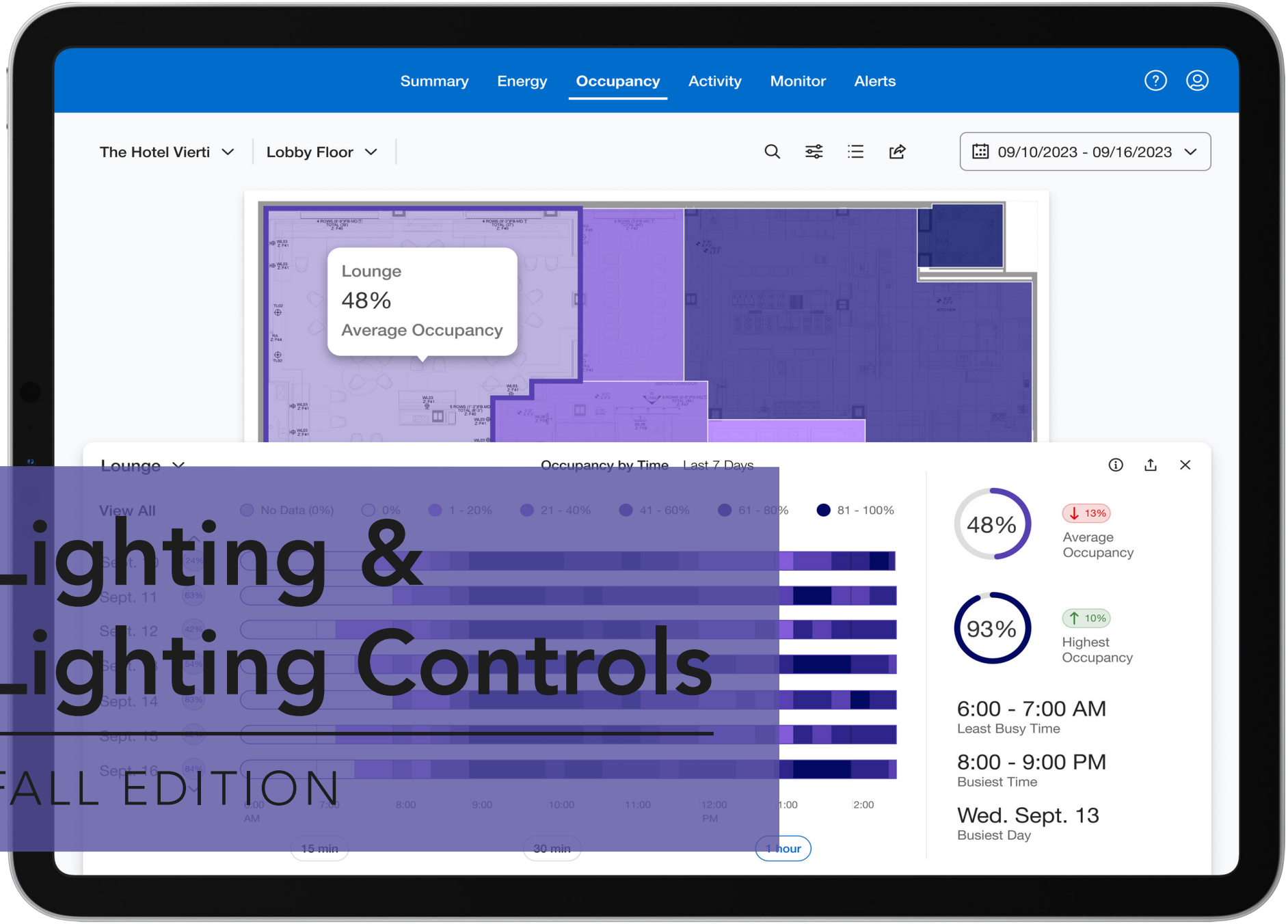

Lighting & Lighting Controls

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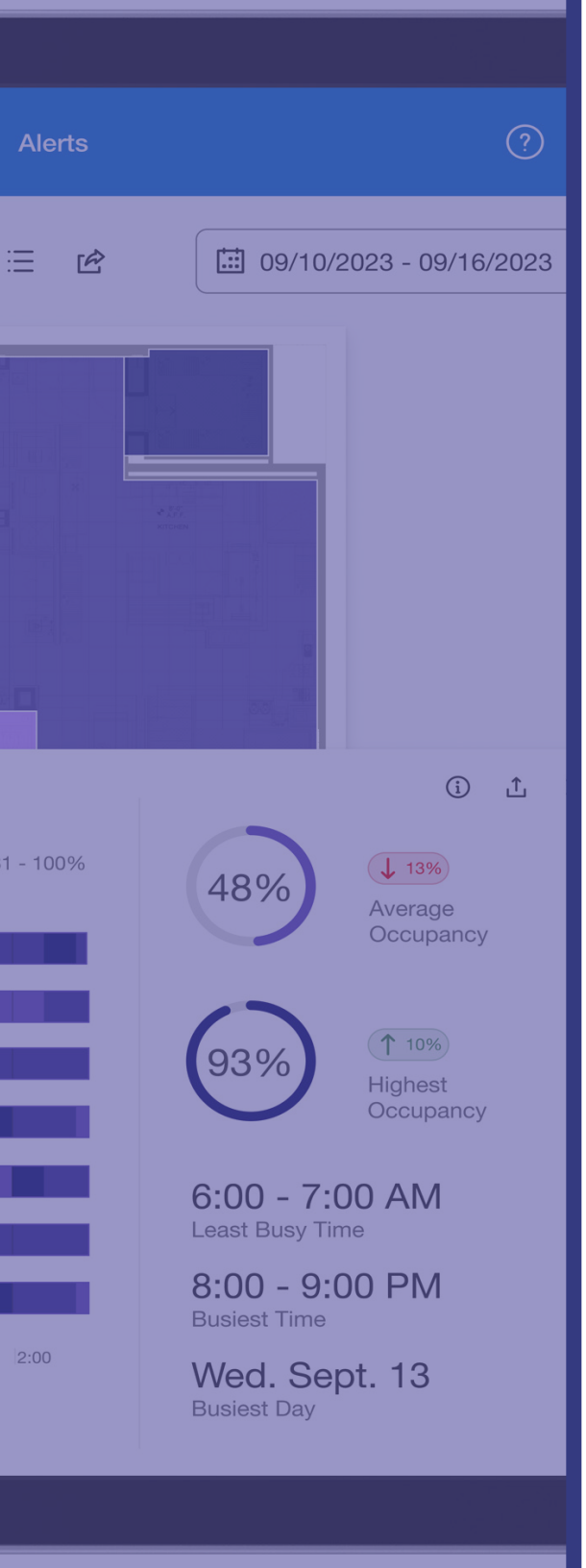

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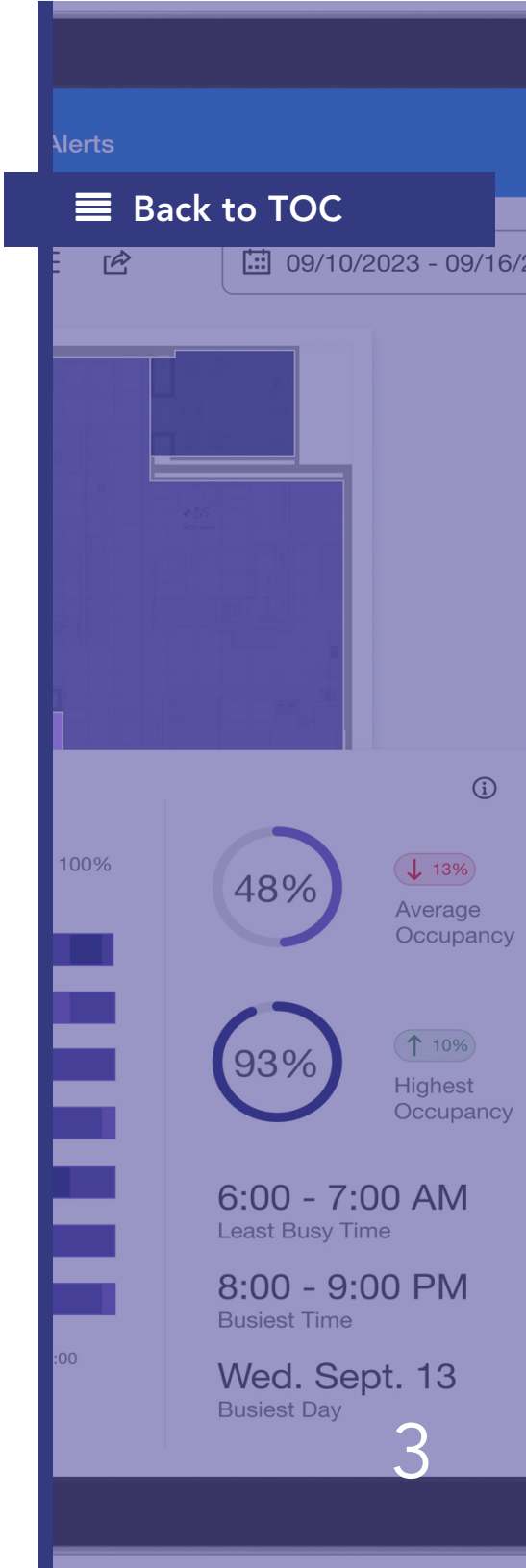
Lighting control for luxury hospitality: A guide for electrical engineers

Sophisticated lighting controls and connected analytics can enhance guest experiences at luxury hospitality venues

Luxury hospitality is one of the fastest-growing sectors in commercial construction. According to research by Morrissey Goodale, published in Consulting-Specifying Engineer, in 2023, construction and design spending was up 29% over 2022. Key market insights anticipate the global luxury hospitality market will grow to $293.61 billion by 2030, with 700 new hotel projects anticipated to open in 2024 and another 800 expected to open the following year.

These projects present tremendous opportunities and unique design challenges to electrical engineers and lighting designers. Owners are looking for human-centric, sustainable solutions that save energy, add value over time, and simplify code compliance and maintenance. Tech-savvy guests expect sophistication, elevated comfort, and personalized amenities, so experience reigns supreme when deciding where to spend their travel dollars.

Design that satisfies all of these interests starts with attention to detail. Lighting plays a defining role in creating continuity throughout the property – a high-impact moment in the lobby, easy-to-understand controls in guest rooms, and meticulously tailored event spaces that reflect the client's unique vision.



