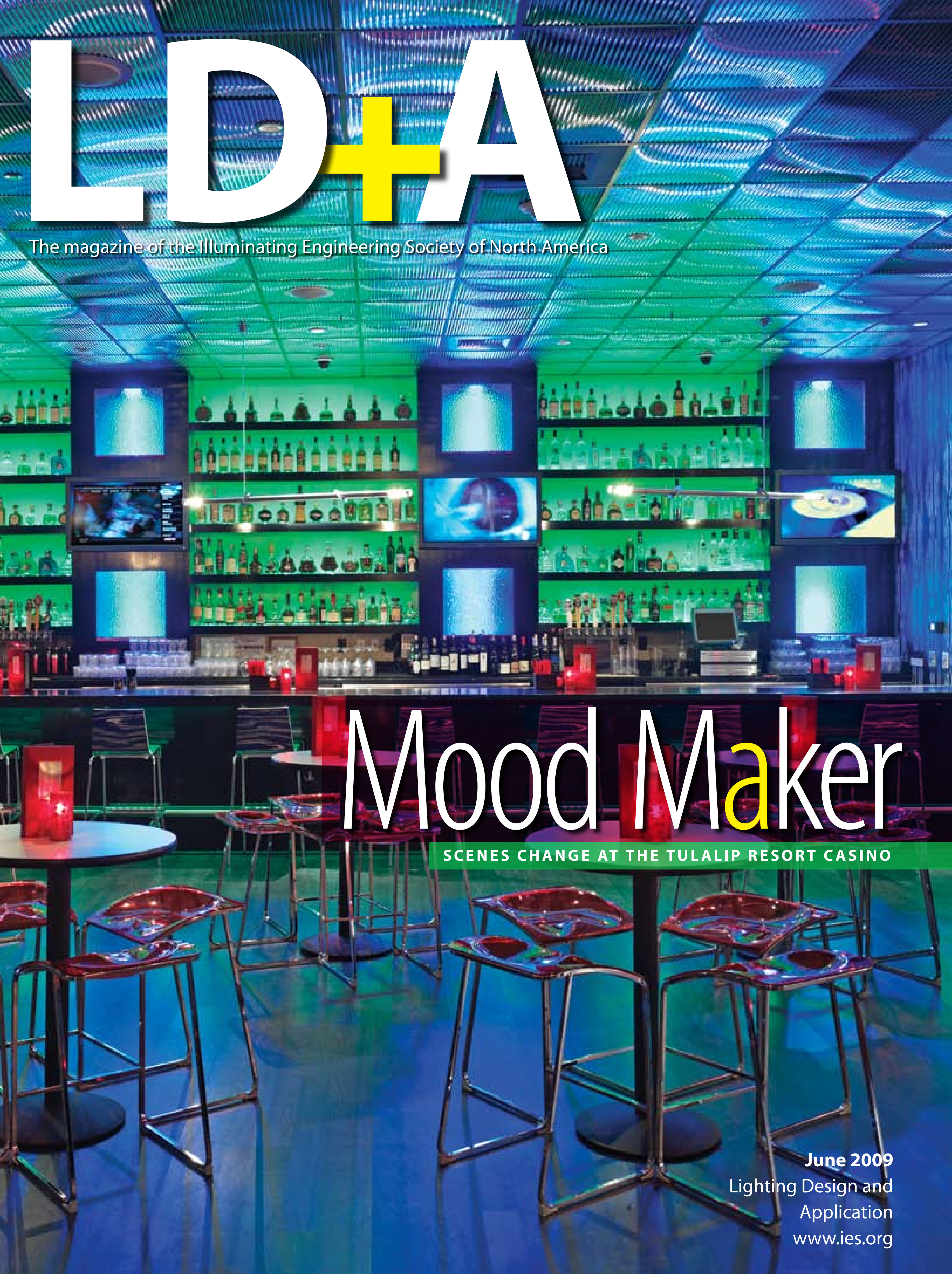

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Mood Maker

SCENES CHANGE AT THE TULALIP RESORT CASINO

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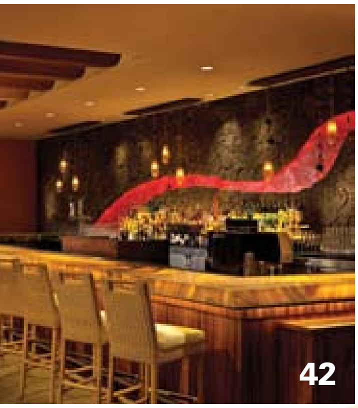
HOSPITALITY LIGHTING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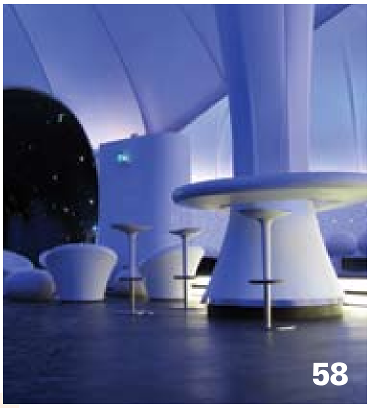
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ON THE COVER:
Colored light is always in sync at the Tulalip Resort's Mpulse lounge (p.36). Photo courtesy of Nexxus Lighting.

