

FIELD GUIDE

Mitigating Wildlife Impacts on Substations

A playbook to prevent faults and repeat incidents

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FEBRUARY 2026



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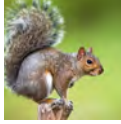
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ACKNOWLEDGEMENTS

This work was supported by the U.S. Department of Energy (DOE) Office of Cybersecurity, Energy Security, and Emergency Response (CESER).

INL thanks Brian McGowan, Scientias-Energy, for preparing the foundational technical report and for providing subject-matter input that informed this guidance. INL and Scientias-Energy also conducted targeted interviews with wildlife-mitigation product manufacturers specifically to inform this guide and incorporated anonymized themes and practical feedback from those discussions. Where relevant, the guide also reflects anonymized themes from utility conversations and interviews conducted across related INL work.

INL thanks the following organizations for their voluntary input: Bird Barrier America, Hubbell Power Systems, Kaddas Enterprises, Midsun, Powerline Sentry, TE Connectivity, Transguard.



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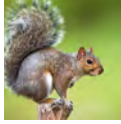
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EXECUTIVE SUMMARY

Wildlife is a leading driver of distribution outages. For many utilities, wildlife accounts for roughly one in five service interruptions, with squirrels often responsible for the largest share. This Field Guide focuses on reducing sustained wildlife-caused outages at substations, with tree squirrels as the primary target, for reasons including the following:

- In 2023, American Public Power Association member data indicated 18.9% of outages were caused by wildlife. The breakdown of that percentage is as follows: 9.8% squirrels, 3.4% birds, 5.7% other animals. Across the span of approximately 30 years, wildlife typically sits in the 18–22% range.¹
- Vendor interviews (n=7), held in summer 2025 with wildlife-mitigation product manufacturers, consistently identified squirrels as the typical substation wildlife problem in routine field experience (see [Technical Guide, Section 3 \(Evidence Snapshot\)](#) and [Appendix B](#)).
- A 2021 Electric Power Research Institute (EPRI) member survey found the most susceptible component to wildlife disruptions was distribution transformers, and the most common animal group was small mammals (including squirrel species).²

This Field Guide is built to complement, not replace, existing wildlife and reliability efforts. It gives a vendor-neutral, principle-based approach that can be folded into routine inspections, maintenance, and outage-response work, especially at utilities with limited staff, time, budget, or staged inventory dedicated to wildlife mitigation. For strategically critical substations, this Field Guide can still support scoping and documentation, but the expected standard is an engineered mitigation plan with managed execution and acceptance.

This Field Guide is meant to reduce sustained wildlife-caused substation outages by discussing what to look for, what to fix first with available materials, what to document for follow up, and how to close out work. The Technical Guide (companion guide) is optional reading and mainly serves as a backup reference of the acceptance standard, inspection and key performance indicator (KPI) details, and supporting evidence behind the Field Guide.

1 APPA. 2024. "What Causes Electrical Outages?" Last modified July 11, 2024.

2 EPRI. 2021. "Survey of Wildlife Protection Products." Technical Update, 3002021639.

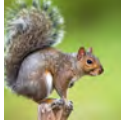
Research suggests that some wildlife-mitigation durability issues stem from installation-related factors, including component selection, fitment challenges, or field installation constraints. In practice, linemen often must adapt to site-specific conditions, and occasional improvisation may be necessary to restore service safely and efficiently. It is, therefore, important to clearly distinguish between mitigation measures that meet durability and acceptance standards and temporary solutions implemented under field conditions. When improvisation is used, it should be an interim measure and followed by a timely upgrade to a more robust, permanent mitigation solution.

Substations defined as strategically important or critical should be managed by strictly adhering to the guidance defined in Section “*The Loop*”. The SEPA-R® process³ is designed to thoroughly assess, design, plan, and execute a complete substation animal mitigation. The process should be applied to high-consequence yards serving critical load. The definition of strategically important assets should be made by engineering management.

Most distribution faults are momentary (~70–90%) and clear with recloser operation. This guide targets the sustained wildlife events that result in sustained outages, often caused by squirrels. Together, the Field Guide and its Technical Guide are meant to make wildlife-mitigation routine work performed in small actions, which steadily reduce risk within normal operation and maintenance (O&M) practices. These guides also offer clear documentation that turns remaining gaps into planned, fundable work.

This Field Guide does not assume crews have a full catalog of wildlife-mitigation products on the truck or the time to fully mitigate unprotected or partially protected yards in a routine substation visit. It is a triage-and-escalation playbook: complete the highest value mitigation actions using available, approved materials, then photo-document remaining gaps so they can be prioritized, planned, kitted, and funded as a follow-up work package.

3 Scientias-Energy. 2024.



GUIDE OVERVIEW

Audience

This guide is written for people involved in wildlife-mitigation work at substations. For example, the following groups may find this guide helpful:

- **Field crews** – Linemen and substation technicians who walk the yard, install mitigation, and respond to wildlife events.
- **Supervisors and foremen** – Those who decide where to send crews, set expectations for each visit, and review photos and acceptance checks.
- **Engineers** – Those who own clearances, standards, and equipment ratings and who need to be confident that mitigation stays within safe limits.
- **Managers and reliability staff** – Those who track System Average Interruption Frequency Index (SAIFI), System Average Interruption Duration Index (SAIDI), Customer Average Interruption Duration Index (CAIDI), budgets, and programs and who need to know whether small wildlife actions are actually improving reliability.

These roles are linked by a simple loop: field work in the yard, operation and maintenance (O&M) checks that keep it healthy, a business view that measures impact, and feedback that updates standards and kits for the next round of work. This guide is meant to keep that loop small and able to be completed so crews know what to do during a visit at one yard, supervisors and engineers can keep the actions safe and repeatable, and managers can see how those actions show up in existing reliability metrics and decisions.

Purpose

This guide gives utility teams a vendor-neutral, O&M-friendly way to cut sustained wildlife-caused outages at substations by standardizing a simple triage-and-escalation approach. It does not assume crews have a full catalog of mitigation products on the truck or the time to fully mitigate an unprotected or partially protected yard in one visit. When required parts, clearances review, or engineering support are needed, the expected outcome is to photo-document the gap and escalate it as a planned retrofit package.

Today, only a small minority of U.S. substations are fully protected; most are partially protected or unprotected because work is incident-driven, installations age out, or budgets are tight. Uneven use of mitigation keeps wildlife-related events high even though practical solutions exist (see [Technical Guide, Section 3 \(Evidence Snapshot\)](#), and [Appendix B](#) for more vendor feedback).

This guide focuses on reducing sustained wildlife-caused substation outages by bringing substations toward a consistent, basic level of wildlife risk reduction that fits within normal working windows while making it easy to flag and plan what cannot be completed in that visit.

Scope

This guide focuses on sustained events that lead to customer outages, equipment damage, or repeated re-trips. It does not cover brief, momentary faults that clear up on their own.

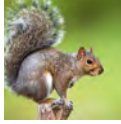
The scope includes the following:

- **Animal:** Tree squirrels are the primary driver of contact events based on industry data and feedback. The principles in this guide apply to small climbing mammals broadly, with prioritization focused on squirrels.
- **Locations:** Equipment and structures inside the substation fence, such as buswork, transformers, and breakers. Issues outside the yard are out of scope.
- **System level:** Distribution and sub-transmission substations. Transmission yards and underground cable systems are not directly covered.
- **Yard population:** This guide is primarily intended for the broad population of partially protected substations where work is often incident-driven and fits within normal O&M windows. Strategically critical substations (high-consequence yards) should be addressed through an engineering-driven, program managed approach such as SEPA-R.
- **Event types:** Sustained wildlife-caused outages and equipment damage and near-misses that show clear contact risk.

Use the Quick Start in [Section “QUICK START”](#) to choose where to begin and how much effort to apply during a visit. Supervisors can use this guide to set realistic priorities and expectations for each visit (including what should be planned and kitted for follow up), and linemen and technicians can use this guide in the field to choose, install, and document solutions within normal O&M windows. For strategically critical substations, use this guide for scoping and documentation, but treat the expected outcome as an engineered mitigation plan with managed execution and acceptance.

Why This Matters

Wildlife is a steady contributor to sustained substation outages. Because species, layouts, and equipment vary across yards, a single, “one-size-fits-all” approach rarely works. As Electric Power Research Institute (EPRI) states,



“Resolving wildlife-caused outages is dependent upon knowing what animals are causing the problems” and then applying the proper solution set (e.g., insulation and isolation).⁴ In practice, the most common problem is not a lack of available products but the inconsistent or partial application of mitigation over time.

Tree squirrels typically enter via overhead lines – seen in Figure 1 – or fencing and cause faults by bridging live parts or chewing insulation. Utilities and vendors report similar patterns across regions, which suggests that basic, consistent protection can address most of the risk (For more vendor feedback, see [Technical Guide, Section 3 \(Evidence Snapshot\)](#) and [Appendix B2](#)). Most substations are only partially mitigated, which leaves residual access paths and drives repeat events.

Despite the proliferation of solutions and suppliers over the past 30 years, wildlife outage figures remain stable in the ~20% range. There are two main reasons contributing to the stagnation:



Figure 1. Overhead lines can act as a ready-made highway for squirrels to enter substation yards.

