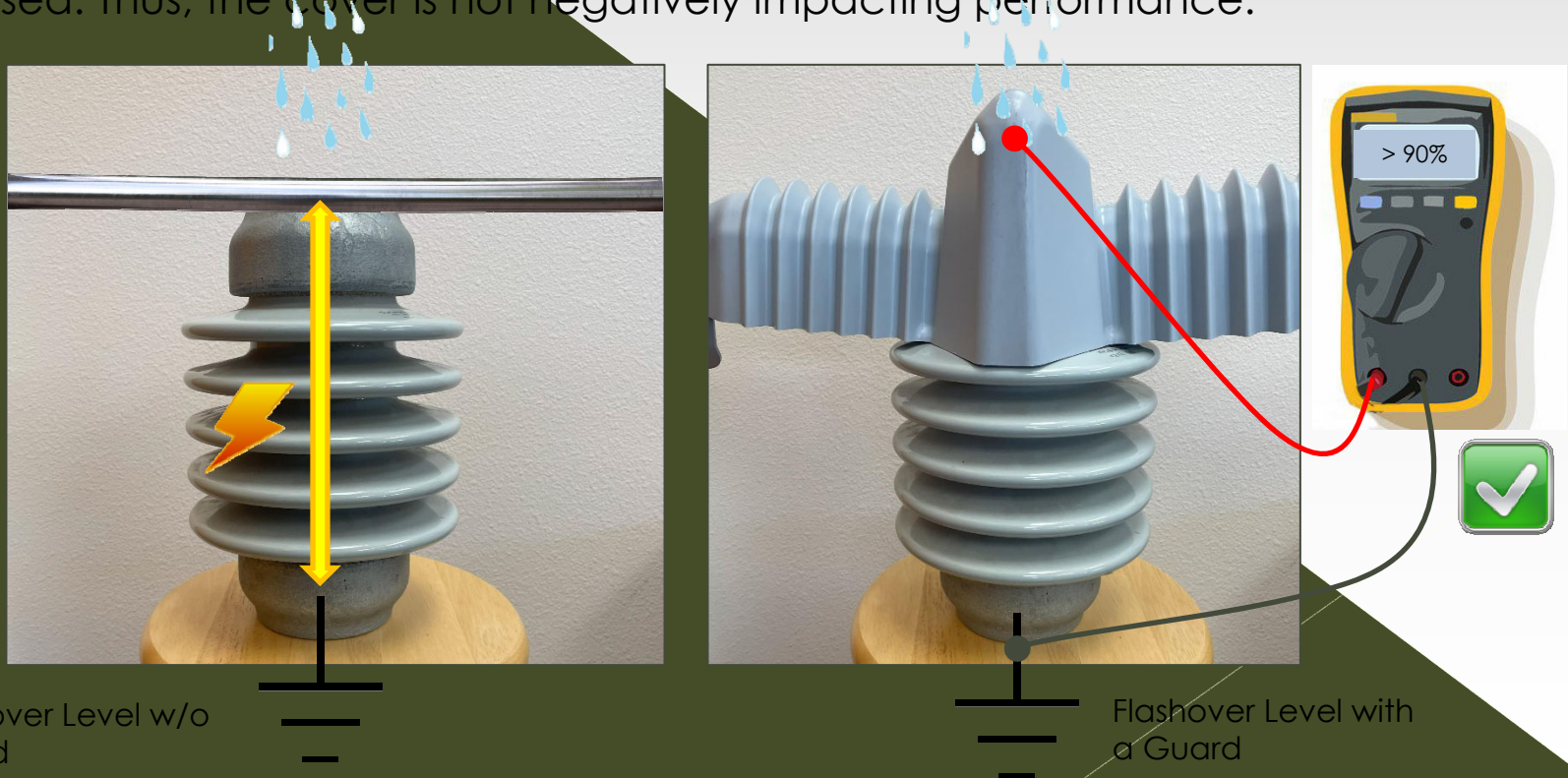


Example:
12 kV = 7.2 kV Phase-to-Ground
Must Sustain 120% = 8.6 kV

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Primary Test #2:

Wet power frequency flashover: Wet power frequency flashover is the next test in the sequence. This test measures the flashover value of an insulator with and without a wildlife guard installed. With a guard installed (Right), it should be 90% or more of the original value. This verifies the leakage path of the primary insulator has not been compromised. Thus, the cover is not negatively impacting performance.