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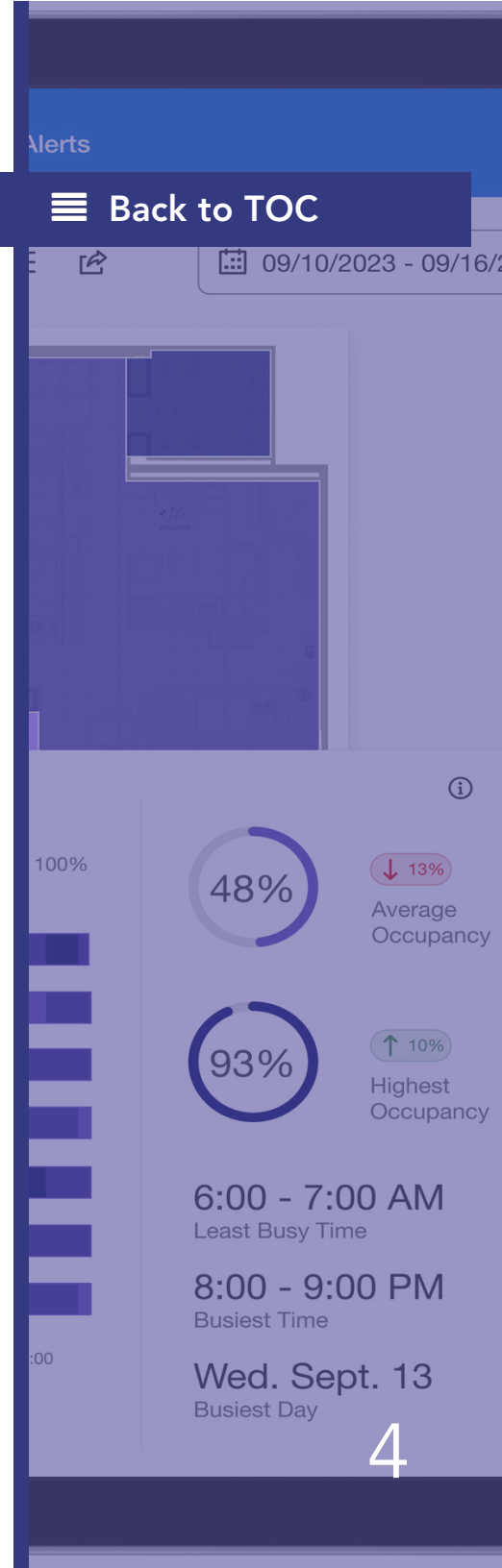
Focus on the guest experience

Luxury hotel guests come seeking a comfortable escape, a productive workspace, or the perfect setting for a once-in-a-lifetime celebration. Each guest is connected by the expectation of a curated luxury experience. Because lighting control is essential to crafting that guest experience, it is vital to consider the control system from the beginning of the project process.

Prioritize systems that simplify day-to-day operations and deliver specialized lighting for public areas, event venues, and guestrooms. Lighting can be a valuable differentiator and an effective marketing tool for creating and promoting destination spaces. High-performance LED lighting and granular, fixture-level control options give event coordinators the power to deliver on their clients' dreams with lighting that changes to match event schedules.

Natural light is a coveted amenity. In many properties, the same expansive windows that embrace daylight and highlight views may also cause uncomfortable glare or heat gain. With the proper control system, lighting and shades can be integrated under a single umbrella, working together seamlessly to draw daylight into a space, adjust automatically with the rhythm of the day, and preserve views while still shielding guests from harsh daytime sun.

Jerry Inzerillo, the former CEO of the Forbes Travel Guide, once said, "When the guest has to think, luxury ends." In that spirit, look for systems that help eliminate complexity and improve the guest experience at every level. Room controls are often the first and only time a guest might interact with the lighting, so it's crucial that both the overall lighting system structure and touchpoints like keypads immediately make sense to a



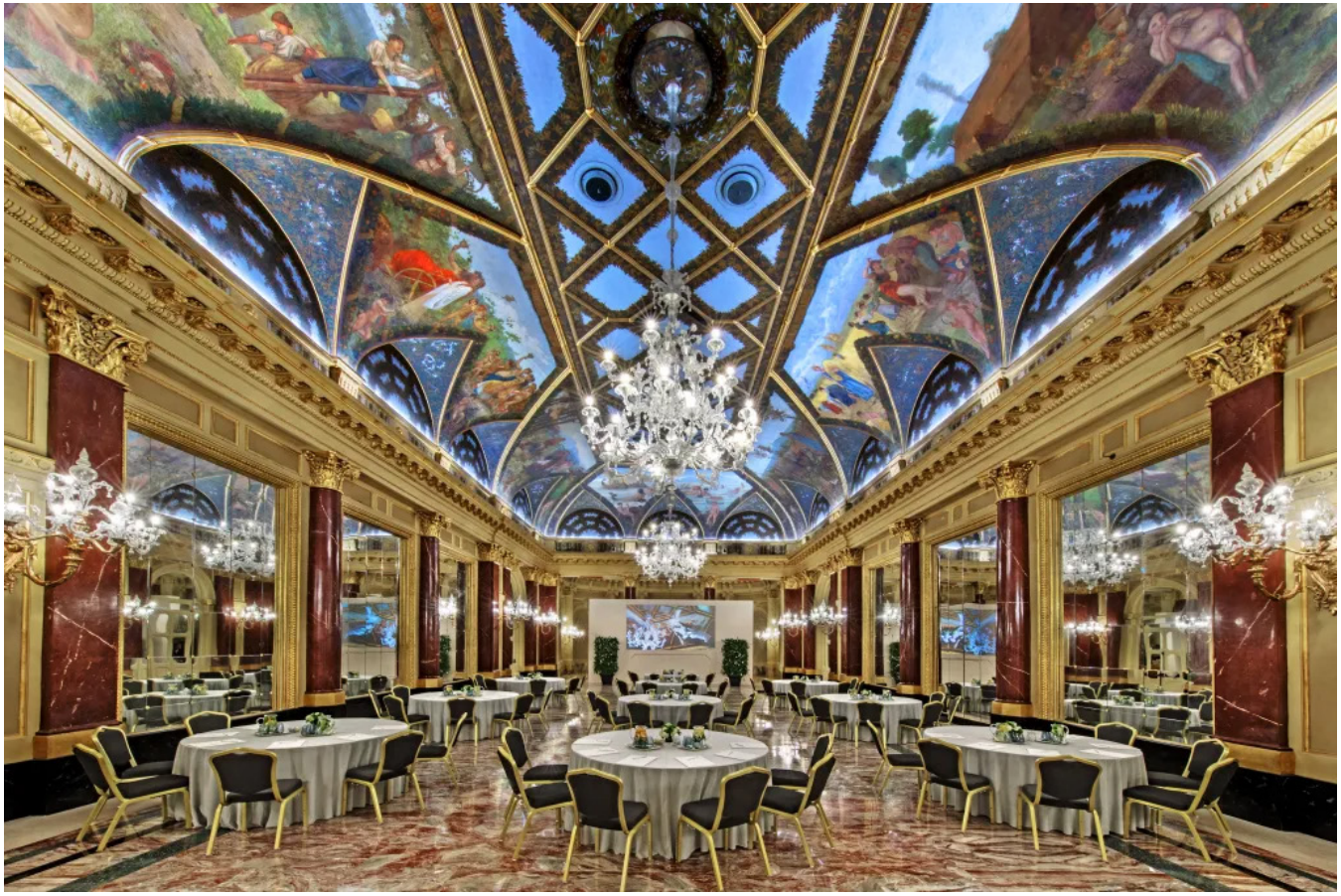


Figure 1: Ensure guest check-in is a positive experience, no matter the time of day, with automated lighting and shading scenes to enhance natural light while reducing glare. Courtesy Lutron.

wide variety of guests. For multi-property brands, owners will appreciate controls that offer the same look, feel, and operation anywhere in the world.

Customized, in-room keypads must provide immediate and easy access to lights, shades, and temperature without the guest having to figure out which control is which or struggle to turn the lights off once they've settled in for the night. Each time a guest has to think about how something works, a bit of

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Figure 2: Sofitel Rome chose custom Lutron Palladiom keypads embedded into the bed's headboard so guests can turn all lights off without getting up. Matched to the headboard's cream leather, the keypads disappear into the room design. Courtesy: J-Ph Nuel-Gilles Trillard, Lutron

comfort gets sacrificed. Those same controls should seamlessly communicate with the front desk and housekeeping to ensure rooms are serviced in the least intrusive way.

Beyond manual options, smart systems that offer automated controls, app-based programming, and scene-setting tools allow lighting designers to craft a lighting personality with pre-programmed scenes that activate throughout the day and create specialized light shows for any occasion. These details can drive loyalty and revenue in a highly competitive space.

Cloud connectivity

A cloud-connected system provides secure sign-on from smart devices, allowing the facilities team to analyze occupant and energy data, make changes from anywhere, and create distinct lighting scenes for any event without impacting the standard programming.

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Owners increasingly rely on system data for actionable insights that support business goals and simplify operations. Sensors throughout the building, or embedded in individual lighting fixtures, can monitor occupancy and daylight patterns. The lighting control system can then provide valuable occupancy data and accurate lighting usage information to help reduce energy use, improve lighting performance and drive a positive guest experience. Cloud-connected software is also a boon to owners with multiple properties who want to manage them all from a single sign-on.

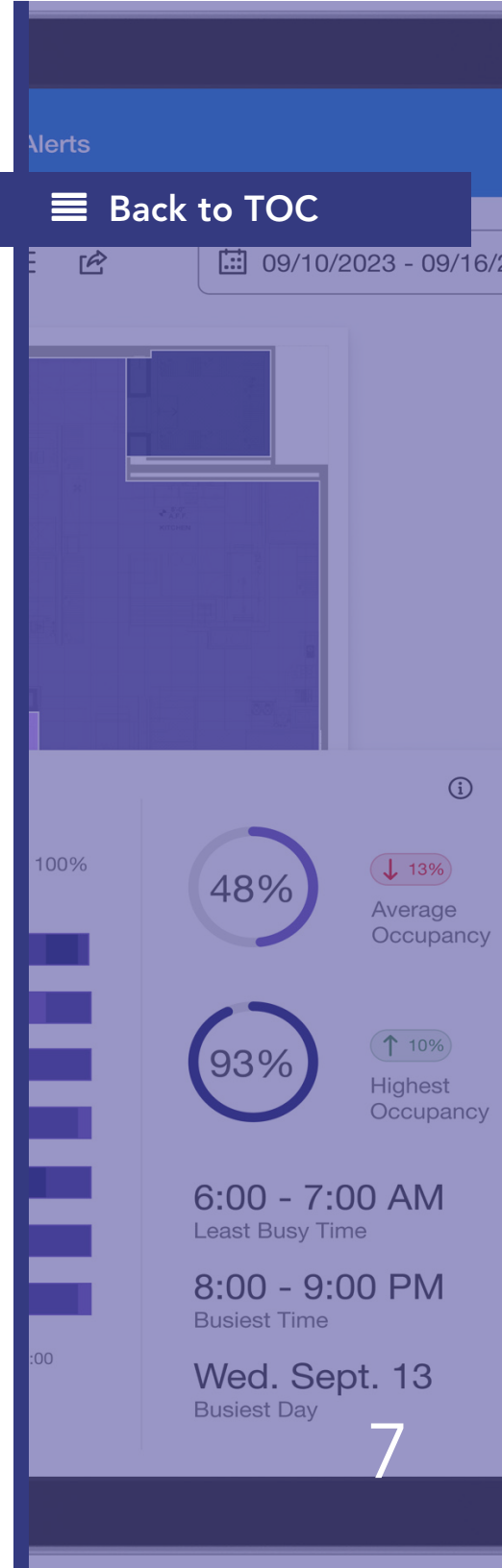
While connected technology is a paradigm shift in lighting control, it is commonplace in people's everyday lives. Today's personal technology comes with the expectation that functionality improvements are delivered frequently and seamlessly via the cloud, improving functionality and lengthening product life. In this way, the control system gets more robust over the life of the system as new capabilities are just a cloud update away.

