White Paper

The Need for Surge Protective Devices in Highway, Street, and Parking Lot Lighting

ASCO Power Technologies®

The Need for Surge Protective Devices in Highway, Street, and Parking Lot Lighting

Common highway, street, and parking lot luminaires use electrical ballasts, LED drivers, and power supplies that are critical to proper function of lighting equipment. The same ballasts and power supplies can also be susceptible to damage from transient overvoltages. For this reason, Surge Protective Devices (SPDs) should be installed to protect streetlight equipment from surges to ensure reliable operation. This document explains the importance of applying a protection strategy when installing, upgrading, or servicing these systems.

THE NEED FOR SURGE PROTECTION

In New York City alone, there are more than 250,000 streetlights. Throughout the world, many millions of streetlights illuminate roadways and public spaces. Each has one thing in common - they are susceptible to damage by overvoltage transients. Because streetlights are usually pole-mounted, they are subject to risks from lightning activity and resulting surges.

The importance of protecting streetlights from damage by transient overvoltages becomes clearer after considering their public safety role:

- Lighted intersections and highway interchanges experience fewer vehicle accidents than unlit intersections & interchanges.[1]
- Studies have shown that pedestrian fatalities are much more likely to occur in darkness rather than daylight.[2]
- Street lighting has been found to significantly reduce pedestrian crashes.[3,4,5]

To ensure public safety, streetlights can be readily protected from the effects of transient overvoltages by installing appropriate SPDs. Doing so reduces the possibility of damage, the associated costs of resulting claims, and costs for lighting maintenance and replacements.

---

[1] Box, P.C. *Relationship Between Illumination and Freeway Accidents.* IERI Project 85-67 - Illuminating Research Institute, New York. 1970. pp. 1-83.
[2] Sullivan, J.M., and Flannigan, M.J. *Assessing the Potential Benefit of Adaptive Headlighting Using Crash Databases,* Report No. UMTRI-99-21. University of Michigan Transportation Research Institute. Ann Arbor, Michigan. 1999
[3] Schwab, R.N., Walton, N.E., Mounce, J.M., and Rosenbaum, M.J. *Synthesis of Safety Research Related to Traffic Control and Roadway Elements - Volume 2, Chapter 12: Highway Lighting.* Report No. FHWA-TS-82-233. Federal Highway Administration. Washington, D.C. 1999.
[4] Elvik, R. *Meta-Analysis of Evaluations of Public Lighting as Accident Countermeasure.* Transportation Research Record 1485, TRB, National Research Council. Washington, D.C. pp. 112-123.
[5] Commission Internationale de l'Éclairage. *Road Lighting as an Accident Countermeasure.* CIE No. 93. Vienna, Austria. 1992.

REAL LIFE PROBLEMS

Studies have shown that intersection and highway darkness result in many crashes and fatalities. Damaged or inoperable street lights could potentially have fatal consequences. Non-functioning lighting in parking areas can pose safety and security hazards at business locations, and present corresponding liability concerns. Hazards resulting from faulty roadway lighting are a liability for government agencies and municipalities that allow such conditions to exist. For example, the City of Birmingham, Alabama, received numerous complaints with city officials about 2,600 inoperable streetlights along interstate highways and 1,100 additional inoperable street lights within the city limits. Birmingham officials earmarked $400,000 to repair and replace all these lights after a state transportation official identified the situation as a safety issue.[6]

Inadequate or inoperable outdoor lighting can lead to pedestrian injuries. Assessments of liability include evaluations of whether potentially responsible parties make reasonable efforts to keep premises safe or fail to correct problems in reasonable time-frames. In *Clay Electric Cooperative, Inc. v. Johnson, 873 So. 2d 1182 (Fla. 2003)*, an accident occurred near a defendant's inoperable streetlight. The Florida Supreme Court ruled that the electric utility was responsible for maintaining the light with reasonable care and ruled in favor of the plaintiff.[7]

Clay Electric Cooperative, Inc. v. Johnson is one of many cases that highlight the importance of ensuring the conditions of outdoor lighting. Various measures can be implemented to ensure the availability of safe lighting. While timely repairs are important, protecting sensitive equipment with an appropriate SPD can prevent problems from occurring.

POWER SOURCES FOR STREETLIGHTS

To better understand the importance of, and options for, protecting streetlights from surges, the following diagrams illustrate generic arrangements for powering them. In the case of streetlights along a public roadway, each luminaire may be mounted on a pole, and a series of poles may be powered from an upstream utility transformer. This arrangement is shown in Figure 1. In this configuration, the streetlight may be susceptible to transient overvoltages from two sources. The most obvious is exposure to the effects of lightning that strikes a pole or a nearby area. The second source is transients that result from upstream utility activity, such as switching on the public grid or a vehicular accident. Such transients tend to exhibit low frequency and high energy.