Flashover Level w/o Guard

Flashover Level with a Guard

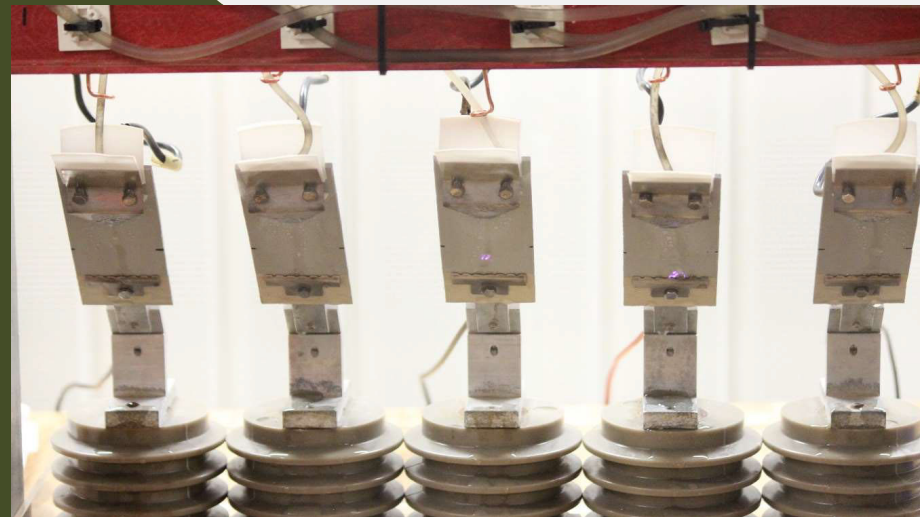
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Sample Tests:

Ultraviolet aging: The test samples are placed in an ultraviolet light aging chamber and samples aged for a period of 1000 h using UV-A type lamps having a peak emission at 340 nm. Conditions in the test chamber follow a repeating cycle consisting of 8 h of UV exposure at 60 °C (140 °F) followed by 4 h of condensation exposure at 50 °C (122 °F). The condition of the test samples before and after this test are documented then resubjected to wet withstand and power frequency tests.



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Sample Tests:

Salt fog aging—Testing for unusual service conditions:

During the aging process, samples are exposed to a high-voltage with an application of salt fog for 4 h, followed by a 4 h period with no salt fog. The total aging period is 1000 h. Then resubjected to wet withstand and power frequency tests.

Flammability testing: Flame retardant properties can be critical in preventing wildfires should a wildlife guard be involved in an insulator flashover event. IEEE test procedures can be used to determine the suitability of a particular device.





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Sample Tests:

Retention testing: The sample should remain properly installed when subjected to a minimum wind speed of 97 km/h (60 mph). Alternate wind speeds based on service area extremes may be specified by mutual agreement between the manufacturer and user. Variations in wind angles should be considered and documented as tested.



Image: NASA



Image: Power Line Sentry

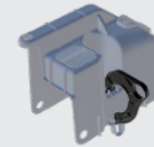


IEEE Guide for Animal Deterrents

A growing number of manufacturers have performed IEEE 1656 testing, which facilitates direct comparison between competing products; however, test reports must be carefully reviewed to ensure vendors have strictly followed IEEE guidance.



UNIVERSAL CUTOUT COVER CT-D02



UNIVERSAL LOADBREAK CUTOUT COVER CT-D04

SKU	FIT	SHED DIAMETER	QTY
CT-D02	FMOST 100 AND 200 AMP STANDARD DISTRIBUTION CUTOUTS	FITS STINGER SIZES #6-4/0 WITH INSULATING LINE HOSE	20
CT-D04	ABB, HUBBELL-CHANCE, ALUMA-FORM, MACLEAN STYLE LOADBREAK CUTOUTS	≤ 5"	20

TESTS	RESULTS
IEEE 1656 / 5.2 WET WITHSTAND	>18 KV
IEEE 1656 / 5.3 WET POWER FREQUENCY FLASHOVER	>95%
IEEE 1656 / 5.4 LIGHTNING IMPULSE WITHSTAND	125KV
IEEE 1656 / 5.5 COLD TEMPERATURE TEST	PASSED / -25C
IEEE 1656 / 5.6 ULTRAVIOLET AGING	5,000 HOURS
WIND RETENTION	>90 MPH
UL 94 FLAMMABILITY OF PLASTIC MATERIALS	V-0

PROPERTIES	RESULTS
ASTM D149 DIELECTRIC STRENGTH	467 V/MIL (18.4 KV/MM)
ASTM D2303 INCLINED PLANE TRACKING AND EROSION: INITIAL TRACKING (VARIABLE VOLTAGE)	4.0 KV
ASTM D638 TENSILE STRENGTH @ YIELD	2,400 PSI (17 MPA)
ASTM D790 FLEXURAL MODULUS	140,000 PSI (966 MPA)



Conclusions

- Global Issue
- Fortunately, solutions exist!
- Build new lines with proper clearances
- Retrofit with insulation products that meet company standards
- Product durability is an important issue
- Compare products using vendor IEEE 1656 results taking care to ensure tests were done correctly
- Monitor product effectiveness

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Acknowledgements

- The Altai Project
- EPRI – Electric Power Research Institute
- IEEE
- NRECA – National Rural Electric Cooperative Association
- Kaddas Enterprises
- Power Line Sentry
- TE Connectivity

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Golden Eagle – Wyoming USA



QUESTIONS?