Templating tools save time and reduce errors

Systems with templating software can help lighting designers save time on-site and complete projects more efficiently. Once guestroom lighting is programmed, the software can replicate settings to all similar room types. This technology also allows facility teams to easily adjust all rooms of the same type simultaneously. Templates can standardize design, software updates, and programming time to help reduce person hours in the final stages of a project, which is an especially significant win when the team is racing to open a property on a tight deadline.

Smart guestroom solutions simplify maintenance

Staffing remains a challenge, even as luxury business and leisure travel continue to grow. Smart building systems can help alleviate the pressure on busy hotel employees



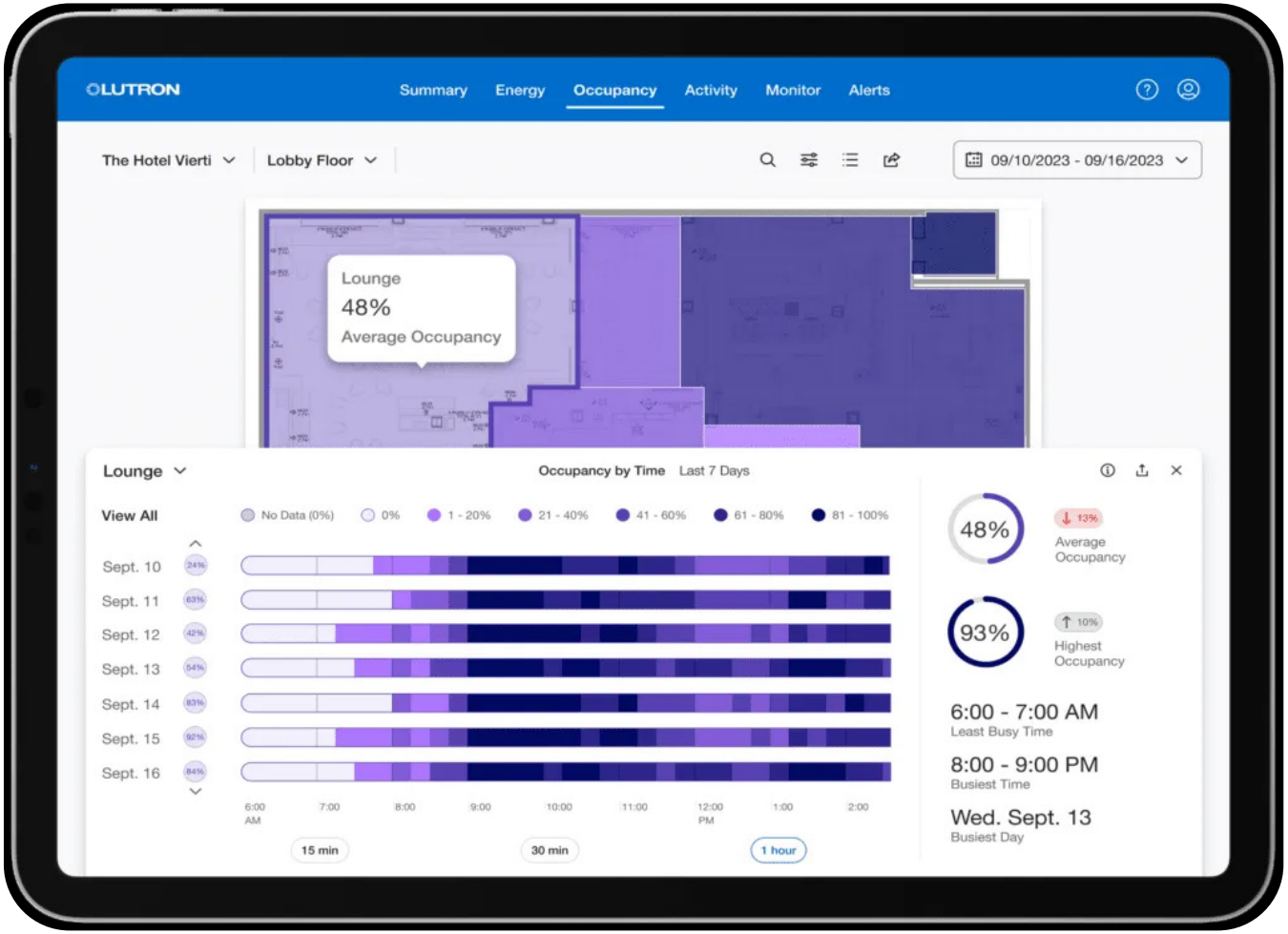


Figure 3: Occupancy data shown in a single, intuitive dashboard gives owners the information they need to make adjustments that enhance their space. Courtesy Lutron.

while ensuring guest satisfaction. They can also reduce maintenance costs and prevent rooms from being out of commission, which is often a costly problem for hoteliers.

Energy consumption analytics can indicate a malfunctioning occupancy sensor or a clogged air filter, and automated alerts make it easy to identify a faulty light fixture, a

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malfunctioning HVAC unit, or a stalled shade. With the proper lighting control system, these problems can be addressed quickly without being flagged by housekeeping – or worse, a guest.

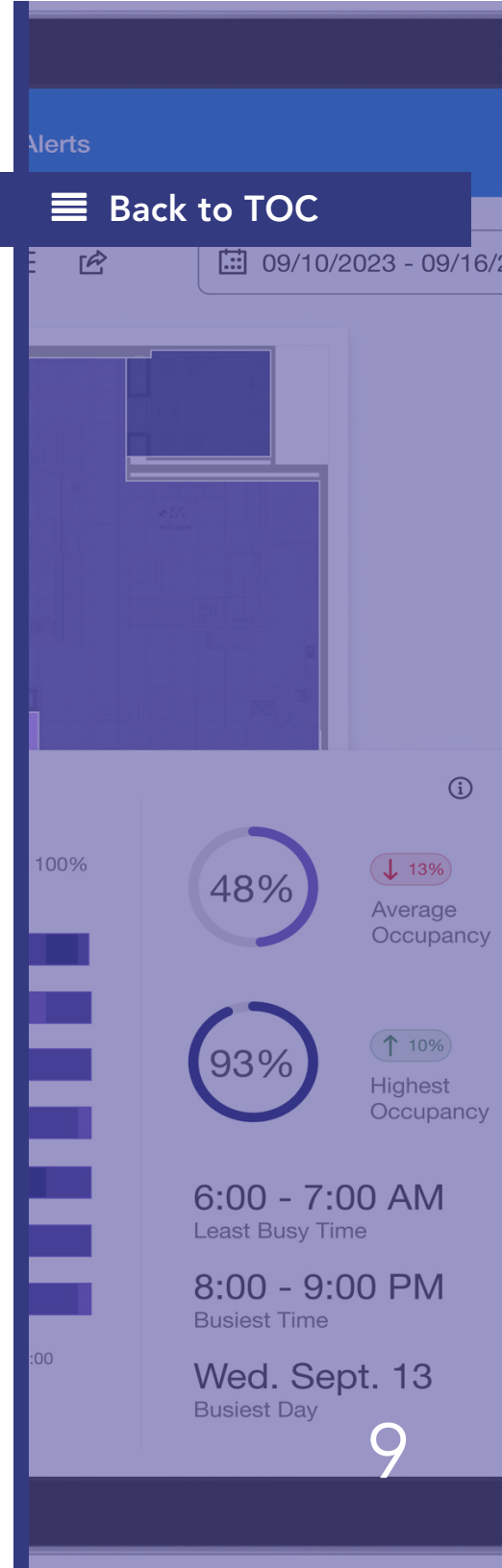
Integrating controls with rapid-response systems can help streamline and simplify housekeeping and maintenance schedules by indicating the right time to service a room and providing a consistent experience throughout the hotel or across a brand's properties.

Design for sustainability

A connected system can give property managers the data they need to make informed adjustments and quickly react to changing occupancy or use patterns. Operational decisions can be made based on energy and occupancy monitoring as well as nuances like seasonality and other factors that may be overlooked without the benefit of powerful system analytics. These strategies can help control costs and reach energy and sustainability goals in the property without negatively impacting the guest experience.

Even more important than codes, regulations, and energy efficiency is the human experience. From the lobby to the guestroom, lighting can raise the bar on luxury, delivering a high-end environment, an aesthetic that complements any brand, and a property that guests will return to again and again.

Ana Maria Huertas Iragorri
Ana Maria Huertas Iragorri, MBA, LEED AP, *is the Global Hospitality sales director at Lutron Electronics*



How to specify emergency lighting controls under new standards

Understand how to approach revised UL listing requirements when specifying emergency lighting controls.

Lighting controls have revolutionized energy efficiency, user experience and architectural expression. Occupancy sensing, daylight harvesting, dimming, color temperature tuning, individual luminaire addressing and third-party system integration are some of the countless advancements since the invention of the light switch by John Henry Holmes in 1884. While it can be easy to focus on these exciting advancements, occupant safety and code requirements cannot be overlooked.

The need for emergency lighting is common in today's built environment. Various International Code Council (ICC) building codes, NFPA standards and Underwriters Laboratory (UL) standards have been adopted that address these needs so occupants may safely exit a building during a power loss.

A simple and robust approach has been to provide continuously illuminated "night lighting" connected to the emergency electrical system, yet this approach wastes energy, may be unsightly and may overuse luminaires. Modern lighting controls provide a more elegant and automated approach to synchronize emergency lighting control with normal lighting, allowing for a homogenous look, energy savings and an improved user experience without compromising safety.