- Increasing wildlife monitoring at many utilities reflects better cause coding and fewer unknowns.
- Even with improved products and more suppliers, the main driver of mitigation success is application quality (i.e., coverage completeness, correct sizing and overlap, and basic maintenance).

Misapplication and partial application are common and are a primary reason wildlife-mitigation fails to hold over time. Pacific Gas and Electric (PG&E) notes that “Recent animal contact is a lagging indicator and requires immediate action to avoid a repeat incident.” PG&E also recommends using leading indicators such as to “BE OBSERVANT AND USE common sense” and act based on site cues (e.g., habitat, evidence of activity).⁵ Efforts in preparing for and resulting from field-level observations are a key part of this guide.

This guide focuses on reducing approach paths and attractants, where feasible, and on protecting priority live parts using simple, principle-based methods. When these principles (Section 5) are paired with quick inspections and photo-verified acceptance, wildlife-related events can reduce steadily, and the mitigation program is easier to maintain over time.

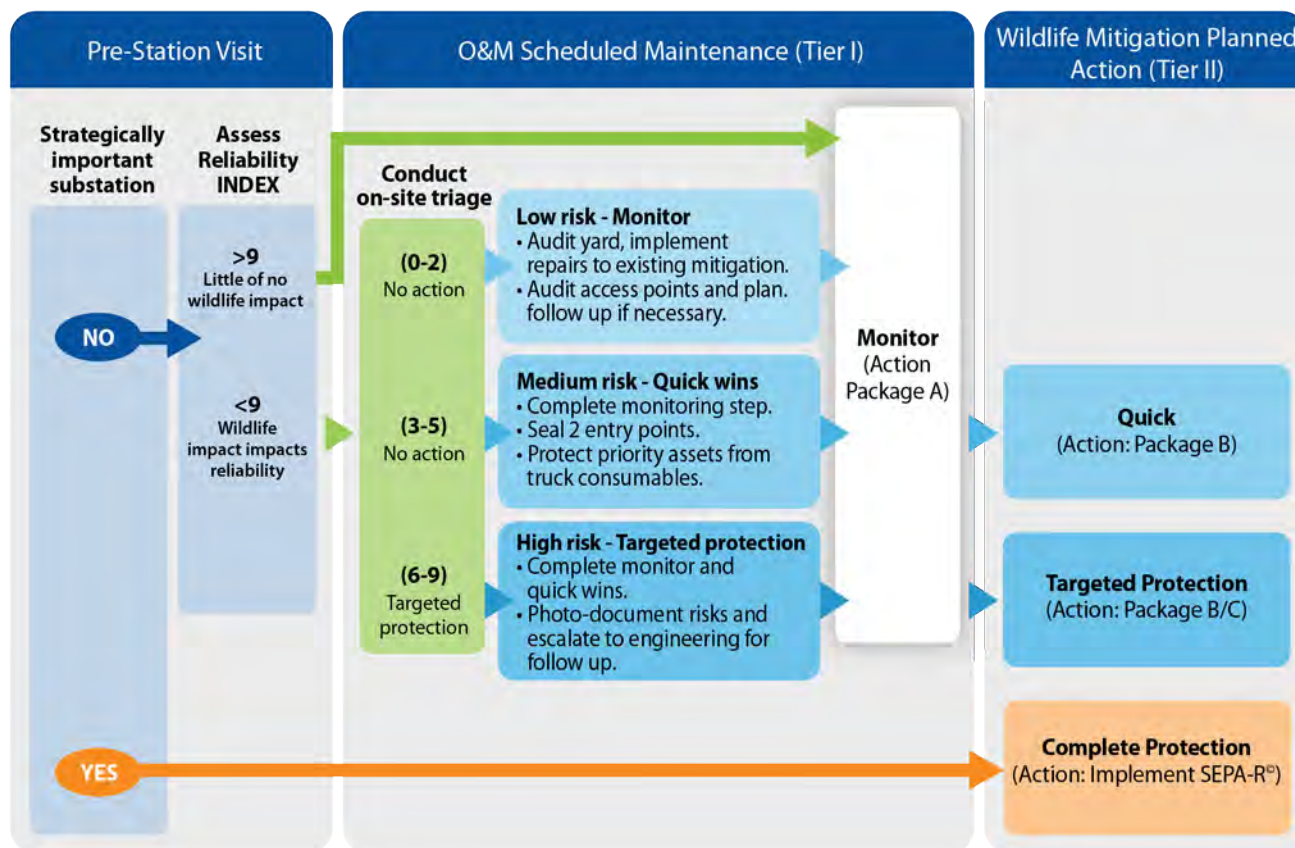
For the vendor/utility themes behind this (e.g., fit and overlap, closures, ultra-violet [UV], displacement), see [Technical Guide, Section 3 \(Evidence Snapshot\)](#).

4 EPRI. 2021. “Survey of Wildlife Protection Products.” Technical Update, 3002021639.

5 PG&E. 2021. “Substation Animal Abatement Measures.” Utility Procedure, TD-3350P-10, Rev. 7.

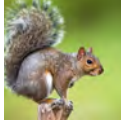
How to Use This Guide

Figure 2 illustrates the overall process followed in this guide. Strategically important stations are screened by engineering and fast-tracked to complete protection, following the SEPA-R process. All other stations will be assessed based on performance and onsite triage. This guide is built so a small team can start with one or two substations and make steady, low-disruption progress toward reducing wildlife-caused outages.



1. **Pick a starting yard.** Choose a distribution or sub-transmission substation with wildlife events, near-misses, or planned crew work. If the yard is strategically critical, plan for an engineering-driven mitigation scope rather than relying on truck-stock actions alone.
2. **Do a quick yard triage (Section 3).** Walk the yard once, score it, and place it into Monitor, Quick Wins, or Targeted Protect action categories.
3. **Follow the actions for that track (Sections 3-4).** Use the checklists and examples to decide what to exclude, clean up, and protect now versus what to photo-document and hand off as a planned work package.
4. **Use equipment quick cards (Section 6).** At each device, use the matching card for "Protect first," "Do," "Avoid," and "Accept."

▲ **Figure 2.** The overall mitigation process used in this Field Guide.



5. **Close out the visit.** Take the standard photo set, log what was completed, and clearly list any gaps that could not be closed out with the parts/time available so they can be kitted, scheduled, and funded for follow up.

Field crews will mainly use Sections 3–6 in the yard. Supervisors and engineers will lean on Sections 3–5, and Section 7 to plan visits (including what must be escalated), approve work, and verify acceptance. Managers and reliability staff will focus on the Executive Summary and Section 7 and Section 8 to see how routine field actions show up in reliability metrics and program decisions.

Definitions

This section defines key terms used throughout this guide. Table 1 lists the definitions.

Table 1. Definitions of key terms used in this guide.

TERM/PHRASE	DEFINITION
Substation Reliability Index (SRI)	Reliability Index is a reliability metric expressed as an index 0–10, with 0 being worst performance and 10 being equal to optimal performance. IEEE-1782 metrics SAIDI, SAIFI metrics, and wildlife cause code may be used.
Substation Strategic Importance Index (SSII)	Strategic Importance Index is a ranking of stations with respect to strategic importance ranging from 0–10, with 0 representing stations with low strategic importance and 10 representing stations supporting sites of strategic importance (e.g., datacenters, military installations) or critical with respect to a specific endangered species (i.e., golden eagles in the USA).
SEPA-R	The SEPA-R (Scientias-Energy 2024) acronym stands for scope, exclusion, protect, audit, repeat. It is a structured process used to develop a robust wildlife-mitigation plan for substations.
Protected Distance Required (PDR)	The minimum air and surface distance that must remain between phases and the ground after mitigation is installed.
Minimum-Viable Set (MVS)	The smallest set of work that is able to be completed to an acceptable standard in a visit (including acceptance checks and photos).
Potential Wildlife Entry Point (WEP)	Any location in perimeter, fencing, gates, adjacent vegetation, or on overhead lines that wildlife can use to gain entry to the substation.

1. SAFETY AND COMPLIANCE

All the work described in this guide must be performed under the utility's established safety rules, switching practices, permits, and clearances. Nothing in this document changes company policy or manufacturer instructions.

If an action cannot be completed according to the acceptance checks (e.g., PDR, interfaces, mechanisms, moisture/heat, photos) with the available parts and time, do not improvise or leave a partial fix—document the gap and escalate it as a planned follow-up work package.

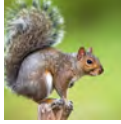
Work Limits and Approvals

- Do not perform energized work unless explicitly allowed by company policy and supported by training, qualification, and permits.
- Follow all applicable codes and standards (e.g., National Electrical Safety Code, Occupational Safety and Health Administration, IEEE 516), as well as local procedures for Lockout/Tagout, minimum approach distances, arc-flash/personal protective equipment, and energized work authorization.
- Use only utility-approved materials, parts, and installation methods for wildlife mitigation. Do not use improvised materials or ad hoc fixes unless they are explicitly allowed by utility standard.

