

A Framework for Lightning Resilience



Protection reduces lightning risk

Performance Verification reveals residual vulnerabilities

Engineering Improvements reduce residual risk

**Together, they produce
demonstrated lightning resilience.**

Figure 1. Performance-Verified Lightning Protection & Resilience Framework.
Adapted from the NIST Privacy Framework Core. SLS Proprietary Material

- **Govern** — Establish lightning-resilience objectives, responsibilities, acceptable risk, performance requirements, evidence criteria, and lifecycle processes.
- **Identify** — Characterize lightning exposure, critical functions, transient paths, vulnerable systems, and instrumentation gaps using engineering analysis and lightning-event evidence.
- **Protect** — Apply coordinated external and internal measures that control attachment, lightning current, electromagnetic coupling, surge entry, and equipment stress.
- **Control** — Monitor lightning activity, measure plant response, verify transient behavior, manage operational response, and maintain configuration control.
- **Communicate** — Convert lightning observations, event evidence, uncertainty, and lessons learned into engineering decisions, corrective actions, and organizational knowledge.

Approach and Collaboration: Building Resilience in Layers

Lightning resilience does not mean eliminating lightning risk. No system can do that. It means reducing exposure, vulnerability and uncertainty through coordinated protection, maintenance and verification.

Standards compliance is the foundation. Proper air terminals, down conductors, bonding, grounding and surge protective devices are essential. They reduce the probability of fire, structural damage, unsafe touch or step potentials and harmful electrical transients. That foundation should never be minimized.

The depth of the resilience program should match the consequence. A hospital, airport, water treatment plant, data center, manufacturing line, power plant or communications hub may justify more analysis and monitoring than a small office building. But a school, warehouse, church, retail building, condominium, sports complex or municipal facility can also benefit from better documentation, inspection access, surge protection coordination and post-storm understanding.

“A Performance-Verified Lightning Protection System does not replace traditional lightning protection. It builds on it.”

A useful framework is a Performance-Verified Lightning Protection System: an engineered combination of external and internal protection measures, supported by monitoring and evaluation methods, intended to help a facility achieve, verify and maintain its safety, continuity and performance objectives over time. This does not replace traditional lightning protection. It builds on it.

External lightning protection remains essential. Air terminals, masts, poles, conductors, bonding and grounding provide critical attachment control and current paths. However, reducing direct attachment risk does not eliminate every internal transient pathway. Lightning-related stress can still enter or couple into a facility through power services, communications lines, metallic piping, grounding systems, cable shields, structural steel, nearby strikes and common-mode reference shifts.

