Are More Stringent Lighting Codes Adversely Affecting Building Security?

More energy efficient lighting codes and pervasive use of LEDs can inadvertently create premise liability issues. Here's what you need to know keep your facilities secure.

By Sean Ahrens and Ferdinand Martija LIGHTING

The evolution of energy codes over the past two decades has challenged engineers, architects, and lighting designers to reconsider traditional mindsets and technologies regarding lighting and lighting controls. Recently, lighting designs have centered on innovative approaches necessary to comply with increasingly stringent energy code requirements. If improperly planned, meeting new requirements of energy codes for lighting and lighting controls may have a detrimental effect on premise security. The primary goal of energy codes is to reduce building energy, and one of the biggest energy consumers is lighting wattage. Lighting and lighting control design addresses the requirements to stakeholders. To achieve satisfaction of these twin pillars, it is critical to understand the evolution of energy codes, and the nuances of lighting and lighting control technology.

Evolution of technology

In the United States, the two codes typically adopted and enforced by individual state and local governments are the International Energy Conservation Code (IECC) and ASHRAE standard 90.1. Certain states adopt their own energy codes, which may have more stringent sets of standards and guidelines. For instance, California adopted its own energy code called Title 24. Both the IECC and ASHRAE 90.1 are revised and reissued every three years, and subsequently, become more restrictive.

Luminaires historically used for interior applications are either incandescent or fluorescent. High-intensity discharge has historically been favored in certain large volume or exterior applications. In both interior and exterior applications, light-emitting diode (LED) lighting supplanted these legacy lighting technologies and shows versatility in a wide variety of environments. Alongside LED lighting's versatility, the increased stringency of energy codes is a key component of the lighting industry shift from fluorescent, high-intensity discharge (HID), and incandescent, to LED as the dominant lighting technology over the past ten years.

The rapid advancement in light source technology requires an understanding of the various tradeoffs and characteristics associated with each type of light source. Effective application of lighting technologies addresses key security objectives such as witness potential, facial or identity recognition via

Selection of lighting technology requires deeper consideration than the quantity of light output the technology may offer. Each light source type varies in the quantity of light (measured in lumens) per watt produced, the ability of the light to reveal colors compared to a natural light source (expressed as color rendering), its optimal operating temperature range, and its useful life.

Incandescent and fluorescent lighting are technologies historically used for interior lighting. Because of various limitations, these lighting technologies are typically not suitable for outdoor applications or large volumetric spaces.

Incandescent lighting is a legacy lighting technology that finds its roots at the dawn of light technology. Incandescent lighting requires a significant amount of power to generate light but offers good color rendition and quick start-up/re-strike time. Incandescent lighting has a brief life, which leads to ongoing maintenance challenges.

Fluorescent lighting is available in tube and spiral lamp (or ‘compact’) form. The lighting is coupled with ballasts, which converts standard building utilization voltage into a regulated form of power usable by the fluorescent lamp. Expensive ballasts customized with fluorescent lamps are required with dimming and in cold environments.

For outdoor or large volumetric applications, high-intensity discharge (HID) lighting is sub-categorized into two specific types that include high pressure sodium (HPS), low pressure sodium (LPS), and metal halide lighting. Both HPS and LPS are typically found in parking lots and street lighting, featuring one of the highest lumens per watts. Two significant drawbacks related to orangish hue with poor color rendition, which is not ideal for surveillance systems. This type of lighting also creates a subliminal psychological effect that has been described as "unfriendly."

Metal halide cannot be dimmed, has long re-strike times, but works well in cooler temperatures. As these lights age, the color temperature can shift, which creates poor color rendition on surveillance systems. Like fluorescent, HID lighting uses ballasts to convert building utilization voltage to regulate power.

Incandescent, fluorescent, and HID lighting are all individual units/single bulbs and immediately cease to operate at the end of their useful life. Until the moment of failure, metal halide and incandescent largely maintain their light output. The light output of fluorescent lamps can diminish over time before ultimately failing.

Enter LED lighting technology

LED luminaires comprise two operational components — the LED driver and the LED module. The LED module contains the actual LED chips, the light sources for the luminaire. The LED driver powers and controls the LED module. The LED driver is also the interface for connecting control inputs, such as dimmers and switches, to the LED module. In legacy lighting technology, lamp failure is a visible sign the lamp requires replacement. However, LED modules continue to diminish in performance indefinitely. LED modules do not have an obvious moment of failure over an extended period and continue to degrade until noticed. LED drivers, similar to ballasts, have a finite useful life and can fail independently of the LED bulbs.

LED luminaires are identified with an L70 rated life, which is the estimated hours that an LED luminaire may function before reaching 70 percent of its initial light output. The L70 rating is considered the luminaire's useful life – ranging from 50,000 hours to well over 100,000 hours.