Clearances and PDR

- Maintain required electrical clearances and creepage at all times. In this guide, protective distance required (PDR) means the minimum air and surface distance that must remain between phases and to ground after mitigation is installed.
 - In its 2001 *Rural Substation Design* report, the United States Department of Agriculture notes that when equipment must be isolated without de-energizing the whole substation, maintain minimum safety clearances and install temporary barriers to isolate the equipment being worked on from adjacent energized equipment.⁶
 - For the PDR definition and a quick visual, see [Technical Guide, Section 5, Definitions](#) and [Figure 1](#). For pass/fail acceptance, see [Technical Guide, Section 4 \(Acceptance Standard \(Pass/Fail\) and Photo Documentation\)](#).
- When in doubt about spacing or reach, stop and escalate to engineering.

6 United States Department of Agriculture. 2001. "Design Guide for Rural Substations." Rural Utilities Service Bulletin 1724E-300.



Equipment Function and Condition

- Do not install anything that would impede mechanical or electrical operation, including switches, breakers, relays, pressure systems, or moving parts.
- Avoid creating moisture traps, blocking drains or vents, or covering areas that depend on airflow or thermal dissipation.
- Inspect equipment before applying covers. Damaged, contaminated, or compromised surfaces may need cleaning or repair before protection is added.

Temporary and Emergency Installs

- Temporary installations used during storm response, switching, or contingency operation must follow company rules for temporary protective devices, tagging, and documentation.
- Temporary installations are for stabilization only. Convert them to an accepted permanent installation (or remove them) as soon as practical. Do not leave temporary measures in place without a tracked follow-up work order.

Escalation

- If any action appears to conflict with clearances, equipment ratings, original equipment manufacturer guidance, or utility standards, stop work and escalate to engineering or supervision.
- Escalate an action when it cannot meet acceptance with available parts and time. Document with photos and add a one-line log so the gap becomes a planned follow-up work package.

These limits are the guardrails for everything in this guide. Wildlife-mitigation work should never compromise clearances, equipment function, or established safety practices. If there is any doubt, stop, escalate, and resolve the safety or acceptance question before proceeding.

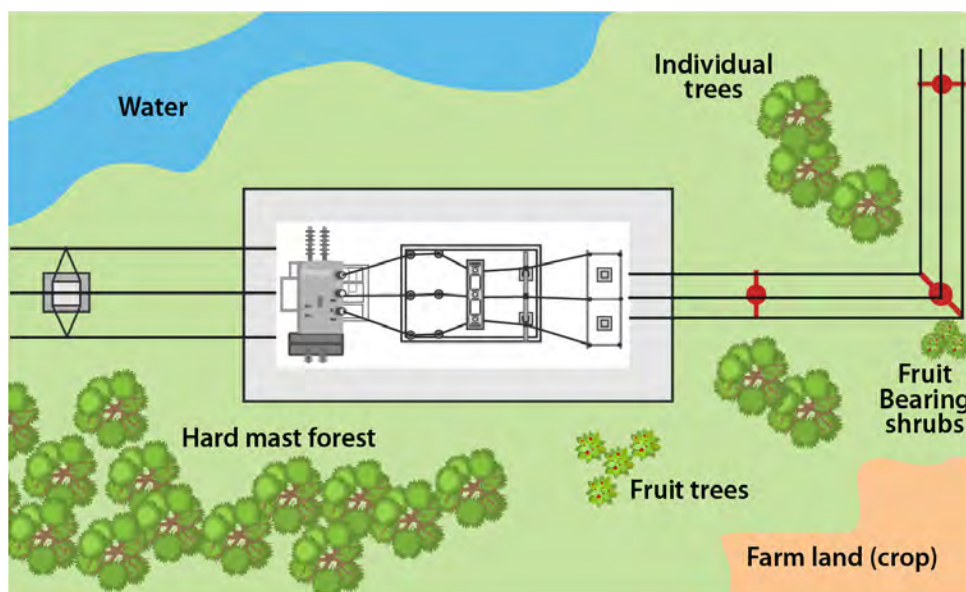
2. QUICK START

Wildlife risk in substations varies by location, species, and yard layout. A quick walk-through is usually enough to gauge how active the yard is and which actions will make the biggest difference with the time and resources available. The triage process in this section offers direction on the appropriate level of effort for a visit.

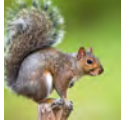
What Drives Risk

Use these cues to score the yard and choose a track.

- **Wildlife entry points:** Overhead lines, nearby vegetation, fences, cable races, climbable poles within four spans of the station boundary or structures that give squirrels or birds easy access.
- **Attractions:** Food (e.g., berry/fruit bearing vegetation, mast trees, dumpsters, nearby feeders), water sources, warm equipment, or sheltered spaces. See *“Figure 3. Substation environment, noting adjacent food sources.”* for an example substation environment with these types of attractants involved.
- **Geometry:** Exposed bus, uncapped tubing, recessed cavities, cross-beams, or other features that create perch, nest, or travel opportunities.
- **Activity signs:** Chew marks, droppings, nests, stored food, animal guano, or tracking on insulation, flashover damage on insulators or buswork, re-trip history, or visible carcasses.
- **Lighting:** The use of lighting in substations may attract insects and insect-feeding avian wildlife. Lighting should be used when necessary; however, always-on security lights should be avoided.



◀ **Figure 3.** Substation environment, noting adjacent food sources.



Yard Triage Score and Track Selection

Use this quick score to decide how much work to undertake during a visit. It should only take a few minutes once you have walked the yard. This score is designed for the broad population of partially protected substations. For strategically critical substations where full-yard mitigation is expected, escalate the actions early to an engineering-driven scope (e.g., SEPA-R) and use the score mainly to support quick documentation and prioritization.

Do not force an installation using the closest fit available parts if the correct component is not available. If an action cannot be completed to standard during the same visit, only perform a safe, approved temporary measure, document it, and schedule a follow up to complete the work with the correct parts.

What to Score (0–9 total; 30 Seconds or Less)

- **Exposure (0–3):** Approaches (e.g., trees, lines, fences), attractants (e.g., food, water), easy climb bus geometry (e.g., angle, flat sections) are examples of exposure. A yard with little canopy, no spans over the fence, and no easy climbs might score 0, while a yard with heavy canopy over lines, multiple spans crossing the fence, and obvious climb paths might score 3.
- **Evidence (0–3):** Chew, nests, droppings, prior wildlife faults, and photos are examples of evidence. A clean yard without wildlife-coded events on record might score 0, while another yard with recent squirrel outages, nests on structures, and clear activity indicators would score 3.
- **Consequence (0–3):** Impact on reliability and restoration difficulty are examples of consequence. A small yard feeding only non-critical load with easy restoration might score 0, while a yard significantly impacting reliability, dense urban load, or difficult-to-restore customers might score 3 for an engineering-driven mitigation scope.

Add the three numbers to get a total score between 0 and 9, a visit-level triage score/tool on what to take on this visit.

Fleet Level Investment Prioritization.

Some utilities separate a Reliability Index (RI, i.e., how often and how badly this yard contributes to wildlife-related events) from a Strategic Importance Index (SII, e.g., critical load, critical facilities). Where available, use local SAIDI/SAIFI-style metrics and wildlife cause codes to inform RI and use utility criticality criteria to inform SII. This overlay is intended for planning and budgeting, not for crews to calculate in the yard. See the [Technical Guide, Appendix B5 \(RI + SII overlay\)](#) for a lightweight template. For strategically critical substations, use RI/SII primarily to justify and schedule planned retrofit work rather than expanding crew expectations during routine visits.

Pick a Track Based on the Total

These tracks set the recommended level of effort for this visit. Choose actions that are able to be completed with the time and materials on hand. If you cannot complete an action to the acceptance checks, do not improvise or leave a partial fix. Instead, photo-document the gap and escalate it as a planned follow-up work package.

- **Triage score (0-2). Low risk, action: Monitor**
 - Walk down the yard, note evidence of wildlife activity, and take photos.
 - Note condition of existing wildlife mitigation, implement repairs, if necessary, or note actions for follow up.
 - Audit potential wildlife entry points such as fencing, gate entry points, vegetation along boundary, and overhead lines crossing boundary. Document concerns for follow up.
- **Triage score (3-5). Some risk identified, action: Implement Quick Wins.**
 - Complete monitoring step, and if possible, fix one key approach path (e.g., fence gap, conduit, cabinet, or similar) using truck supplies; otherwise, document it for follow up.
 - Seal at least two entries; otherwise, document the highest risk entries.
 - Protect 2–3 priority assets (typically bushings and jumpers on high-consequence equipment); otherwise, photo-document the specific contact points and escalate it as planned retrofit.
- **Triage score (6-9). High risk identified, action: Targeted Protection**
 - Complete monitor and quick win actions.
 - Treat conduits, trenches, and other penetrations; otherwise, plan a brief out-of-service window and escalate the scope as needed.
 - Document and take pictures of all contact, nesting, and wildlife entry point risks. Escalate to engineering and request a wildlife-specific follow-up visit.

The score and track indicate whether a visit is a simple cleanup visit, a small installation, or a targeted protection pass, as well as what should be documented and planned for follow up if it cannot be completed in one visit.



Photos

Take a consistent photo set so crews, supervisors, and engineers see the same information and can review work later.

Before visiting a substation, obtain station reliability metrics and analyze outages attributed to wildlife as well as those classified as unknown. Look for patterns related to the time of day or seasonality that may correspond with wildlife activity or breeding cycles.

At each yard visit, take the following photos. If any work is temporary, partial, or staged due to unavailable components, photo-document it and ensure a planned follow up is created.