Though each application is unique, this article overviews a pragmatic strategy to integrate emergency lights with modern control systems that may be relevant to common scenarios.

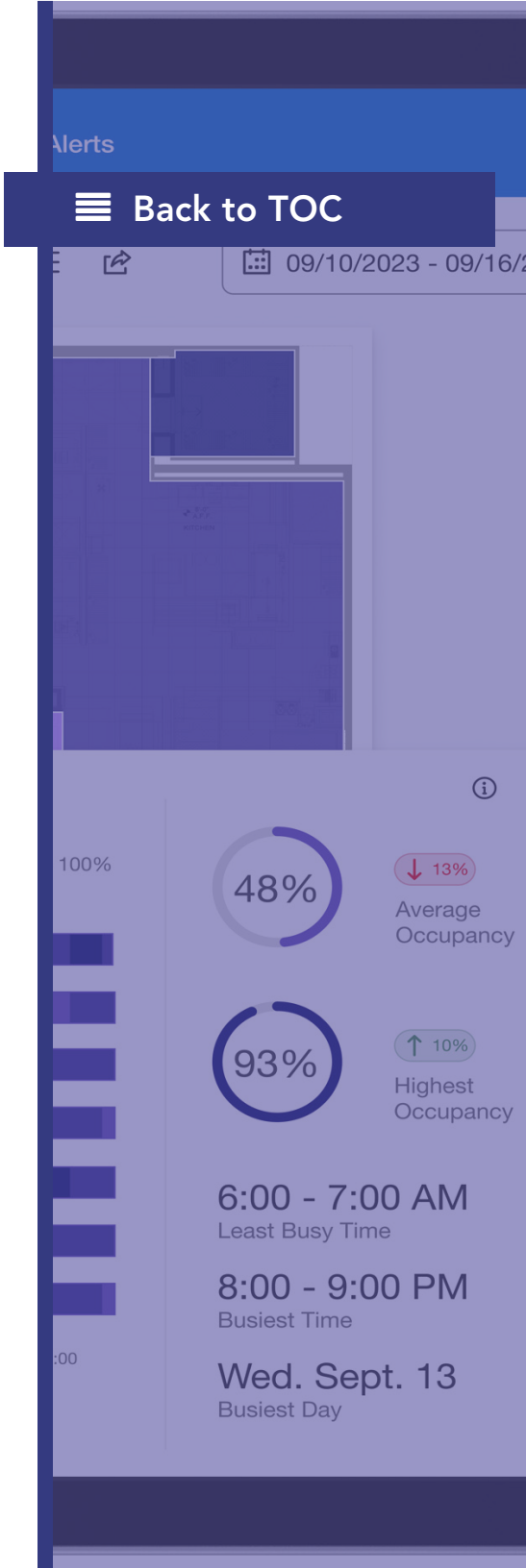


Figure 1: An example of a listed ELCD. The scale of the device and threaded hub permits straightforward installation into a standard one-half inch knockout. Courtesy: HDR, Inc.

Changes in emergency lighting codes

Effective May 6 2022, there was added language to UL 924 requiring emergency lighting control devices (ELCDs) to monitor the "branch circuit associated with its controlled loads." This is a change from the 2020 language that requires ELCDs to, "monitor the input signal referred to in 47.2(c) for the branch circuit associated with its controlled loads."

This added language is significant as it closes a gap among various emergency lighting control code requirements and product listings. An exhaustive review and interpretation of these code requirements is outside the scope of this article, but specifiers and facility owners should understand these requirements when evaluating a lighting control system.

Long standing UL 924 interpretations allowed lighting control manufacturers to obtain listings when normal power from the utility or a panelboard was monitored instead of from the branch circuit. Due to this updated UL language, products not monitoring the

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normal branch circuit can no longer be listed and cannot be used to automatically control emergency lighting, in accordance with NFPA 70: National Electrical Code (NEC). It is important that the emergency lighting controls are evaluated against code and listing requirements to ensure a safe and effective design.

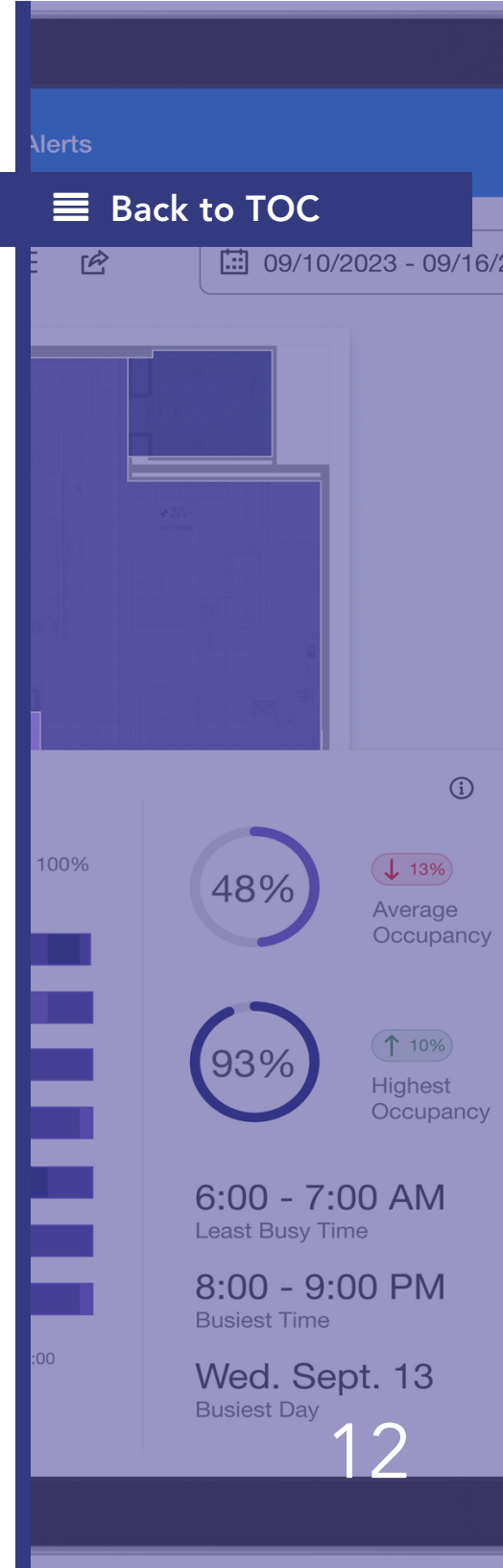
2021 NEC language:

700.26 Automatic Load Control Relay. If an emergency lighting load is automatically energized upon loss of the normal supply, a listed automatic load control relay shall be permitted to energize the load. The load control relay shall not be used as transfer equipment.

Emergency lighting recommendations

The following recommendations are applicable where emergency lighting is desired to be synchronized with adjacent normal lighting (i.e., either dimmed or switched together as a single "zone"). This strategy is common in public spaces such as lobbies, large conference rooms, ballrooms, public corridors or other applications where unswitched emergency "night lighting" would be unsightly or prohibitive. The authority having jurisdiction should be consulted to verify local requirements.

Several manufacturers offer properly listed products to automatically control emergency lighting with adjacent normal lights. These devices "listen" to both normal branch circuit availability and control input to synchronize normal and emergency lighting control. With these products, the emergency lights are always powered by the emergency electrical supply and the lighting control system wiring is separated by dry contacts within them. Upon loss of normal branch circuit power, these devices automatically



latch closed and disconnect the control input, raising the emergency lights to full output, regardless of local switch, dimmer or control position.

Many products are available that are agnostic to the lighting control system, yet careful selection is necessary to ensure compatibility with the desired control protocol. Figure 1 depicts an example device intended for a ceiling plenum installation adjacent to a remote lighting controller.

Additionally, several lighting control system manufacturers offer proprietary solutions. Though each manufacturer's solution is unique, it's critical to verify that each component is individually UL924 listed and that the overall system meets International Building Code (IBC) and NFPA performance requirements.

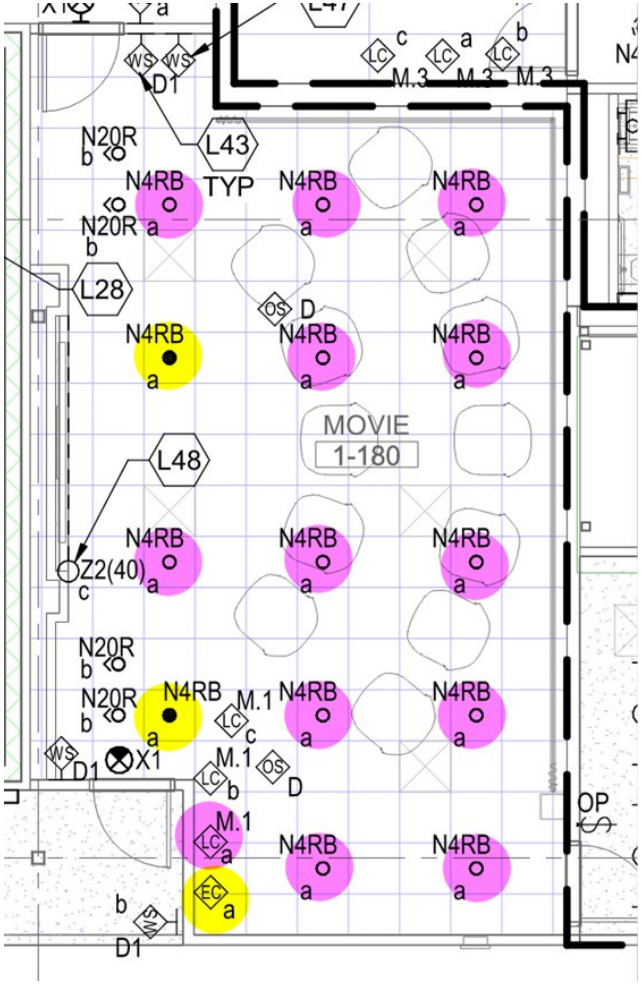


Figure 2: Example of annotating common control of normal and emergency lights (zone 'a'). Magenta highlights for normal lighting and yellow highlights for emergency lighting are provided by the author for emphasis. Courtesy: HDR, Inc.

Based on the revised UL language, these devices can be tricky to specify and confusing to evaluate during the submittal review process. Following is a strategy to assist the design and construction teams in providing a compliant solution:

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- On the lighting plans, annotate lighting control zoning to include common control of normal and emergency lighting. Figure 2 depicts a generic example where lighting symbol subscripts indicate common zoning.

