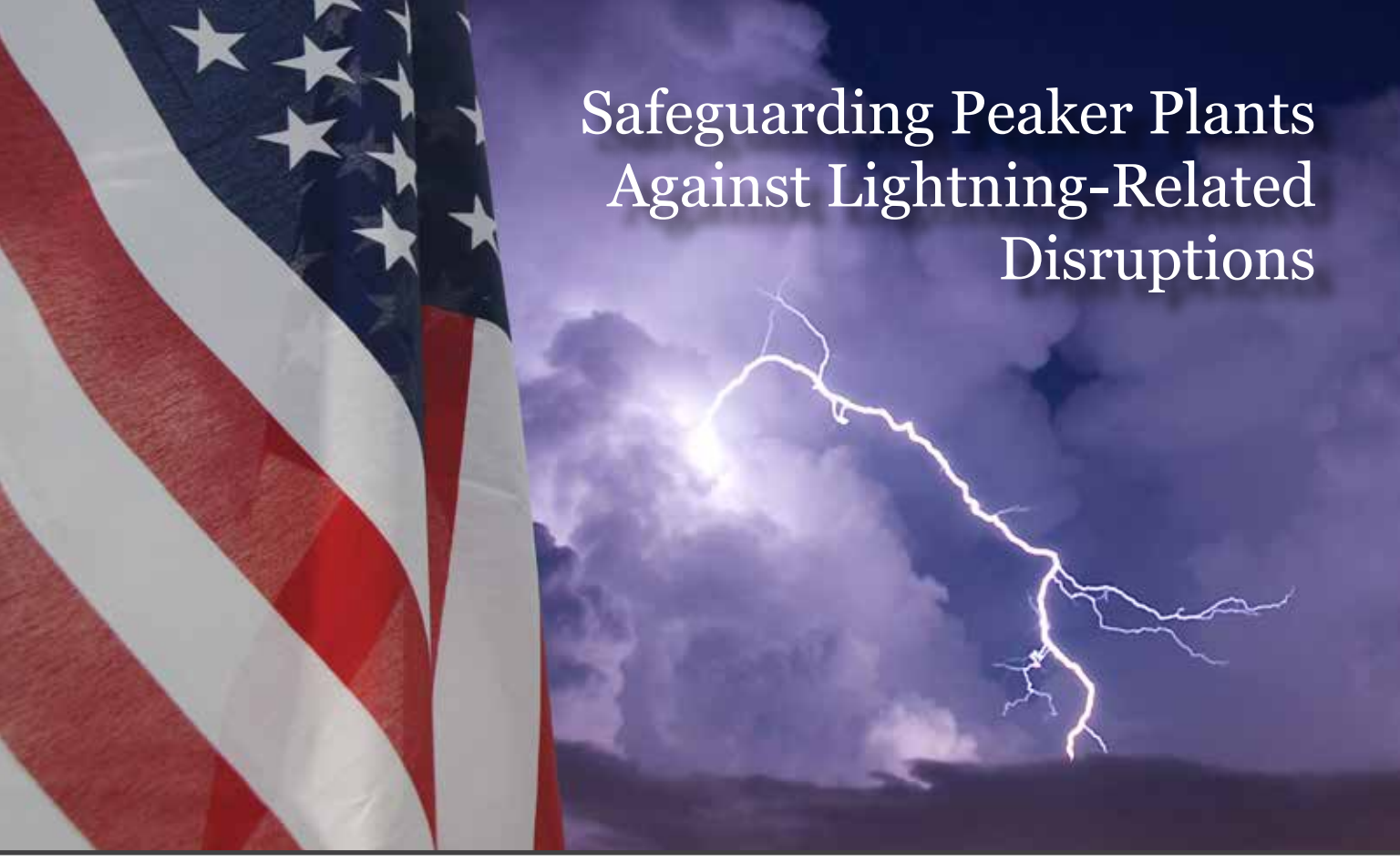
Building
Maintenance & Safety
Products
May 2026

Functional Safety at Scale: Safeguarding One of the World's Largest Ethylene Plants



Safeguarding Peaker Plants Against Lightning-Related Disruptions

Comprehensive lightning protection measures help keep peaker plants in a constant state of readiness, enabling them to deliver supplemental power at a moment's notice when electrical grids become overloaded

According to the latest federal data, the United States currently has just over one thousand peaking power plants in active service. Also known as peaker plants, these electric power generation facilities are designed to operate only during periods of high electricity demand. Their function is to supply additional grid support, activating when baseline utility power generators such as nuclear, coal, hydroelectric, or large combined cycle plants cannot meet short-term spikes in load.

Although simpler in infrastructure and more compact than traditional power generation facilities, peaker plants are among the most vulnerable to operational disruptions caused by direct lightning strikes and their secondary effects.

Peaker plants are particularly susceptible to lightning effects for several reasons. They often include prominent structures such as exhaust stacks, transmission towers, and open-air substations, all of which act as likely lightning strike collection points. Within the facility, large amounts of electrically conductive equipment are directly tied into the grid. Generating units, power transformers, switchgear lineups, control platforms, and communications networks operate under high electrical stress and are susceptible to transient overvoltage.