- Wildlife evidence (e.g., feathers, bones, flashovers, guano, nests)
- Fence line gaps and obvious entries
- Overhead approaches (e.g., overhanging vegetation, line spans, communications cables)
- Cabinets and penetrations (e.g., station service, control, conduits, trenches)
- Bushings, jumpers, switches, and other exposed live parts
- Potential transformers (PT), voltage transformers (VT), current transformers (CT), and other instrument transformers
- Trenches and cable races near the fence or structures
- After photos for each action taken (one wide shot and close-ups at interfaces).

You can use the score, chosen track, and photo set to pick your package in Section 4 and the specific devices to treat using the equipment cards in Section 6. For the required closeout photo set and quality rules (what must be visible), see [Technical Guide, Appendix A1](#).

3. ACTION PACKAGES BY TRACK (VISIT ACTIONS)

Basic wildlife-mitigation work using truck consumables should fit inside routine O&M when possible to make improvements from standard truck stocks. The goal is to reduce how animals enter or move through the yard and to protect the priority live parts most likely to cause sustained events. The packages in this section work for unprotected, partially protected, or fully protected yards.

All packages follow the same simple loop: Scope, Exclude, Protect, Audit, Repeat (SEPA-R); Scientias-Energy 2024). For each yard visit, apply only what fits the time and resources at hand. If an action cannot be completed to the acceptance checks, photo-document the gap and escalate it as a planned follow-up work package.

The SEPA-R approach is the pattern for any visit. The tracks (Monitor, Quick Wins, Targeted Protect) indicate how much to undertake during a visit based on the yard's triage score – including what should be planned and kitted for follow up –, and the packages (A, B, and C) group work within the crew's available time.

The Loop

Use the SEPA-R approach, illustrated in [Figure 4](#), on every yard visit. Perform a small piece of work that can be completed in one visit each time to an accepted standard. For example, pick one approach to fix and one device family to protect, then check the work and log it. If the correct component is not available to complete a standard installation, do not improvise a permanent substitute. Rather, document the condition, apply only an approved temporary measure, and schedule a planned follow up.

Figure 4. SEPA-R® process for wildlife mitigation at substations.





If the yard serves high-consequence load or is designated as strategically critical, use the approach outlined in Figure 4 to support scoping, documentation, and short-term risk reduction only. The expected approach for full mitigation is an engineering-driven effort with planned retrofit execution and acceptance.

Scope – Pick the Visit’s Target

- Prior to site visit, review any recent wildlife-coded events or re-trips.
- Use the yard triage score and recent events to pick the highest risk wildlife entry points and action for the day’s work.
- Take four photos: a yard-wide view, the worst approach path, the highest risk device, and any evidence (e.g., nests, chew marks).
- If the visit’s highest risk device requires parts that are not on hand, scope the device anyway (photos and one-line note) so the follow-up work package is ready. Then, prioritize an Exclude win (below) you can finish this visit.
- If the yard is strategically critical, treat the visit’s scope as an engineering scoping. Capture the highest risk approach paths and prioritize live-part interfaces so the planned retrofit work package is ready for execution.

Exclude – Fix Wildlife Entry Points and Attractants

- Close obvious fence gaps, underpasses, or conduit and trench openings.
- Remove vegetation overhanging boundaries or trim branches that create a primary jump-path onto lines.
- Clear obvious food and water cues (e.g., pooling water).
- Remove or relocate nests within the boundaries of U.S. Fish and Wildlife permits and advice.
- Check drainage—Substation drainage should be sufficient to exhibit little standing water within a few hours after heavy rainfall.⁷
- Audit overhead line access points and, where necessary, plan the installation of wildlife guards to prevent squirrels from entering the station via overhead lines. Additionally, implement anti-climb measures on poles located within 1,000 feet of the station boundary.

PG&E notes that first-line defense is keeping the perimeter controlled: “perimeter fence is intact, without gaps at the bottom and no overhanging vegetation.” PG&E also flags burrowing access by repairing and grading to prevent entry through “gaps larger than 2 inches.”⁸

Protect – Install an MVS When Parts and Clearances Allow

Install a utility-approved protection on one priority device family this visit when you can meet acceptance with available materials. For strategically critical sub-

7 United States Department of Agriculture. . 2001. “Design Guide for Rural Substations.” Rural Utilities Service Bulletin 1724E-300.

8 PG&E. 2021. “Substation Animal Abatement Measures.” Utility Procedure, TD-3350P-10, Rev. 7.

stations, do not attempt to complete mitigation through incremental truck-stock actions alone. Minimum-viable set (MVS) is only acceptable if the correct size/form-fit component is available. Do not force-fit a too-big or too-small cover. If the correct fit is not available, document the specific contact points (photos and one-line note) and treat the Protect scope as a planned follow-up work package.

- Maintain required PDR (clearances and creepage).
- Keep interfaces overlapped at sheds, boots, and bends.
- Ensure mechanisms move freely (open, close, stroke).
- Avoid moisture cups and keep drains, ventilation, and heat paths clear.

Audit – Confirm the Day’s Work

- Ensure PDR is intact (clearances and creepage still met).
- Confirm interfaces are closed (overlap at sheds, boots, bends). Refer to [Technical Guide, Section 5, Engineering Reference](#).
- Verify mechanisms are free (full open/close or stroke).
- Confirm there are no moisture traps (no up-facing cups; drains clear).
- Save/Log before/after photos.
- **Stop rule:** If any acceptance check fails, treat the work as not accepted. Do not leave a partial fix. Correct it now if feasible; otherwise document the failure mode and escalate it as planned follow up.

Audit maps to Technical Guide, Section 4, Table 2, and Appendix A1 (includes required closeout photos).

Repeat – Expand Coverage Over Time

As seasons, loads, or yard conditions change, repeat this loop and extend coverage where it helps most. Each pass should remove one more approach path, protect one more priority device family, and tighten the quality of past installations.

Once the quick wins have been completed, if wildlife continues to cause power continuity issues, it is recommended to move to a full station audit and implement the SEPA-R process in full.

MVS – Match the Level of Effort

When time, staffing, or staged inventory are tight, use MVS – the smallest set of work that is able to be completed to an acceptable standard in a visit (including acceptance checks and photos). If the correct parts/clearances are not available to protect a device to acceptance, the MVS is an Exclude win and requires clear documentation of the Protect gap for planned follow up with available parts. In all cases, start by auditing any pre-existing mitigation in the work area first and making repairs/replacements as needed before adding new coverage.

- **Light effort (quick stop/single-crew task):** Update transformer high voltage bushings and jumpers (or the highest risk breaker) to full acceptance. Otherwise, complete one Exclude win and document the highest risk device contact points for planned follow up.



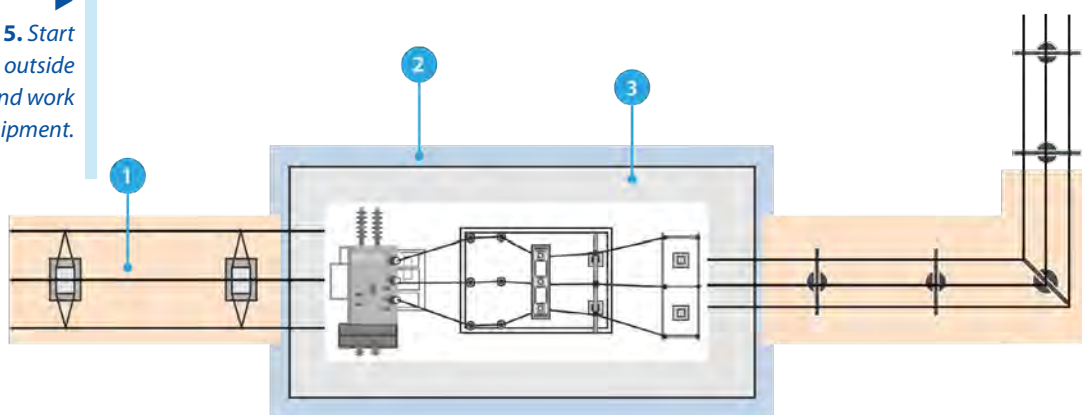
- **Medium effort (bay-level work/targeted package):** Add the next device family (for example, breaker bushings and jumpers); otherwise, complete Exclude and corrective fixes on any failing legacy installations that can be brought back to acceptance. Document what remains.
- **High effort (area sweep/multi-device coverage):** Finish three devices, then schedule a post-storm check in inspection cadence; otherwise, complete the highest value accepted installs you can and turn the remaining gaps into a follow-up work package (photos and one-line log).

In all cases, the MVS should be able to be completed in one visit (including acceptance checks and photos) and focused on priority equipment first. When protection cannot be accepted with available parts/clearances, the outcome that is able to be completed is clear documentation and escalation. These same MVS patterns apply across the equipment types in Section 6.

Packages by Yard State

Use the SEPA-R approach to match what is done in a visit, working from the outside-in (Figure 5) and based on the yard's current state and the available time the crew has.

Figure 5. Start observations from outside the station and work toward critical equipment.



Null (No Protection in Place)

- Exclude one key approach (e.g., line span, fence, gate, conduit, or trench).
- If parts and time allow, install the MVS on bushings, jumpers, and operating devices, in that order. If protect-to-acceptance cannot be completed with the available resources, document the highest risk contact points (photos and one-line note) and escalate as a planned follow-up work package.