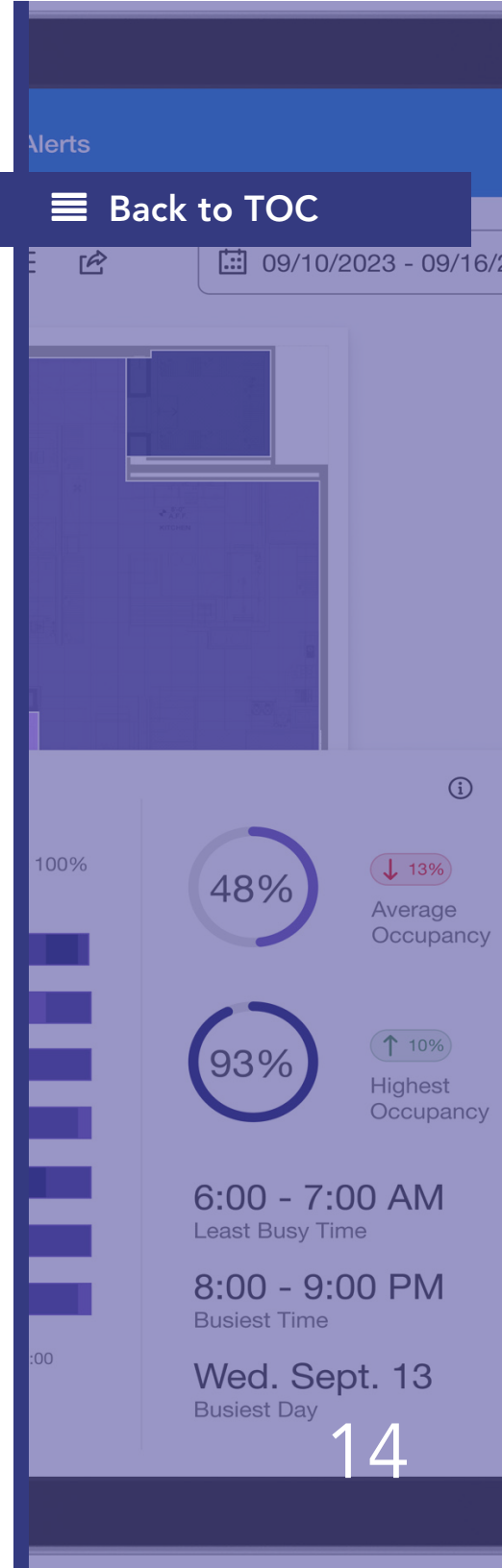
- Supplement emergency lighting control zoning with a schematic of a UL924 listed product. This diagram is useful for electrical contractors to understand the design intent and the obligation of providing individually listed products. During submittal review, this diagram is used as a basis of design for evaluation. Figure 3 depicts an example schematic.

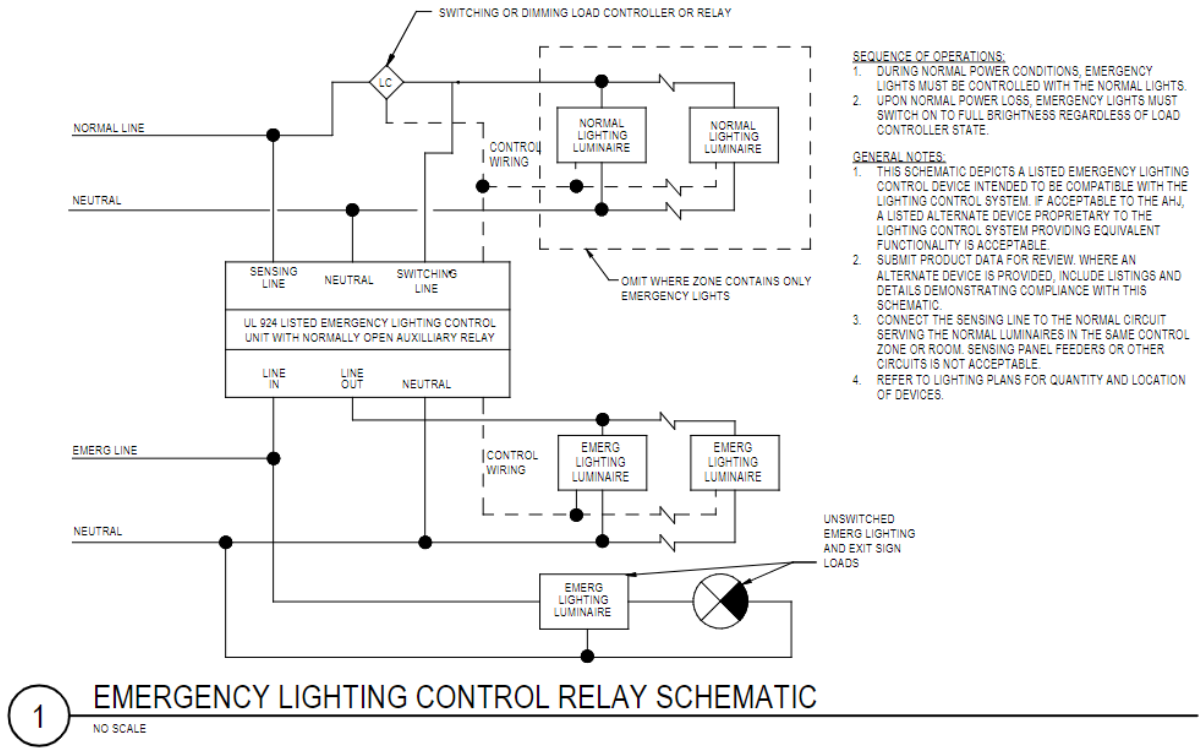
Analysis of the code

NEC article 700.26 permits listed controls to automatically energize emergency lighting upon loss of normal power. This practice is common and familiar among lighting control system manufacturers, electrical contractors and inspectors. Each lighting control manufacturer's solution varies from localized ELCDs to systemic "head-end" strategies, either wired or wireless. Of concern is each product's UL labeling and compliance with the emergency lighting performance requirements described in the IBC and NFPA 101.

Some manufacturers rely on a "phase loss" device that monitors normal utility or panelboard power and transmits a signal to activate a systemic emergency override sequence. In these systems, if a normal phase becomes disconnected due to a fault or utility outage, designated "emergency" relays are automatically latched closed and any dimming is reset to full output or other preprogrammed level.

Previous UL 924 language permitted these lighting control systems, "phase loss" devices and "emergency" relays to be individually listed because UL's previous requirement





to monitor normal power was interpreted as normal utility or panelboard power. Though previously compliant for UL, this "head end" monitoring disregards potential faults at a branch circuit, posing a safety hazard. Additionally, this strategy does not meet the emergency lighting system performance requirements described in NFPA 101 and by the IBC since normal power serving individual spaces is unmonitored. The updated UL requirement for ELCDs to monitor the "branch circuit associated with its controlled loads" aligns product listing requirements with these other IBC and NFPA requirements.

Figure 3: Example UL924 listed ELCD schematic. A sequence of operation and clarifying notes reinforce a code compliant design intent. Courtesy: HDR, Inc.

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Lighting control system manufacturers have been forced to react by removing the UL924 listing from their systems where the associated normal branch circuit is not monitored. However, these systems remain marketed as having been evaluated by UL or meeting the intent of UL924 without specific listing or labeling, which can be misleading and confusing. Regardless, to meet the NEC, each device controlling emergency lighting must be listed and labeled by a nationally recognized testing laboratory such as UL.

Continuously illuminated "night lighting" has been a tried-and-true method to meet the IBC and NFPA emergency lighting requirements. Fortunately, modern lighting control systems can incorporate ELCDs capable of synchronizing normal and emergency lighting control for improved aesthetics, efficiency and user experience. Revised language in UL Standard 924 adds specific listing requirements for ELCDs to monitor normal lighting branch circuits, not the overall utility or panelboard. Specifiers should carefully evaluate their application's emergency lighting control strategy to verify each component controlling emergency lighting is UL924 listed and labeled, and the overall performance meets IBC and NFPA requirements.

Eric Rushenberg
Eric Rushenberg, *Sr. Lighting Designer, HDR, Omaha, NE*

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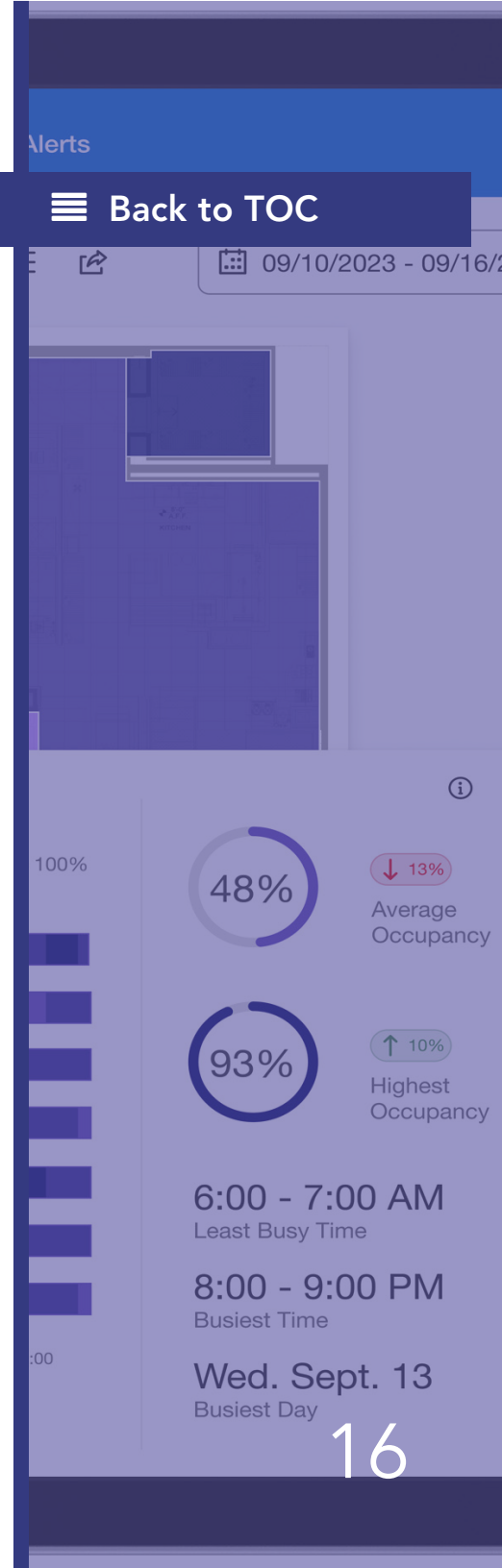

Compare emergency illumination systems for life safety

Emergency illumination and lighting designers need a basic understanding of the various emergency lighting systems and how they compare

There are many methods available to energize emergency illumination for egress in a commercial facility. Regardless of the source of power, the primary codes one must be familiar with and adhere to are NFPA 101: Life Safety Code, International Building Code, NFPA 70: National Electrical Code and additional source dependent NFPA standards. When other project requirements such as fire pumps, elevators or owner preferences do not steer the source of power decision-making, batteries are an attractive option.