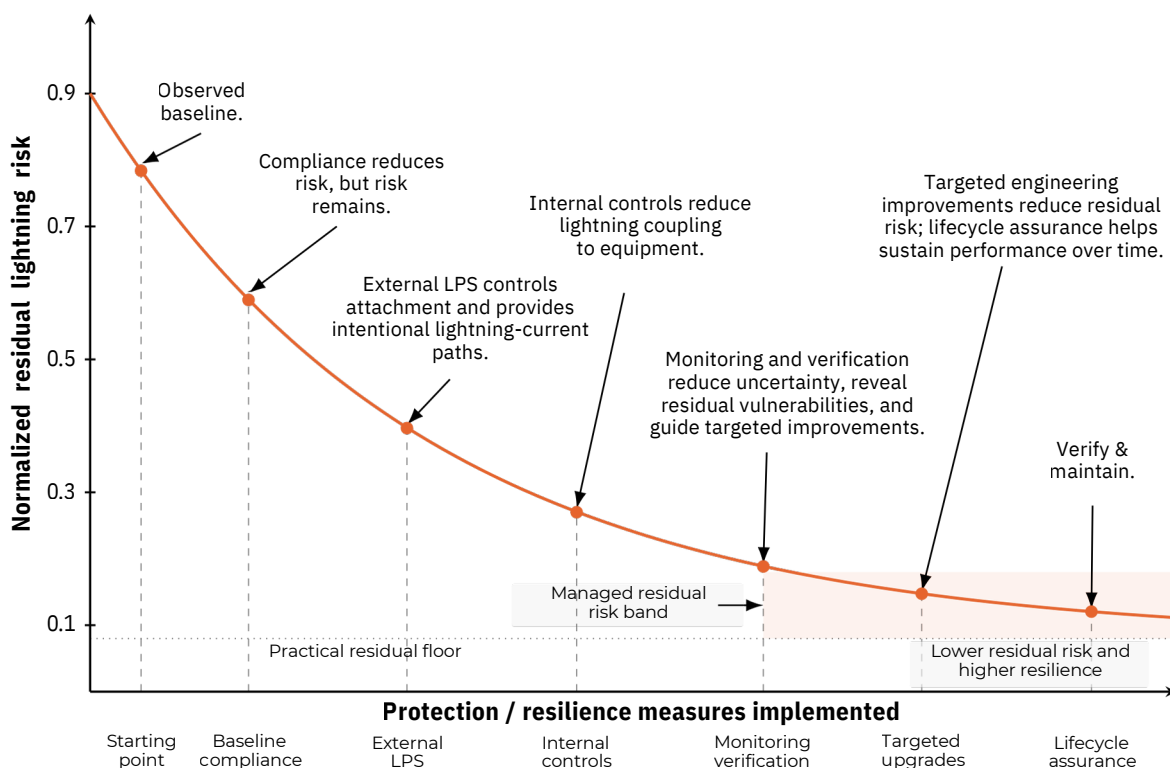


Figure 2. Conceptual progression from installed protection toward managed residual lightning risk. Protective measures and targeted engineering improvements reduce residual risk, while monitoring and verification reduce uncertainty, reveal residual vulnerabilities, and provide the feedback needed for continued improvement. The objective is managed residual risk, not zero risk.

Feedback: Moving From Assumption to Evidence

Many lightning protection systems operate with little feedback. They are installed, inspected visually from time to time and assumed to be performing. Visual inspection is important, but it cannot answer every post-storm question.

For high-value, repeatedly affected or operationally sensitive facilities, local lightning detection, current sensing, field measurements, transient recorders and event correlation can help owners and installers move from assumption to evidence.

- Did lightning current enter the system?
- Did a surge protective device operate?
- Did a sensitive circuit experience a damaging transient?
- Was a later failure related to lightning, or was it caused by switching, aging, installation issues or another disturbance?