Partial (Some Legacy or Scattered Installs)

1. Audit the pre-existing mitigation condition by fixing sizing, addressing overlap concerns, or fixing PDR issues on existing installations (e.g., daylight at seams, stretch gaps, lost clearance).

2. If parts allow, extend the MVS to the next priority device family using correct, form-fit components. Otherwise, document what remains and escalate it as planned follow up.

Full (Broad Coverage Already Installed)

- Re-scope the yard (e.g., brief walk, photos, and review of recent events).
- Replace tape-only, PVC tape, or ad hoc retention installs with form-fit components where feasible. When tape is used, treat it as a controlled method using utility-approved high-performance tape.
- 3. Move all covered devices into the routine inspection described in Section 7.

Acceptance Checks (Use Every Time)

After any installation or change, confirm the following:

- **PDR intact:** Required clearances and creepage still met (no clearance theft).
- **Interfaces closed:** Continuous overlap at sheds or boots; no stretch gaps.
- **Mechanisms free:** Covers or barriers do not impede travel (open, close, stroke).
- **Moisture and heat OK:** No up-facing cups; drains, airflow, thermal paths clear.
- **Photo closeout:** Wide before photo, interface close-ups, final after photo, and a contextual wide shot; log the work.

IEEE 1264 emphasizes selecting animal mitigation based on operating history, applying methods without creating new hazards (e.g., maintain electrical clearances), and monitoring performance after installation.⁹ For acceptance, as EPRI's survey indicates, "installation errors are the most widespread challenge," and many utilities report they occur often—making closeout checks and repeatable photos one of the most preventable failure levers.¹⁰

Full technical acceptance criteria are in the [Technical Guide, Section 4 \(Acceptance Standard \(Pass/Fail\) and Photo Documentation\), Table 2](#); required closeout photo views and reference product photos are in [Appendix A \(A1/A2\)](#).

Packages A, B, and C

These packages scale work to the yard, time, and parts for a visit. If an action cannot be completed to the acceptance checks, do not improvise or leave a partial fix. Rather, photo-document the gap and escalate it as a planned follow-up work package. If the yard is strategically critical, prioritize documenting and scoping remaining paths and exposed interfaces so the planned retrofit work is complete.

9 IEEE Std 1264-2022. 2022. "IEEE Guide for Animal Mitigation for Electric Power Supply Substations."

10 EPRI. 2021. "Survey of Wildlife Protection Products." Technical Update, 3002021639.



Package A – Quick Exclusion Wins (≤ 2 hours)

- Audit existing wildlife mitigation, make repairs as necessary, and note follow up required if repairs cannot be implemented from truck consumables.
- Fix one major approach path (e.g., canopy bridge, fence entry, conduit, or gland opening); otherwise, photo-document the approach and log it for follow up.
- Seal two major openings with serviceable closures (e.g., cabinet entries, trenches, conduits, under-gate gaps); otherwise, document the highest risk opening(s) for planned follow up.

Package B – Protect Priority Live Parts (3–4 hours)

Install the MVS on the following:

- Bushings, jumpers, switches, PTs, and CTs (in that sequence).
- Maintain PDR, continuous overlap, and mechanism freedom.
- If the right parts are not available to protect a device family to acceptance, do not leave a partial fix. Instead, photo-document the specific contact points and escalate it as a planned retrofit.

Package C – Commission and Log (≤ 30 minutes)

- Run the acceptance checks.
- Capture before and after photos.
- Log where, when, and what was installed using your existing work management tools.

These packages can be combined based on available work windows. For example, a quick wins visit might run Package A and Package B, followed by a brief Package C to close out and document both completed works and any planned follow-up gaps.

Tracks by Triage Score

Use the yard's triage score (0–9) from [Section "QUICK START"](#) to choose the right track. The track indicates the typical level of effort for a visit and how many packages (A/B/C) to run. For strategically critical substations, use tracks to support documentation and risk reduction, but plan for an engineering-driven mitigation scope.

Monitor (0–2)

- Run a light Package A by performing a walkdown, taking photos, and sealing at least one obvious wildlife entry point if feasible using an approved closure.
- Document with before and after photos and a one-line log entry.

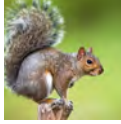
Quick Wins (3–5)

- Run Package A and Package B only where the action can meet acceptance with approved parts.
- Protect 2–3 priority devices (typically bushings and jumpers on high-consequence equipment); otherwise, document highest risk contact points and escalate it for follow up.

Targeted Protect (6–9)

- Run Package A and Package B on 3–4 priority devices.
- Plan a brief out-of-service window, if needed, for tight clearances or repositioning.
- Finish with Package C (Commission and Log) so the visit's work is accepted and tracked. Any remaining gaps are captured as planned retrofit items.

Most substations are only partially protected, and many existing installations fail due to incorrect sizing, poor overlap, lost PDR, moisture traps, or blocked mechanisms. The device priorities in Section 5 and the acceptance checks above are designed to close those gaps and make results durable. Detailed examples, specifications, and field photos are provided in the Technical Guide.



4. PRINCIPLES (HOW TO INSTALL AND ACCEPT)

Effective wildlife mitigation depends on a few simple principles that keep installations safe, durable, and consistent across different crews, yards, and equipment types. These principles let field crews work quickly in normal O&M windows and give supervisors and engineers a clear way to check whether the work meets safety and equipment requirements.

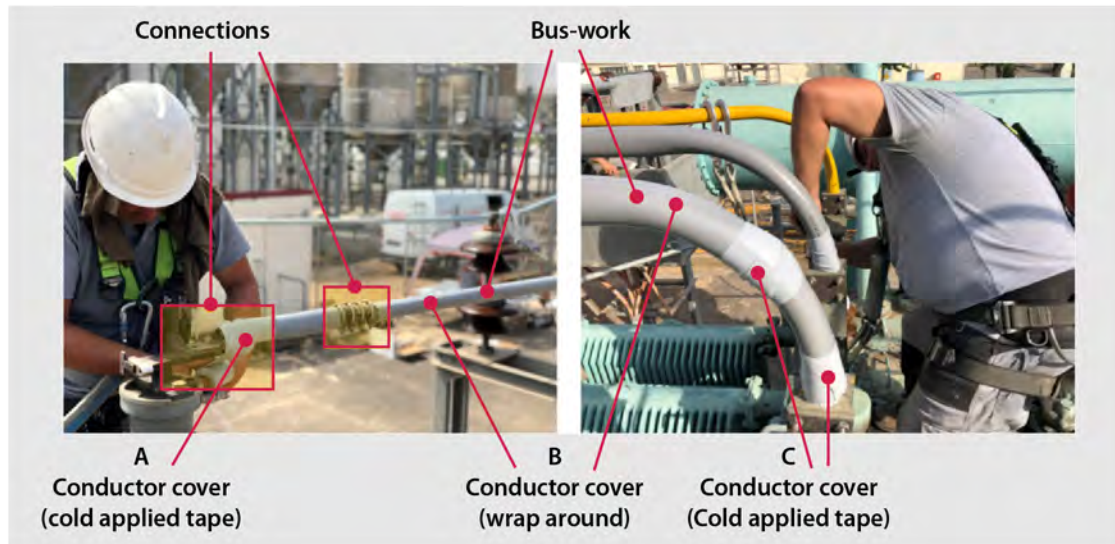
Core Principles (Quick Field Checklist)

Use these principles for every installation, review, or approval of wildlife protection. If an installation fails any one of these principles, treat it as not accepted. Correct it immediately if feasible; otherwise, do not leave a partial fix. Photo-document the gap and escalate it as a planned follow-up work package. For strategically critical substations, these same principles still apply, but the expected outcome is an engineering-driven mitigation scope and is no longer reliant on incremental truck-stock alone.

If these principles cannot be met because the correct component is not available, do not improvise a permanent substitute. Rather, treat the condition as not accepted, document it, and schedule a planned follow up to complete the install with the correct part(s).

- Maintain required clearances and creepage (PDR).
- Seal interfaces with continuous overlap, with the seams face downward.
- Avoid moisture cups; parts should tilt or drain naturally.
- Ensure mechanisms move freely (blade travel, breaker stroke, hinge action).
- Keep thermal paths open; do not blanket hot or ventilated surfaces.
- Prefer form-fit, re-enterable parts; use tape only to finish small bends or ends (seen in Figure 6), short transitions, or complex geometry. Try not to use tape as primary insulation approach.
- If tape must be used as primary insulation, use a utility-approved high-performance product and install per manufacturer requirements.
- Photo-verify acceptance (before, interfaces, after) and log pass/fail for work completed.

These core principles are enforced as pass/fail in Technical Guide, Section 4.



Insulation vs. Barrier (Short Decision Rules)

Use the simplest solution that keeps PDR, movement, and thermal performance intact. When choosing between insulation and barriers, base the decision on whether the following will result:

- PDR (clearances and creepage) can be maintained
- Solution keeps movement and heat flow intact.

Use Insulation (Covers/Boots/Guards) When the Following Can Be Met

- Required PDR (example seen in Figure 7) is maintained after installation.
- Bushings, jumpers, taps, or bends are protected.
- Water drains freely and does not pool.

▲ **Figure 6.** Use of versatile tape to fill small gaps in insulation and to secure wrap around insulation.