According to NFPA 101, Section 7.8.2.1, there are three common and reliable forms of battery topology used in emergency lighting applications: general-purpose light fixtures with battery backup, a centralized battery inverter system and unit equipment with self-contained batteries.

For general-purpose light fixtures with battery backup, specific light fixtures within a space are designated as emergency fixtures. An emergency LED driver with an integral battery will be provided for each designated fixture. When normal power is lost, the designated fixtures are provided with backup power from the battery and will remain on.

A centralized inverter is similar in function, yet there will be a larger localized battery providing power to many designated light fixtures, similar in topology to a standby generator.

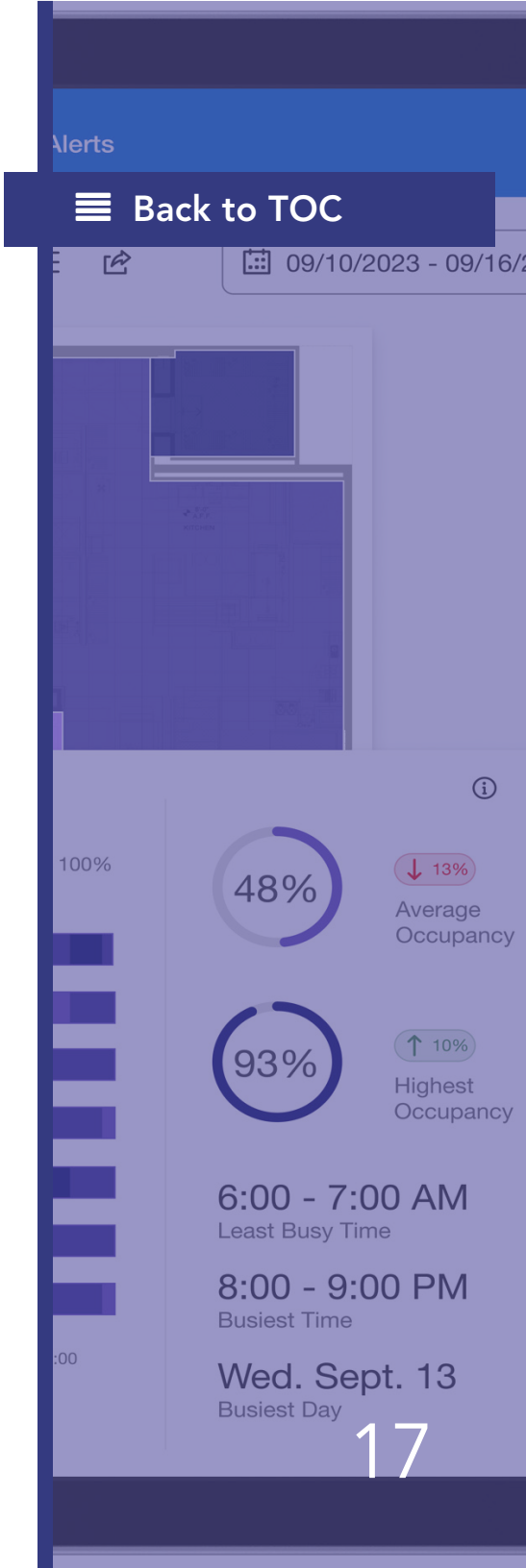

Figure 1: Wall-mounted unit battery equipment. Courtesy: SHP

Unit equipment is different in that they are additional fixtures provided for the sole purpose of emergency illumination and do not provide any general lighting per NFPA 101 Section 7.8.2.2. They have self-contained batteries within their housing and are known colloquially as bug-eyes.

Emergency illumination cost

Cost is a common driver in the emergency illumination decision-making process for the owner. A cost analysis shows a centralized battery inverter system makes more economic sense on large-scale projects with high fixture counts, where integration with advanced lighting controls is needed and where low yearly testing/maintenance cost is desired.

Labor rates play a bigger role when specifying a centralized system due to emergency lighting branch circuits being separate from general lighting branch circuits from source to load per NFPA 70 Section 700.17. Unit batteries are a better bang for your buck on smaller projects including renovations, addition or new construction with low fixture counts, where labor costs are high. The cost for general lighting with battery backup typically lands snug between these two for Day One costs.

Lifetime cost of ownership for emergency illumination would include routine testing, maintenance and replacement of batteries. These costs accumulate for a large facility

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with emergency batteries distributed throughout a building and should be weighed against the larger Day One costs of a central system.

Emergency lighting aesthetics

Emergency lighting does not quite fit into the architectural formula of aesthetic lighting design. Their expectation is that they will have to choose between a bad or a worse option. A centralized system is the more aesthetic option as it is likely to be hidden behind the doors of an electrical closet. Thermoplastic unit equipment is not likely to clash with the visual appeal of most maintenance facilities, but would likely stick out in a premium or minimalist architectural space (see Figure 1).

There are options for concealed unit equipment that are recessed and hidden behind what looks like an access panel and drop down to present themselves when normal power is lost. General lighting provided with backup batteries blend into the space, but the same is not true of their associated relay test buttons (see Figure 2).

Figure 2: Test button and LED indicator provided for the adjacent general-purpose downlight fixture with battery backup. Courtesy: SHP

This small single-gang sized device with a test button and LED indicator is only a potential problem for premium and minimalist architectural spaces. Typical emergency illumination manufacturer specifications allow for these test switches to be as far as 50 feet away from the light, which may allow for careful consideration in placement if necessary.

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Performance of emergency illumination systems

Despite all operating on batteries, these systems can perform differently while still meeting the minimum time requirement of 1.5 hours (see NFPA 101 Section 7.9.2.1). Knowing the difference is key to designing a code-compliant system. The centralized battery system provides full rated output for the entirety of the 90 minutes.

The biggest performance weakness of a centralized system is in its name, it is a single point of failure. Unit batteries can present a challenge when balancing the maximum-to-minimum ratio of 40:1, according to NFPA 101 Section 7.9.2.1.3.

When general-purpose light fixtures with battery backup are specified, one must keep in mind the reduced lumen output when powered from the battery. A standard 2×4 troffer provided in a 12-foot ceiling may be specified at 4,800 lumens. A standard 10- or 14-watt battery pack provided for backup would provide something close to half the normal lumen output. This reduction is critical to keep in mind when performing photometric analysis for emergency egress illumination. Additionally, its lumen output declines throughout the 90-minute period that it is fed from the battery. While a degradation in lumen output is allowed within the code (NFPA 101 Section 7.9.2.1.2), it is something to be aware of. There are both high wattage and constant output battery pack options available, but they come at a price.

Emergency illumination limitations

One potential limitation for a centralized system is space. If the goal is to use a central inverter on a smaller project, it may be difficult to find wall or floor space for the unit. Due to it being stored in a conditioned space, it does not suffer from the same limitations as the two other options that are located out where the lighting is located (see Figure 3).

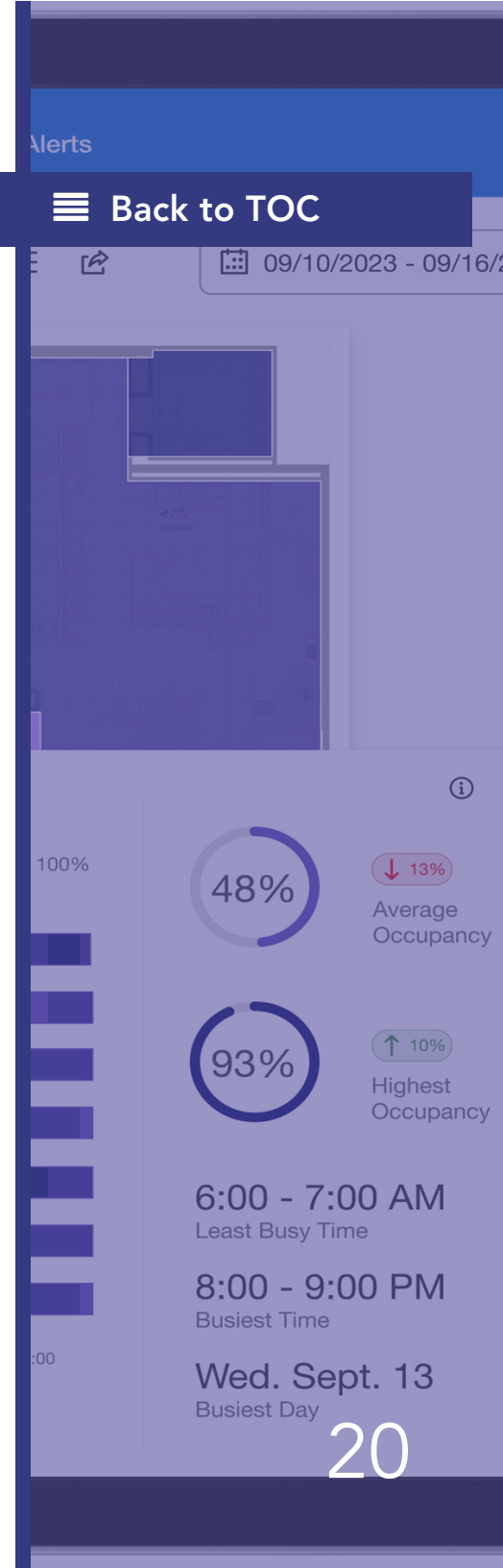

Figure 3: An installed emergency lighting inverter. Courtesy: SHP

One limitation that engineers must be kept in mind in colder climates is the temperature rating. This rating is important to be mindful of when providing exterior emergency lighting and designing with battery drivers or self-contained batteries outside. The standard low-end threshold is 32°F.

One common method for providing emergency battery backup to an exterior wall-mounted light is to locate the battery on the opposite side of the wall inside the building. A cold weather battery pack can be specified when batteries must be located outside and the temperature is a concern, but these can be pricy (see Figure 4).

In addition to the temperature, other environmental factors one would want to keep in mind when specifying outdoor unit equipment and batteries would be wet, damp or hazardous environments.