LED modules are manufactured in various physical shapes, sizes, and with chips arranged on the module board. Standardization of LED modules has not yet been adopted. Lighting fixture manufacturers design their lighting products around the LED modules they select for their application. When replacement of a fluorescent tube or metal halide lamp was necessary, maintenance staff could have confidence that a replacement lamp of similar lighting characteristics could be readily acquired from many of the lamp manufacturers. Maintenance staff could also have confidence that the installation of replacement lamps would not affect the lighting performance of the light fixture. In contrast, however, the lack of industry-wide standardization of LED modules largely requires replacement of the entire luminaire or that LED modules be purchased specifically from the manufacturer of the affected luminaire, if available.

LED lighting has created many opportunities for innovation in lighting controls. Not only is LED lighting inherently dimmable, it can turn on and off with no prolonged re-strike effects, and can function in a broader temperature range. With LED's inherent ability to dim, reducing energy usage through dimmable wall controls, daylight harvesting, and light level setbacks in unoccupied areas are now more cost effective than a similar strategy using fluorescent lights. Where HID lighting has a long re-strike, LED lighting can be switched on and off with a quick return to full brightness. Spaces such as warehouses and parking lots have now become targets of controls.

Energy codes and requirements

While energy codes intuitively govern lighting power densities (watts per square foot), the emergence of LED lighting technology created new opportunities to pursue energy savings through means of lighting control. For instance, with exterior lighting, the energy code expanded control requirements from the traditional time of day and availability of daylight to include shutting off or dimming light output by 30 percent when activity has not been detected for 15 minutes. Lighting control designers should consider the impact of these requirements on the goals of security focused stakeholders. This is especially important where light levels are required to enhance visibility for persons or cameras. There are provisions to exempt code requirements for areas designated as security areas, but this exemption is subject to interpretation by the authority having jurisdiction. Targeted security areas and the definition of “security” would require discussion with the authority having jurisdiction (AHJ) to ensure the final lighting controls design meets requirements of all stakeholders involved.

Premise liability vs codes

The goal of someone considering an illegitimate activity is to maintain anonymity, which makes lighting a significant deterrent to criminal behavior. Lighting supplements witness potential by reducing anonymity and increases the psychological perception by an aggressor that they would be observed and caught, thus increasing deterrence. These statements are emphasized by the following question: As a child, would you pick the most well-lit home rolls over a tree in the middle of the night or would you prefer to do this during daytime hours?

Premise liability legalities are typically addressed in the courtroom through civil adjudication. The lack of lighting, amount of lighting, type of lighting, and the maintenance of lighting is effective in assigning liability upon an organization. Previously, existing conditions would immediately substantiate if lighting was present or luminaires were burned out. LED lighting and energy conservation create new challenges and renewed need for documentation and maintenance not rigorously practiced with previous lighting types.

Additionally, lighting codes can indirectly create premise liability exposures. LED sources use a partial intensity and full intensity outputs which can be controlled by an onboard motion sensor. Motion activated lights have been observed to malfunction in colder temperatures. This condition is often observed after an event occurred, creating a preponderance of the evidence that the device did not function on the day of the incident. Often, legacy lighting technology is replaced without consideration of the subtle differences of light output and other technology characteristics that result in vastly different light distribution and aesthetics from the original layout. Unlike other lighting technologies, LED fixtures and their output are not by one bulb, but an array of light emitting "chips," which together create the total light output.

As seen in a recent security assessment, a light appeared functional, but noticeably had a decreased lumen output. As observed in the day, that same light, which appeared functional, had in fact lost 60 percent of its LED array. As the degradation of LED occurs over time, the light decay is difficult to technologies are not apples to apples comparisons, and consequently, not always a one-for-one replacement. New lighting layouts should be considered in achieving the lighting objectives with expected degradation.

Considerations for the future

While LED lighting is versatile and energy efficient, it must be designed by those who are qualified to do so. LED retrofits should be evaluated and approved by electrical engineers. Many organizations are replacing legacy lighting technology with self-contained LED replacements that require an in-depth assessment of the existing luminaire to prevent premature lamp failure and ensure the new luminaires serve the lighting needs appropriately.

A lighting design that meets expectations of stakeholders provides the required light levels throughout the useful life of LED luminaires. An effective lighting design also considers and minimizes the costly luminaire replacement cycle required to provide the prerequisite light levels while balancing energy codes and light trespass regulations.

The entire lighting program should be documented, including temperature standard and motion activated outputs. Maintenance should not be deferred, and will probably be more complex, as these metrics will need to be confirmed and documented periodically by those who own these systems. Outside of recurring and documented maintenance, LED lights will need to be completely replaced periodically at specific time frames.

Te advancement of the Internet of Things (IoT) presents the opportunity for new features such as self-diagnostics, on board photo optics to measure identifying and mitigating premise liability concerns involving lighting systems that use LED systems. These potential future technologies could also eliminate holistic and expensive maintenance programs.

The current reactive chase for savings and energy conservation, along with improperly designed and implemented lighting technologies, present more expense when compared to a premise liability judgment.

Sean Ahrens (sahrens@aeieng.com) is a premise liability security expert project manager with Affiliated Engineers Inc., a multi-disciplinary engineering firm that provides electrical engineering, lighting and security design consulting/ assessments for many project types.

Ferdinand Martija (fmartija@aeieng.com) is an electrical engineer with Affiliated Engineers Inc.

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