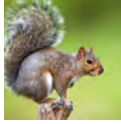
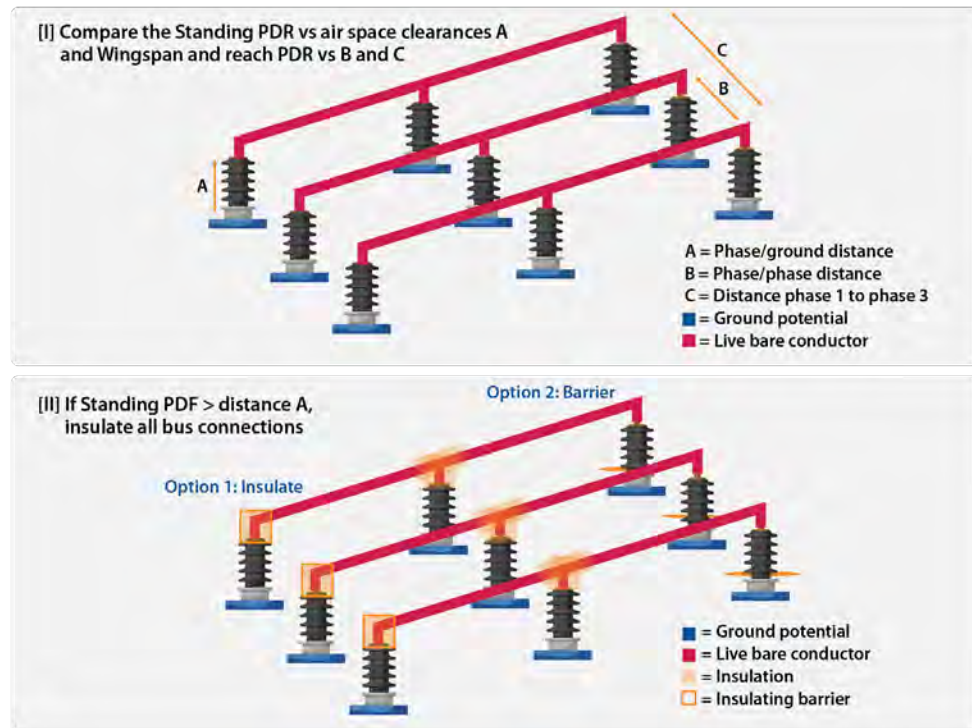


Figure 7. Examples of PDR spacing.



Use Barriers (Rigid Boards, Discs, Shields) When the Following Applies

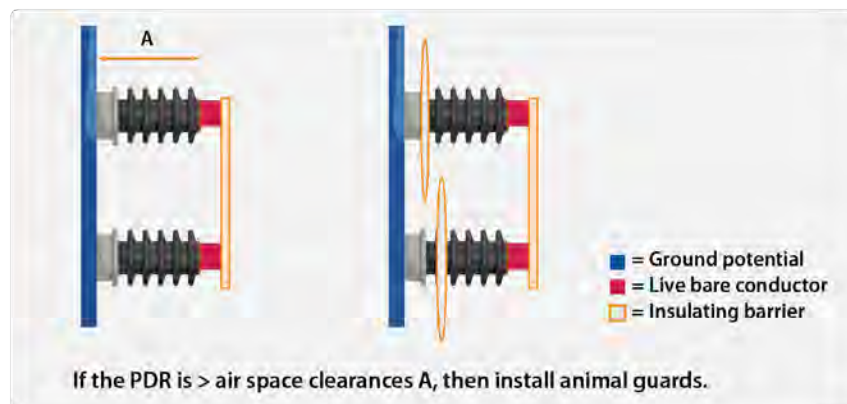
- Insulation would steal clearance or reduce creepage.
- Equipment moves or runs hot and needs free travel or airflow.
- Consider tapered barriers if shedding debris or nesting material.
- Spacing is tight near grounded steel.

Use insulation and barriers when a live interface needs insulation but nearby steel or tight geometry requires a small barrier to keep debris, moisture, or animals away. If the yard relies on thermography, confirm cover selection and inspection practice will not mask loose connections or critical hot spots. Some utilities choose mesh- and thermography-friendly models for that reason. (See [EPRI, 2021 Survey of Wildlife Protection Products](#), for discussion on bushing covers and impacts on infrared inspection).

Overall, use insulation first where spacing allows and mechanisms and heat paths are unaffected. Use barriers (Figure 8) first where spacing is tight or equipment moves or runs hot. If insulation threatens PDR, free movement, or heat paths, treat that as a cue to favor barriers or a combined approach.

EPRI notes that “Separation and insulation typically provide the greatest benefits.” Where insulation is constrained (e.g., tight geometry, movement), “isolation is usually less effective but better than an unmitigated unsafe design.”¹¹

Figure 8. Using animal guards to protect horizontal elements.

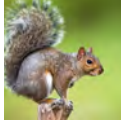


Common Errors and What to Do Instead

Use this as a fast yard check. These are the errors (seen in Table 2) most often linked to failures and re-trips. If the correct component is not available, do not improvise a permanent substitute. Use only an approved temporary measure, document it, and schedule a follow up.

Table 2. Errors typically linked to failures and re-trips.

ERROR	HOW ERROR APPEARS	WHAT TO DO INSTEAD
Wrong part or size	"Daylight" at seams, lost overlap, cover bulging, latch does not close	Measure the hardware, use a form-fit part, restore continuous overlap through the first bend, and re-shoot photos. If only wrong-size substitutions due to inventory are available, log visit as not accepted, then escalate it and plan a retrofit.
Inadequate overlap between matting insulating components	Gaps in insulation	Ensure adequate overlap (see Technical Guide, Section 5). Ensure fastening of solution is secure and durable over time.
UV aging	Chalky or brittle plastic, cracks, broken latches	Replace the part, flag the lot, then specify UV-rated materials with declared service life for replacements. EPRI notes failures can compound over time (e.g., "ultra-violet deterioration leads to tracking and, ultimately, a flashover"), which is why UV condition is replacement-level and not cosmetic. ¹²



FIELD GUIDE

ERROR	HOW ERROR APPEARS	WHAT TO DO INSTEAD
Wind displacement	Covers rotated, lifted, or rattling; barriers shifted	Replace or refit with latched or compact designs; ensure ends are secure and avoid oversized parts.
Tape-only installations	Tape unravelling, gaps at ends, sticky dust on exposed spans	Option A: Replace with form-fit guards/covers sized to the hardware so the solution is re-enterable and not installer-sensitive. Option B: Use a utility-approved high-performance insulation tape as a controlled option to acceptance. Both options: Tape is not a substitute for wrong sizing, poor overlap, or broken latches. If tape is being used to “hold together” a failing cover, treat as not accepted and escalate it to a planned retrofit.
Moisture traps	Standing water in covers, green residue, corrosion, algae	Tilt or rotate parts so they drain or change to a design without bowls; eliminate any up-facing cups.
Clearance theft	Insulation looks bulky near steel, spacing feels tighter, PDR borderline or short	Remove bulk, switch to a barrier solution or smaller part, and re-check PDR (clearances/creepage) before accepting.

Two Key Points

1. Some failures occur at bends in conductor or along an open seam.
2. Thick insulation near grounded steel often steals PDR. If added thickness reduces clearance, switch to a barrier instead of adding more insulation.

Use “[Table 2. Errors typically linked to failures and re-trips.](#)” as a quick yard check whenever there are existing wildlife covers or barriers. If any of these red flags show up, treat the installation as not accepted. Attempt to correct the issues using approved parts, then re-run the PDR and acceptance checks so the fix is accounted for.

5. EQUIPMENT QUICK CARDS (DEVICE-SPECIFIC GUIDANCE)

These pages give device-by-device guidance that can be used in short O&M windows. Each equipment card is organized the same way:

- **Protect first** – what to cover or shield first on that device family
- **Do (MVS)** – the MVS when time or staffing is tight
- **Avoid** – common mistakes that cause failures
- **Accept** – quick checks to confirm the job is done.

These quick cards are written for standard installations using the correct components. If the correct component is not available, do not force a fix with closest match parts or makeshift closures. Use only an approved temporary measure, document it, and create a planned follow up to complete the installation to standard.

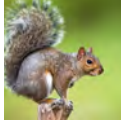
Order of Priority

If the utility has reliable local outage history/cause codes, site conditions, and species patterns that clearly point to a different sequence, follow that local prioritization. If not, use the priority order below as a guiding hand.

Based on cross-source evidence (see [Technical Guide, Section 3 \(Evidence Snapshot and Industry Observations\)](#), and [Appendix B](#)), begin with the highest impact equipment first, as listed in “[Table 3. High impact equipment—transformer bushings and jumpers.](#)” to “[Table 10. High impact equipment—fuses, cutouts.](#)”, from transformer bushings/jumpers down through lower frequency device families.

Table 3. High impact equipment—transformer bushings and jumpers.

TRANSFORMERS – BUSHINGS AND JUMPERS	
Protect First	Bushing terminals/lugs; jumper and grounded steel within PDR.
Do (MVS)	Right-size form-fit bushing covers; jumper sleeve to first support (or insulated conductor); seams downhill; re-enterable; add small barrier if steel is close; photo-log before, interfaces, after.
Avoid	Closest match parts that bulge or leave daylight; moisture cups; horizontal guard shelves; blocking radiator airflow; PVC tape, cable ties/zip-ties, or tape-only retention fixes used to hold closures together.
Accept	PDR met (air and surface); overlap continuous; latches secure; seams draining; no pooling water; heat paths clear; before/after photos saved and logged.