Figure 4: Exterior rated unit battery supplied lighting. Batteries are located on the interior of the building. Courtesy: SHP

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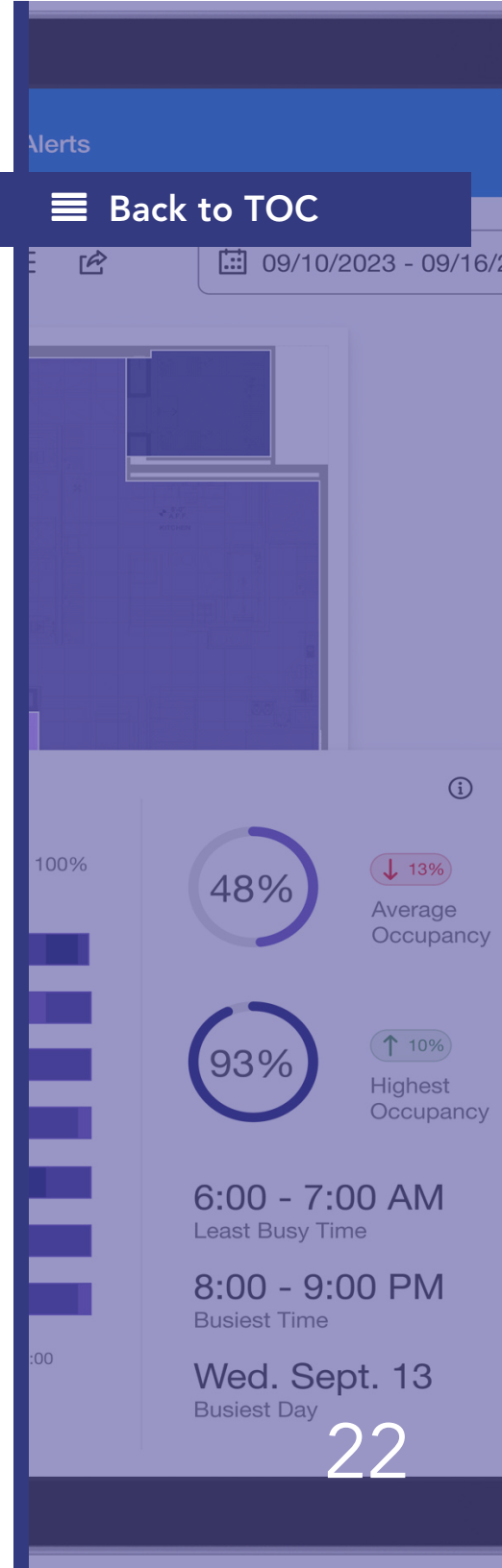
Maintenance and testing

Maintenance and testing of emergency illumination systems can be a tedious task to perform for trained personnel or staff totaling many hours for larger buildings. One benefit of a centralized inverter is that all the equipment is in a single location and should be easily accessible. The testing and reporting can be an automatic feature of the system to not require any true procedure to be performed per NFPA 101 Section 7.9.3.3.

Maintenance on the other hand, typically requires more specialized skills and is not something a commercial building's maintenance staff is often qualified to repair. Emergency drivers with battery backup provided for general-purpose light fixtures and unit equipment with self-contained batteries share many of the same benefits and downsides.

With both being distributed, the total quantity of devices to test and perform maintenance on can be overwhelming. The most budget-friendly options require a button to be pressed to indicate a status (NFPA 101 Section 7.9.3.1.1). The self-test feature is available with most battery units that will continuously display battery and light fixture status with an LED, automatically performing the NFPA required testing as outlined in NFPA 101 Section 7.9.3.1.2. This alleviates the need to be within hands reach of the light fixture for testing.

Laser pointers are a common optional feature that allow for emergency illumination system testing from a distance. Testing and reporting for general-purpose lighting with battery backup can be simplified with automatic testing and reporting by specifying driver capable of remote testing and reporting via Bluetooth. Maintenance in buildings

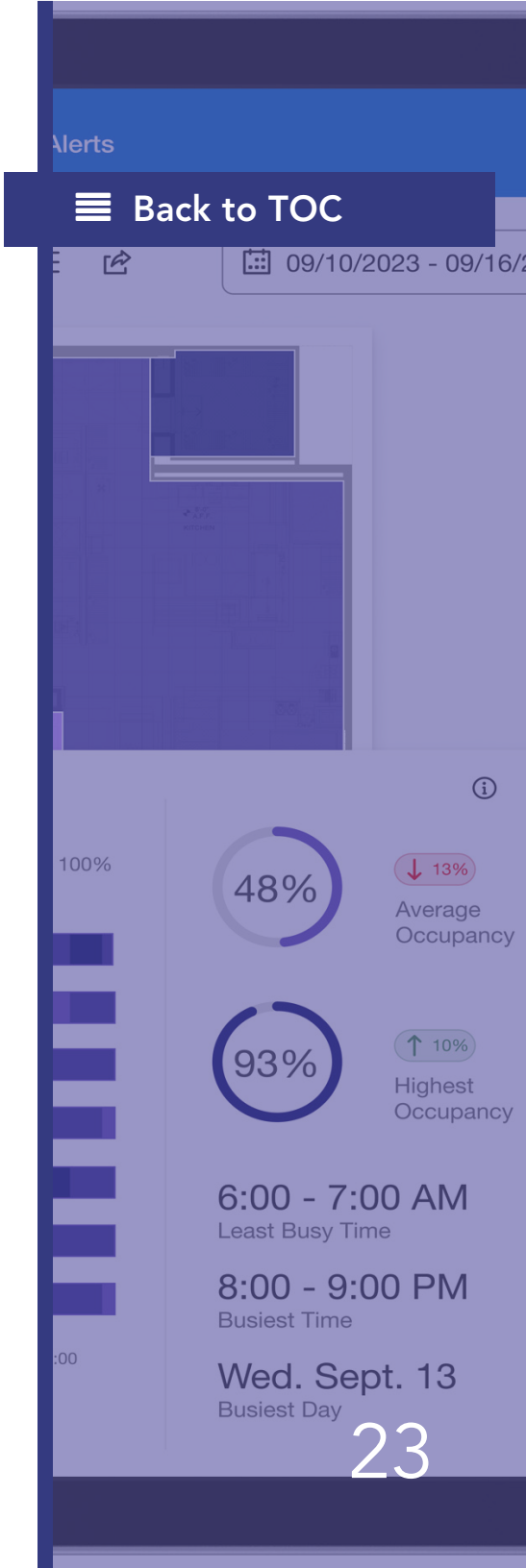


with different fixture types and many different types of batteries can be intensive. The use of general lighting with battery backup in large spaces with tall ceilings may require tools beyond a standard ladder for maintenance and testing.

The three common battery backup options are all effective when specified correctly. The best option will depend on the requirements of the project and the needs of the client. It is recommended to review these considerations early in the design process to avoid any potential rework.

Joe Faiola, PE

Joe Faiola, PE, *is a senior electrical engineer at SHP with experience in designing electrical systems for commercial and institutional projects including K-12, corporate interiors, retail and multitenant high-rises.*



Lighting: How codes, guidelines affect lighting design

Good lighting and lighting controls enhance building design, conserve energy and increase productivity, safety, security, personal comfort, sales, attendance and profit.

Good lighting and lighting controls enhance building design, conserve energy and increase productivity, safety, security, personal comfort, sales, attendance and profit. According to several government sources, up to 40% of the total energy used in commercial buildings is used for artificial lighting.

In lighting, one size/type does not fit all. LEDs in particular have gained prominence in lighting design for their energy efficiency, holistic lighting options and operational savings. LED retrofits can save 40% or more energy when compared with traditional light sources such as incandescent, halogen and high-intensity discharge.

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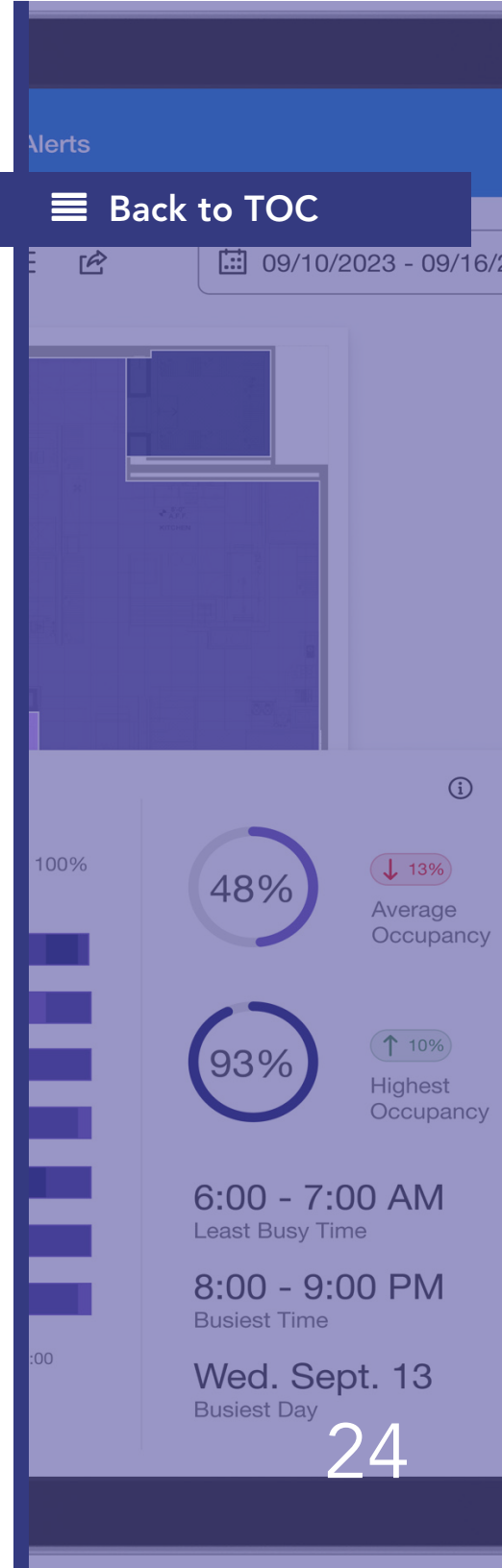
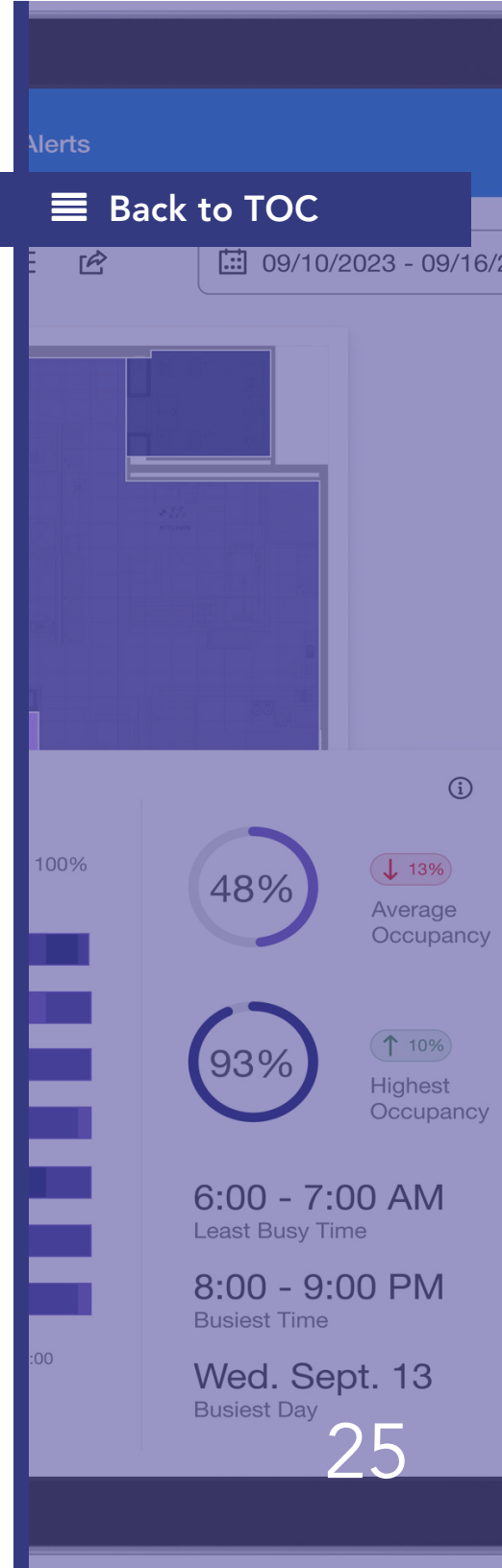