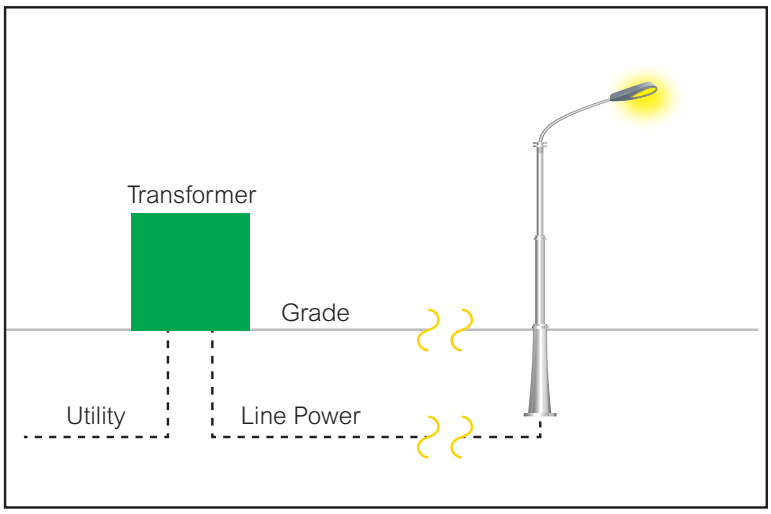

Figure 1: Roadway Lighting

Alternatively, pole-mounted lights that illuminate a parking area may be powered from an electrical distribution panel within a nearby building, as shown in Figure 2. In this arrangement, the pole-mounted light is subject to the same environmental sources of transient overvoltages as roadway lighting. The light is also subject to transients from upstream utility sources, and from transients generated by operation of electrical equipment within the building. The latter transients are often of lower energy and higher frequency. Nevertheless, the system configuration also offers a risk of exposing the building electrical system to transients from environmental sources, which could enter along the conductor that runs between the pole and the power distribution panel.

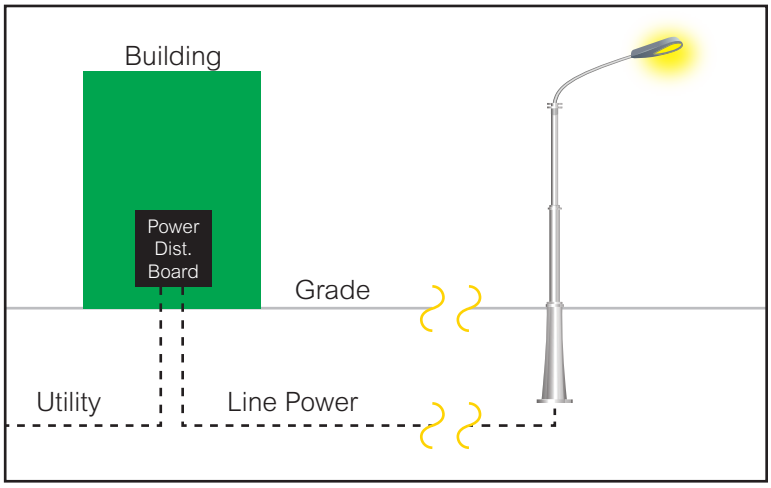

Figure 2: Parking Lot Lighting

[6] Ginny MacDonald, The Birmingham News, Dec. 12, 2011, Driver's Side: Few places darker than a Birmingham interstate, (al.com).
[7] The Florida Senate Interim Project Report 2005-148, (2004); Duty to Maintain Streetlights.

In either case, the luminaire may be factory-fitted with a surge protection device. The capacity of these devices is often insufficient to protect to the luminaire and adjoining equipment from the full amount of transient energy to which it could be exposed.

TECHNICAL CONSIDERATIONS

Protection from Sources of Surges

Lightning strikes are often cited as a primary cause of equipment damage. Although a single lightning event can cause catastrophic damage, lower level transients are more likely to damage sensitive electronic components over time. Transient overvoltages from each of these sources are potentially damaging to unprotected or inadequately protected streetlight equipment. Upstream SPDs can protect streetlights from transients generated by utility switching or facility equipment operation. Installing an SPD at the base of the pole can protect lighting equipment from foreseeable surges.

When a light in a parking lot is powered by a branch circuit extending from a nearby building, an SPD at the streetlight protects its components from environmental sources of transients. It also mitigates the amount of energy that could enter the remainder of the building's electrical system from the streetlight or its wiring. Nevertheless, IEEE 1100 recommends applying SPDs at a building's service entrance and power distribution panels using a cascaded approach. This arrangement can protect equipment from surges that could enter the building along the conductor from a light pole.