**Table 4. High impact equipment—breakers, disconnects, switches, reclosers, switchgear.**

OPERATING DEVICES – BREAKERS, DISCONNECTS, SWITCHES, RECLOSERS, SWITCHGEAR	
Protect First	Jaw/blade ends; live stabs; adjacent bus; exposed control leads.
Do (MVS)	Rigid barrier boards at jaw/blade ends (preserve PDR); form-fit guards where spacing allows; tidy/armor control leads; verify full stroke; photo-log before, interfaces, after.
Avoid	Bulky insulation that steals clearance or binds travel; tape only as primary insulation.
Accept	PDR OK; full stroke free; seams draining; no heat blockage; before/after photos saved and logged.

Table 5. High impact equipment—cable terminations.

CABLE TERMINATIONS	
Protect first	Meet PDR at the lug and any exposed conductor using rated covers or insulation; consider insulated conductor replacement where feasible.
Do (MVS)	Insulate from the lug to the first rigid support using form-fit boots; keep overlaps tight; seams oriented downward; seal penetrations to prevent moisture entry.
Avoid	Oversize or undersize boots (closest match fits); moisture traps at the lug or first bend; non-rated or tape-only spans; makeshift closures; anything blocking labels or mechanism travel.
Accept	PDR met (air and surface); closures lock with no bulge or rotation; drainage clear; seams down; leads have drip loops; adjacent leads protected.

Table 6. High impact equipment—bus and flexible jumpers.

BUS AND FLEXIBLE JUMPERS	
Protect first	Flexible jumpers at bends; bus taps; tight phase-phase points.
Do (MVS)	Jumper sleeves through first bend; cold-applied wraps at tight curves; small barriers where spacing is tight; guano shields above porcelain in bird-pressure yards.
Avoid	Long horizontal guards (debris shelves); unsealed ends; wraps that migrate.
Accept	Continuous coverage; ends sealed; no sag or rub; creepage intact; PDR met.

Table 7. High impact equipment—instrument transformers – PT, VT, CT, coupling capacitor voltage transformers (CCVT).

INSTRUMENT TRANSFORMERS – PT, VT, CT, CCVT	
Protect first	Secondary terminals, top bushing; small exposed leads; nearby grounded steel.
Do (MVS)	Form-fit terminal covers and jumper sleeve; small barrier where spacing is tight; secure leads; photo-log.
Avoid	Oversized covers that become perches; blocking vents or cooling; tape only.
Accept	PDR met; vents clear; seams drain; leads secured.

Table 8. High impact equipment—surge arresters.

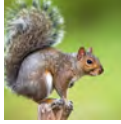
SURGE ARRESTERS	
Protect first	Live head/terminal; first conductor segment; base hardware.
Do (MVS)	Terminal cover with real overlap; sleeve first segment; bolt-cap the base.
Avoid	Tiny caps with no overlap; water traps on top; straps that stress the column.
Accept	Overlap continuous; seams down; vent path clear; base hardware covered.

Table 9. High impact equipment— cabinets and penetrations – station service, control panels, conduits.

CABINETS AND PENETRATIONS – STATION SERVICE, CONTROL PANELS, CONDUITS	
Protect first	Conduit entries; cable trays; vents; under-door gaps.
Do (MVS)	Fine-mesh screens; gaskets/seals; door/gate sweeps; warm LEDs (low insect draw); rodent control (no poison).
Avoid	Foam-only fixes; rust-prone screens; poisons (secondary kill).
Accept	Openings $\leq \sim 3/8"$; under-gap tight; no fresh pest sign.

Table 10. High impact equipment— fuses, cutouts.

FUSES, CUTOUTS	
Protect first	Live ends and jumpers; hinge or bail area; closest grounded steel.
Do (MVS)	Cutout covers that preserve drop; jumper sleeve through first bend; verify free drop; photo-log.
Avoid	Covers that impede drop; tape only; moisture cups.
Accept	Manual drop test adequate; PDR met; seams drain.



These equipment cards can give crews a fast, repeatable way to install protection correctly on the devices that matter most (based on vendor feedback, see [Technical Guide, Section 3 \(Evidence Snapshot and Industry Observations\)](#) and [Appendix B](#)). Once these actions are in place, the next step is keeping them maintained. Section 7 discusses how to fold this work into routine inspections, seasonal timing, and a few simple KPIs so improvements stay durable and visible over time.

6. SLOTTING INTO O&M (INSPECTIONS AND TIMING)

It is not necessary to protect every substation from all types of wildlife. Instead, stations should be graded based on their strategic importance, ensuring that comprehensive mitigation measures are applied to critical or high-priority substations. For all other stations, conduct a wildlife risk assessment and implement mitigation strategies that are appropriately scaled and optimized for the specific risks identified. According to vendors, most problems trace back to misapplication, aging materials, or gaps in insulation (see [Technical Guide, Section 3 \(Evidence Snapshot and Industry Observations\)](#) and [Appendix B](#)). Because of this, the goal should be to finish an action, verify it, and keep it healthy using the same inspections and walkdowns already being conducted.

An effective maintenance program includes scheduled periodic maintenance and corrective procedures. Maintenance should consider the specific equipment (e.g., make, model, age, load profile), site environmental conditions, site access, and the equipment's importance to system reliability.¹³ This section focuses on when to look, what to look for, and how to document work so crews, supervisors, and engineers see the same story.

Maintenance Cues

Regular checks keep good installations from quietly turning into new risks. Use the same basic cues for all wildlife-mitigation parts in the yard. Aim for a steady cadence of standard, verifiable improvements rather than one-time perfection.

When to Inspect

- During routine substation inspections (at least annually)
- After high winds, ice, or heavy snow
- After any wildlife-coded event at the yard, even if the device did not trip
- After significant work on protected equipment (e.g., switching, outages, rebuilds).

¹³ United States Department of Agriculture. 2001. "Design Guide for Rural Substations." Rural Utilities Service Bulletin 1724E-300.

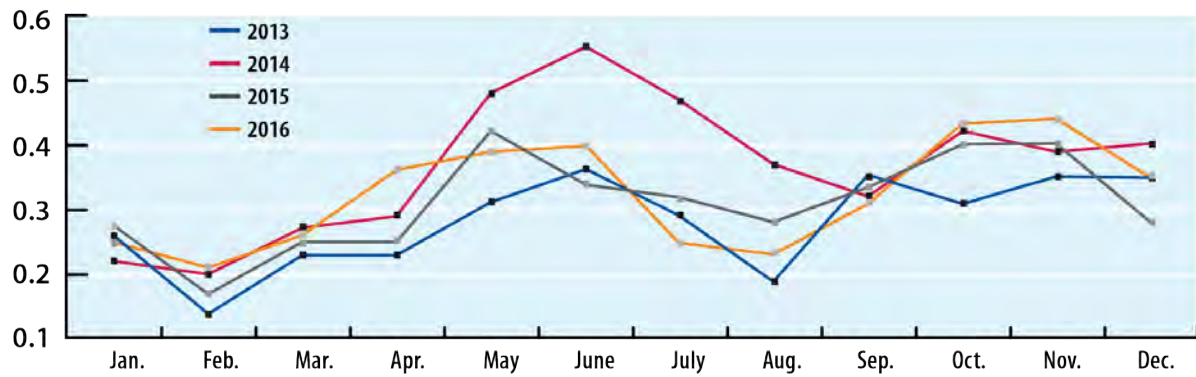
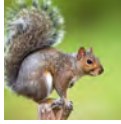


Figure 9. Sustained outages (5 minutes or longer) per 1,000 customers across years and months.

What to Look For

Replace or repair the part if the following is discovered:

- Cracks, chalking, or brittle polymer that suggest UV damage or aging
- Missing or broken latches, clips, or fasteners
- Any exposed live metal that should be covered
- Tracking, burn marks, pits, or melted areas on covers or nearby hardware
- Displaced guards, rotated covers, or open seams (“daylight” at interfaces)
- Standing water, corrosion, algae, or green residue inside covers.

When You Make A Correction

- Restore full coverage and overlap using form-fit parts
- Re-run the principles from Section 5 (e.g., PDR, seams, mechanisms, moisture, heat, photos)
- Log the action (e.g., date, device/area, what was fixed, pass/fail, photo link) in the work system. If anything could not be corrected to acceptance, log it as a planned follow-up gap (what is needed and photo link).

Maintaining a record of inspection that indicates wildlife-mitigation equipment condition and maintenance history is for a program involving regulator checks.¹⁴ If there is uncertainty as to whether an installation is acceptable, treat it as not accepted, correct it if practical, and re-check it before leaving the yard.

Seasonal Timing

Wildlife activity and nesting pressure change throughout the year, so timing checks with peaks (see Figure 9 for an example) improves results without adding a new program. In many regions, squirrel activity and nesting

¹⁴ . United States Department of Agriculture. 2001. “Design Guide for Rural Substations.” Rural Utilities Service Bulletin 1724E-300.

push wildlife risk higher in late spring and in fall.¹⁵ American Public Power Association's Squirrel Index (TSqI) peaks are from May to June and October to November. Use those peaks to time checks:

- Before peak periods, schedule quick nest and cavity checks and seal obvious entries.
- During high-activity months, do short walkdowns to confirm covers, barriers, and exclusions are still in place and draining properly.
- After major storms or high winds, re-check exposed yards and high-value equipment for shifted guards, broken parts, and new nests.