Even in areas with infrequent thunderstorms, severe lightning events can still occur, leading to catastrophic damage, injury, downtime, fines, and negative impact to corporate reputation. When this occurs, the financial consequences can be devastating. A single strike can ignite fires, destroy valuable assets, and lead to costly downtime and environmental damage.

The secondary effects of lightning are also significant. Ground potential rise and electromagnetic energy coupling into control and instrumentation cabling can disrupt plant functions or damage sensitive hardware where grounding, bonding, surge protection, and shielding are not in place.

The operating profile of a peaking facility adds another layer of exposure. These units run only when supplemental capacity is needed and are designed for rapid startup, which often means long periods offline. Insulation systems, grounding networks, and related protective features must therefore remain dependable despite long periods of inactivity and cold equipment conditions.

Lightning-induced surges can introduce hidden degradation that may not appear during routine maintenance and inspections but later interferes with startup when the unit is urgently required for peak demand or grid support. The impact is considerable because these plants are called upon during periods of system grid stress.

For these reasons, peaker plants typically incorporate comprehensive lightning protection measures, including air terminals, which are designed to attract lightning and will only protect structures. Low-impedance grounding grids and transient voltage surge protection devices are also included in the lightning protection measures. Lightning avoidance technologies may also be utilized, such as Charge Transfer technologies. A Charge Transfer System not only protects structures but allows reliable operation of the control and monitoring automation through the storm.

"Rather than offering a one-size-fits-all solution, lightning protection and mitigation recommendations should be tailored to a facility's unique vulnerabilities, whether that involves direct strike avoidance, secondary damage caused by a nearby strike, or grounding improvements," says Peter Carpenter, Director of Applied Engineering at Lightning Eliminators & Consultants, Inc. (LEC), a pioneer in the field of lightning protection since 1971.

LEC's solutions protect critical operations and structures for some of the world's most recognized companies, including Tennessee Valley Authority (TVA) nuclear facilities, Exelon, Constellation Energy, Duke Energy, and Consumers Energy, Federal Express, UPS, Marathon Petroleum, Chevron, ExxonMobil, and thousands of others.

Prevention is the Best Defense

According to Carpenter, the most effective defense is to prevent a lightning strike from occurring.

"This is a far superior solution than a lightning rod-based system that attracts lightning to the protected site and then attempts to manage the strike," explains Carpenter.

Lightning occurs when the difference in potential between storm clouds and the earth reaches a critical level, triggering an electrical discharge. For lightning to strike, it requires a connection be-

tween a downward leader from the cloud and an upward streamer from the ground.

The Dissipation Array System (DAS®) from LEC is designed to prevent direct lightning strikes within its designated protection area by lowering the electric field to levels below those required for lightning to form.

"DAS prevents these connections by using point discharge technology, which neutralizes the charge differential before a strike can occur. Through a system of well-grounded points, DAS facilitates the exchange of ions between the air and the ground, disrupting the conditions necessary for a lightning strike," says Carpenter.

DAS can be integrated with a wide range of structures, including buildings, towers, tanks, and stacks. Since its inception, over 4,500 DAS installations have been deployed worldwide, accumulating more than 100,000 system-years of effective performance. Testimonials from industry leaders confirm its effectiveness, with companies reporting significant reductions in downtime, maintenance costs and improved reliability.

LEC even offers a "No-Strike" warranty for all supervised installations, ensuring complete protection when the system is properly maintained and inspected.

The effectiveness of DAS is enhanced when combined with a comprehensive lightning protection system that includes a low-impedance grounding system, transient voltage surge suppression, and modular strike prevention devices. Together, these components ensure optimal protection against both direct strikes and secondary electrical surges.

Lightning Risk Assessments

Due to the wide range of available technologies, mounting an effective defense against lightning-related threats typically requires a tailored strategy that integrates multiple solutions, each having its own specific purpose for minimizing damage or avoiding it altogether. The optimal combination depends on the specific site conditions and the nature of the operation.

Carpenter says the appropriate combination of solutions can only be determined through a comprehensive evaluation of each facility's current protection measures, grounding systems, and overall risk exposure.

"Understanding a peaker plant's past issues, vulnerabilities, and protection goals helps determine whether the solution should focus on grounding enhancements, surge protection, direct strike avoidance, secondary damage from a nearby strike, or a combination of all three," says Carpenter.

By conducting a thorough site assessment, LEC helps facilities identify vulnerabilities and implement customized mitigation strategies, whether that means improving grounding, adding targeted surge protection, or implementing direct strike mitigation solutions.

This proactive step not only safeguards critical infrastructure and personnel but also helps prevent costly disruptions and reinforces a facility's long-term resilience against lightning-related threats.

For more information: call 303-447-2828 or complete the Free Lightning Risk Assessment for Critical Operations.