Protection of Lighting Components

Electrical ballasts regulate current to supply the correct amount of power to a lamp. Two types are commonly used in streetlighting. Magnetic ballasts have a long service history in legacy streetlight applications. In addition, High Frequency Electronic Ballasts are increasingly used when energy-efficient Light-Emitting Diode (LED) lamps are deployed. While both types can be affected by transient overvoltages, the electronic ballasts and components that serve LEDs can be particularly susceptible to damages from surges.[8]

Figure 3: The ASCO Model 235 fits into the openings found at the base of light poles.

[8] ASCO Power Technologies, Inc. *Protecting Electronic Lighting Components From Transient Overvoltages.* Florham Park, New Jersey. 2017. https://www.ascopower.com/globalassets/documents/asco-white-papers/wp-50015_protecting-electronic-lighting-components_165814_0.pdf, viewed October 27, 2018.

The deterioration of ballasts, power supplies, and other components may cause lamps to operate intermittently. If malfunctions are not repaired quickly, components and wires can overheat, presenting a risk of fire. Such events would require costly replacement of damaged equipment by a qualified electrician. For elevated lights, an aerial bucket truck may also be required at additional cost. For each of these reasons, it is important to protect the ballasts and the lamps they serve by installing suitable SPDs, such as the unit shown in Figure 3.

Surge protection is often overlooked when deploying lighting systems. For LED applications, *ANSI C82.11-2002 - High Frequency Fluorescent Lamp Ballasts* states, "Electronic high frequency ballasts are more susceptible to line transients than line frequency magnetic ballasts. Therefore, transient protection shall be included." In addition to being a best practice, installing SPDs into light poles is an easy, inexpensive, and reliable method of protecting lighting equipment from transient overvoltages. Where served by a distribution panel in a nearby building, an additional SPD should be installed on the line side of the panel, to protect against transients that could enter structure along the lighting circuit. Figure 4 shows suggested locations for installing SPDs. Consult SPD manufacturers for application-specific guidance regarding SPD selection.

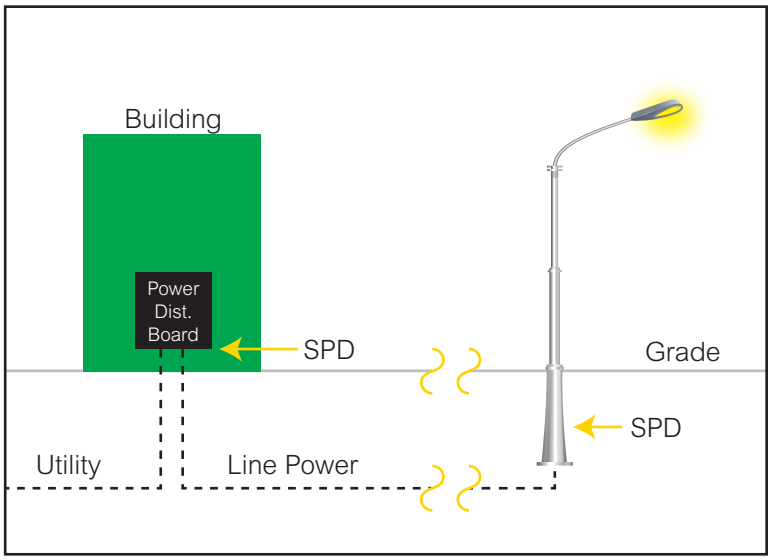

Figure 4: Suggested SPD Installation Locations

SUMMARY

Installing or repairing expensive highway and parking lot lighting without installing SPDs can leave important safety and security lighting unprotected from transient overvoltages and present liabilities to parties responsible for their operation. Surge protective devices can provide cost-effective easy-to-install protection for outdoor lighting systems. Qualified representatives of SPD manufacturers can provide guidance in selecting appropriate models for specific applications.

[9] National Electrical Manufacturers Association, *ANSI C82.11-2002 - American National Standard for Lamp Ballasts— High Frequency Fluorescent Lamp Ballasts.* Rosslyn, Virginia. 2002. p. 9.

ASCO Power Technologies - Global Headquarters
160 Park Avenue
Florham Park, NJ 07932
Tel: 800 800 ASCO
customercare@ascopower.com

Surge Protection
14450 58th Street North
Clearwater, FL 33760
Tel: 800 237 4567 (U.S & Canada Only)
727 535 6339 (Outside U.S.)
Fax: 727 539 8955

WP-50028 (r- 10/18)

surge.ascopower.com

whitepapers.ascopower.com
www.ascoapu.com

ASCO. Innovative Solutions.