Use personal outage history and local knowledge (e.g., seasonal climate patterns, mast crops, nearby feeders, harvest periods) to fine-tune timing. The goal is simply to line up existing inspections and walkdowns with the times when wildlife pressure is highest.

Photo Protocol

Photos are the simplest way to prove an installation was done correctly and to keep acceptance standards consistent between crews, supervisors, and engineers. It will enhance ownership of the installation if the installer is identified in the report out. Every visit should finish with a minimum photo set including the following:

- A before wide shot showing the device and surrounding area
- Close-ups of key interfaces such as sheds, bends, seams, overlaps, and any tight clearances
- An after close-up of the final installation
- A final wide shot showing clearances, nearby equipment, and overall context.

Store photos where crews and supervisors can find them (e.g., linked in a work management system). For each gap that could not be closed out, log what is needed (e.g., parts/kit/outage/engineering) and link the photographed gaps so they become a clean planned work package. Use the same pattern for new installations, maintenance fixes, and post-event repairs. These photos support acceptance decisions in the yard and feed directly into the simple KPIs and root cause failure analysis (RCFA) log in Section 8. This photo protocol is formalized in [Technical Guide, Section 6 \(Required Photos\)](#), and [Appendix A1](#) (including photo quality rules tied to acceptance).

15 Hofmann, A. 2017. "Defending Against Outages: Squirrel Tracker." APPA. Last modified July 26, 2017.



7. MEASURING EFFECT AND BUILDING THE BUSINESS CASE (KPIs AND DOLLARS)

Wildlife mitigation is easiest to defend when results are simple, repeatable, and visible as well as when it is clear what crews could feasibly finish in a normal window versus what would require planned retrofit. This section keeps measurement light so crews, supervisors, engineers, and managers can all identify whether actions in the yard are reducing wildlife events.

What is Measured

- **KPI-1** – Wildlife or squirrel-coded events per 90 days (yard level). This tracks how often wildlife-driven outages or sustained events occur at a yard.
- **KPI-2** – Re-trip ≤ 30 days after a wildlife-coded event (Yes/No). This shows whether fixes at that device are holding or failing quickly.
- **KPI-3 – Photo-Acceptance Closeout Rate.** Defined as actions with acceptable after photos divided by the total accepted actions, with a target of 100%. During initial implementation, utilities may use an interim performance threshold (e.g., $\geq 90\%$) to track rollout maturity, but the standard remains: if interfaces are not visible in the after photos, the action is not accepted for documentation and must be re-photographed or revisited so acceptance can be verified.
- **KPI-4 – Photo-Acceptance Coverage.** Planned retrofit backlog (open gaps) is a count of documented gaps that could not be closed to acceptance in the visit and remain open.

Together, these KPIs show how often events are happening (KPI-1), whether fixes are holding (KPI-2), whether installations are being done to standard (KPI-3), and whether the remaining scope is being captured and burned down through planned work (KPI-4).

Wildlife, and squirrel peaks in particular, tend to push SAIFI and SAIDI higher. Events per 90 days roughly track with SAIFI, while repeaters and repair durations influence CAIDI and SAIDI. Keeping wildlife coding aligned with existing practices makes it easier to plug these KPIs into current reliability reporting. For KPI definitions/calculation (including the KPI-3 photo-accepted rule), see [Technical Guide, Section 7 \(Data Capture, Key Performance Indicators, and RCFA Templates\)](#).

One-Line RCFA Log

Use a simple, one-line RCFA log so crews can maintain it in the field without adding a new system. The key is to log both accepted work and planned follow-up gaps in the same lightweight format. The following is an example of how a log entry may look:

Suggested Headers

Date | Yard | Device | Suspected species | Fault mode (bridge/chew/nest) |
Track (Monitor/Quick Wins/Targeted Protect) | Action taken | Acceptance (Y/N) |
Photo link | Follow up needed (parts/kit/outage/engineering) | Notes

One line per event or action is enough to see patterns over time and decide what to change in the next pass of the SEPA-R cycle. For minimum-required fields (action record and optional RCFA mini-template), see [Technical Guide, Section 8 \(Templates and Comparison Windows\)](#).

Before/After Window

Use a consistent comparison window so seasonal patterns do not distort results.

- **Baseline:** A 12-month yard history, including wildlife-coded events and unknowns with clear wildlife signatures (e.g., chew marks, nests, carcasses)
- **After-period:** 6–12 months after running the action packages at that yard
- **Compare like with like:** Whenever possible, compare the same seasons year-over-year so breeding, roosting, food, and weather cycles are similar.

The key question is whether wildlife-coded events and repeaters at the yard drop after running the SEPA-R cycle and whether the planned retrofit backlog (documented gaps) shrunk over time. For the recommended comparison windows and timing cues, see [Technical Guide, Section 8 \(Before/After Comparison Window\)](#).

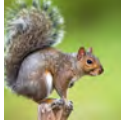
Converting Results to Dollars (Order of Magnitude)

If the utility has approved value-of-service or continuity cost figures, use those numbers first. Otherwise, pick conservative dollars-per-meter-hour values for residential, commercial, and industrial customers.

A simple form is as follows: $\text{Outage cost} \approx \text{meters affected} \times \text{hours} \times \$/\text{meter-hour}$

Use ranges unless using utility-approved numbers. A squirrel-caused substation event (e.g., about 10,000 meters for two hours) gives a straightforward before and after comparison at a single yard. Equipment damage and replacement costs are additional and are not captured in interruption factors.

A practical modifier for leadership is cost-to-close gaps: pair each planned retrofit item with rough crew hours plus rough material/kit cost so leadership can understand the size of the backlog and the burn-down plan. This converts the message of “the crew could not finish it today” into a fundable scope.



Turning Results into a Defensible Business Case

Once the KPIs and RCFA lines show fewer events and fewer repeaters (and a shrinking backlog of documented gaps), turn that into a simple story for leadership. Keep the story split by yard population: most partially mitigated yards improve through repeatable packages and backlog burn down, while strategically critical substations should be handled as engineered retrofit scopes.

Set Clear Yard-Level Targets Up Front, Such as These

- Reduce wildlife-coded events at this yard by a chosen percentage over 12 months.
- Zero re-trips within 7 days after wildlife-coded events.
- At least 90% photo-acceptance coverage for accepted installations.
- Reduce planned retrofit backlog by a chosen amount (e.g., close 50% of documented gaps within 90 days).

Pair Each Target with Both of the Following Points

- The action packages used (from the SEPA-R cycle)
- Approximate crew hours and material spent (plus rough hours/material to close the documented gaps that were escalated).

Describe Typical Impacts in Plain Language Rather than Fixed Percentages Such as in the Following Examples

- Excluding wildlife entry points and tightening fences and penetrations often cuts momentaries and reduces predator traffic.
- Protecting bushings, first jumpers, and obvious bridging points typically removes repeaters on those devices.
- Running score-based passes on priority devices often leads to noticeable drops in wildlife-coded events at those locations when work is applied correctly.

Present these as typical outcomes, not guaranteed numbers.

Close the Loop

- Use RCFA entries and photos to decide which fixes move into standard kits and design standards.
- Use the backlog (documented gaps) to justify staged inventory and planned retrofit work for the broad yard population and to trigger engineering-driven retrofit scopes for strategically important substations instead of repeated incident response.
- Add accepted devices into the light inspection cadence in Section 7.
- Store after photos in a shared location so quality is visible to crews, supervisors, and managers.

Over time, this process keeps installations healthy, builds institutional memory, and creates a straightforward, evidence-based case for continuing or expanding wildlife-mitigation work.

8. MAKING WILDLIFE-MITIGATION ROUTINE WORK

Wildlife will always be present around substations, but sustained outages from squirrels and other animals do not have to be. This guide is built on one simple idea: small, repeatable steps that are run inside normal O&M can steadily reduce wildlife risk without requiring new programs or major capital projects.

The practical pattern is the same at every yard. Use triage and the SEPA-R approach to decide what to do during a visit. Fix one approach path or attractant, protect one priority device family to an acceptable standard, and document what actions were taken with photos and a short log entry. The core principles—preserving PDR; keeping seams overlapped and draining; avoiding moisture cups and blocked mechanisms; and favoring form-fit, re-enterable parts—keep installations safe and durable, while the equipment quick cards, O&M cadence, photo protocol, and simple KPIs and RCFA log give supervisors, engineers, and managers a clear way to identify whether actions are improving reliability.

This guide does not replace utility standards, engineering judgment, or species-specific compliance requirements. It is a foundation that can be adapted to different yard layouts, species mixes, and resource levels. The Technical Guide provides deeper evidence, definitions, and examples. As utilities apply and refine these practices, local lessons, photos, and RCFA findings can feed back into the SEPA-R approach, making wildlife mitigation more routine, more targeted, and easier to sustain over time.





*Battelle Energy Alliance manages INL for the
Department of Energy's Office of Nuclear Energy*



26-60100