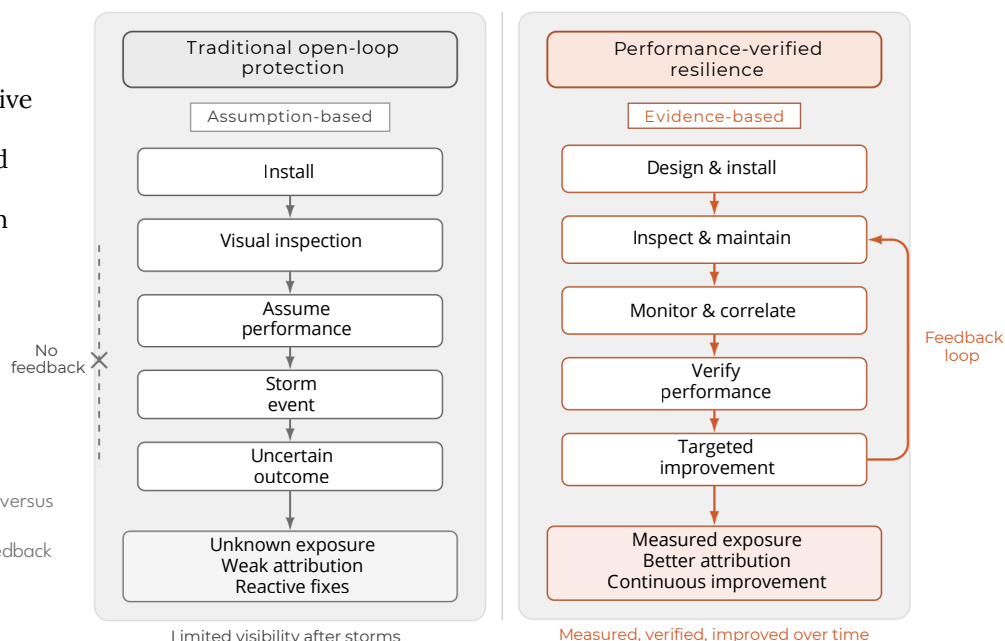


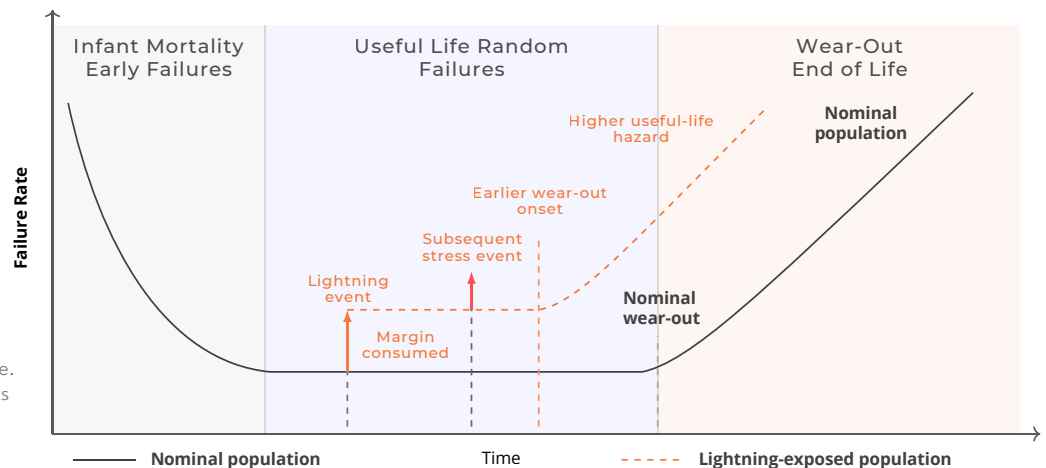
Figure 3. Traditional open-loop protection versus performance-verified resilience. A performance-verified approach adds feedback through monitoring, event correlation, inspection and targeted improvement.

Latent Damage: When “Still Operating” Is Not Enough

Lightning effects are not always dramatic. Sometimes equipment fails immediately. Other times, the concern is more subtle. A component may pass a basic function check after exposure while having reduced insulation strength, weakened semiconductor robustness, degraded surge protection, damaged contacts or shortened remaining life. Still operating is not always the same as undamaged.

This concept is known as latent damage. Not every delayed failure after a storm is caused by lightning, and event-specific evidence matters. But lightning can impose electrical, thermal, dielectric and electromagnetic stress that consumes reliability margin without immediate loss of function.

Figure 4. Conceptual illustration—not to scale. Actual degradation and remaining-life effects depend on component technology, exposure severity, protection, and failure mechanism.



Examples include critical assets such as generators, transformers, switchyard equipment, protective relays, fire alarm systems, pumps, elevators, emergency power systems, medical equipment, control systems and communications networks.

Outcome / Takeaway: A Better Question for Every Project

For installers, this evolution is an opportunity. The industry is not simply placing metal on buildings. It is helping owners manage risk. Workmanship, bonding quality, documentation, inspection records, maintainable test points and coordination with surge protection all become part of a larger resilience value proposition.

For owners and operators, lightning protection should not be treated as a box checked at project closeout. Owners should ask: What systems matter? What remains exposed?

Are surge protective devices coordinated and properly bonded? How will the system be inspected, maintained and reviewed after changes? How will we know what happened after a storm?

Lightning protection should be designed earlier, coordinated more fully, documented more clearly, maintained more deliberately and verified where the consequences justify it. When that happens, **the industry moves from installed protection to verified lightning resilience—and owners gain a more reliable path to safety, continuity and long-term performance.**



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