Before starting any lighting design specifications, several resources must be considered, which will be presented at this session. Engineers also should seek third-party objective sources for information on and comparison of directionality, efficacy and other properties.

Presenters

- Barrett Newell, LC, Associate IALD, Senior Associate, Lighting Design, CannonDesign, Boston
- Michael Chow, PE, CEM, CxA, LEED AP BD+C, Principal, Metro CD Engineering LLC, Columbus, Ohio

Consulting-Specifying Engineer



Case study: Laboratory combines lighting and life safety lighting

To save money, designers connected select light switches to a power source for life safety purposes

SmithGroup was tasked with designing the lighting for a laboratory renovation for a major university system located in the Midwest. Because it was a laboratory, target illuminance within the laboratory space was designed around a 50 footcandle (fc) average at the work plane.

Rather than designing separate egress lighting, it was more cost-effective to connect select light fixtures to a life safety power source than to provide separate dedicated emergency lighting fixtures.

Paired alongside the egress lighting circuit was the use of a UL 924, which allows the egress lighting fixtures to be controlled together with the normal lighting fixtures under normal power operations. Upon loss of normal power, the UL 924 devices trigger and override the on/off or dimmed controls that were in effect during the normal power operation.

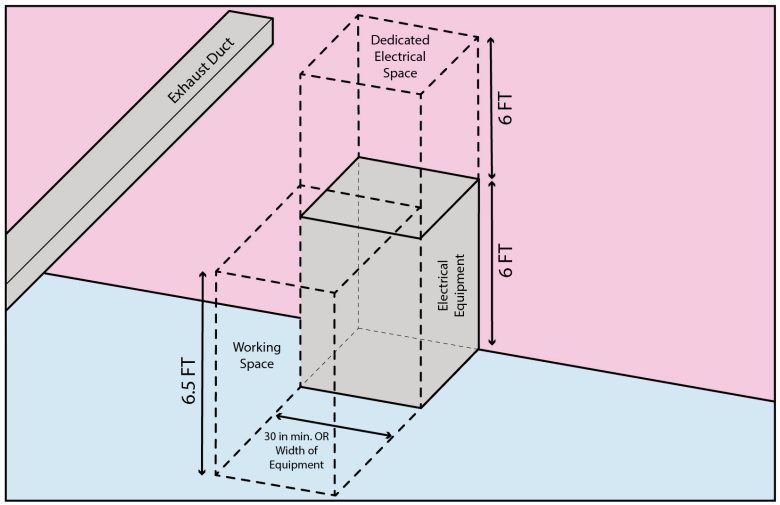
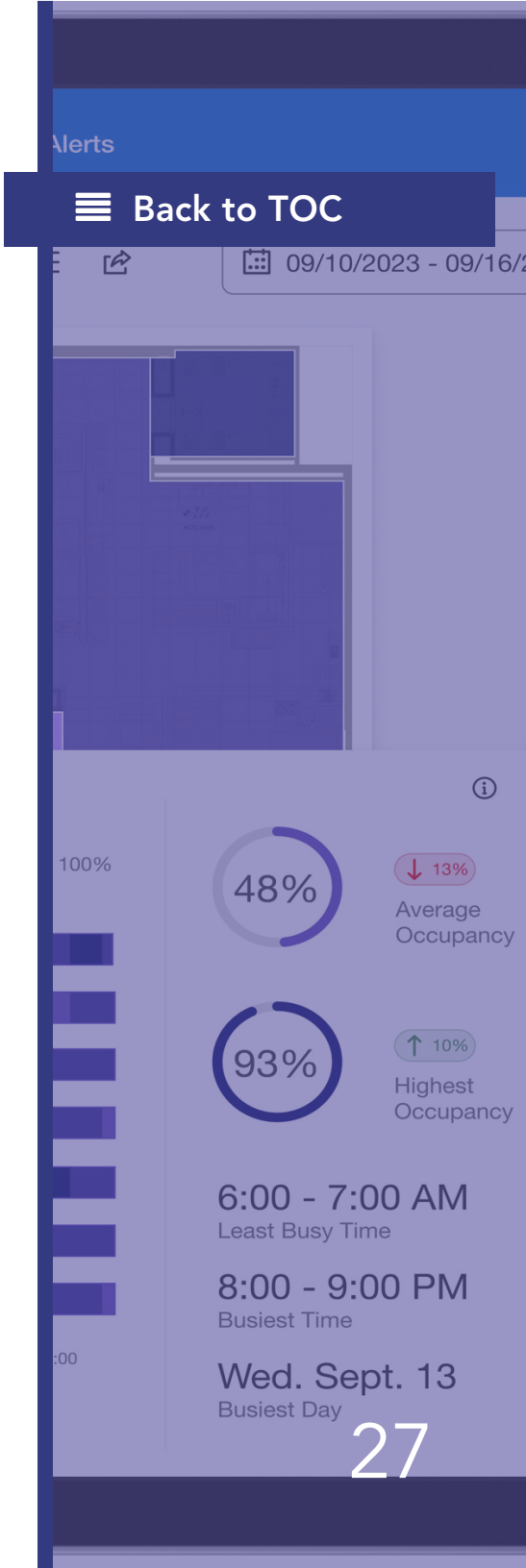


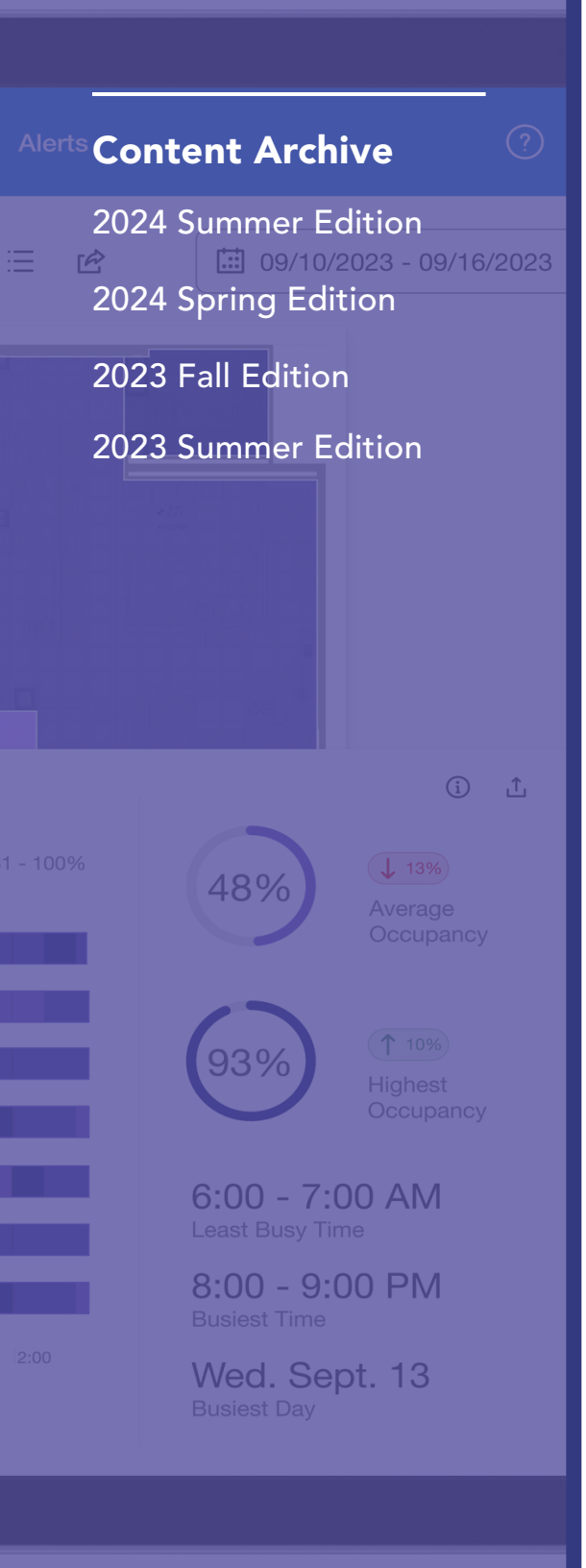
Figure 4: Lighting illuminance rendering for a lab. Courtesy: SmithGroup

In addition, the averaged maintained illuminance and the minimum illuminance along the egress pathways during emergency operation exceeded the requirements of International Building Code and NFPA 101: Life Safety Code requirement of 1 fc average and 0.1 fc minimum. The uniformity ratio between the maximum and minimum illuminance values also exceeded the requirement of 40:1.

Brian Rener and Jacob Clatanoff

Brian Rener, PE, *is Mission Critical Leader and Principal at SmithGroup. He is a member of the Consulting-Specifying Engineer editorial advisory board.* ***Jacob Clatanoff,*** *PE, is Project Electrical Engineer at SmithGroup.*





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