The DC Lighting Alternative

BY BRIAN T. PATTERSON AND PAULA ZIEGENBEIN

Lighting specifiers, of course, are familiar with the need to save energy. Reduced lighting power density is often desired by the client and more likely required by new code or energy guidelines. The requirements imposed by these increasingly stringent measures can come at a cost of reduced design freedom, reconfiguration flexibility and future upgradeability.

Part of the underlying problem is that we are trying to use a 20th century power infrastructure to meet 21st century building challenges. While nobody wants to relive the 100-year-old battle between Edison and Westinghouse, we do need to recognize that today's buildings house a complicated and often wasteful maze of disparate electrical sources, and use devices that aren't always in sync with each other.

THE BASICS OF POWER

Power is typically distributed as AC (Alternating Current) electricity, while most devices (electronic fluorescent ballasts, controls and now solid-state lighting) use DC (Direct Current) electricity to do their work. Most alternative energy generators (photovoltaic panels, wind turbines, fuel cells and battery back-up systems) natively produce DC electricity.

One of the subtle obstacles facing almost every advanced lighting technology is that electrical circuits for electronic devices such as ballasts, controls and LED drivers must include power conversion capability to transform AC branch distribution voltages (typically 120-277V AC) to low-voltage DC power. While this process is fairly simple, it adds cost and can reduce the power efficiency of the devices themselves.

State-of-the-art high-efficiency fluorescent lighting takes an efficiency hit because electronic ballasts have a front end that converts AC input voltage to DC voltage. Electronic ballasts require DC voltage to efficiently drive fluorescent lamps at high frequency as well as to facilitate dimming, programmed starts and other digitally managed tasks. Typical AC to DC conversion efficiencies range between 85 percent and 92 percent.

Although the focus of this article is lighting, our industry is not alone. All digital devices used in commercial buildings have the same issue—they are DC devices operating in an AC environment. The problem, thus, affects computers, printers, cell phone chargers and other personal-use devices, as well as basic building controls, sensors, HVAC actuators, security systems and A/V systems. Digital devices have increasingly become a larger portion of the fixed building's use of power.

The situation is not much different for new types of power generation, such as site-based photovoltaic (solar), wind or other renewable energy sources. The native DC power generated by these sources must be converted and synchronized with utility-based AC power. This comes at a higher initial investment cost for inverters, isolation, controls and noise filters, and a significant operating efficiency loss.

An alliance of more than 30 companies, including many in the lighting industry, is leading the creation and deployment of a new power, control and device-level technology standard for commercial interiors, developed around the distribution and use of safe, low-voltage DC power

STREAMLINING CONVERSION

But there is an alternative. It is an option that particularly favors the use of solid-state devices like electronic ballasts, LED light engines, and digital or solid-state lighting controls. Taking the form of a hybrid distribution layer of low-voltage DC power, it does not replace AC in a building, but complements it. The goal is to aggregate or eliminate multiple AC to DC device-level conversions, thereby making devices simpler, safer, more efficient and more flexible in use.

There are two reasons to add DC:

1. ***Efficiency.*** Both alternative power generation and device consumption becomes more efficient with the consolidation or elimination of poor and highly fractionated power conversion.

2. ***Cost.*** More and more devices, like electronic ballasts and LED drivers, are native users of DC power, and therefore can be easier, more cost-effective and more sustainable to build when designed for direct connection to DC power.

There are also two reasons for low-voltage power:

1. ***Safety.*** Low-voltage power allows use of greatly simplified and less expensive Class-2 wiring, according to the NFPA National Electrical Code, and device protection greatly reduces spark and fire hazards and eliminates shock/startle hazards.

2. ***Flexibility.*** Low-voltage power allows for "hot-swap" plug-and-play connectivity that can be embedded into existing building infrastructure elements, such as suspended ceilings, modular furniture, modular walls, floor systems, etc.

Figure 1 represents a typical ceiling-based plug-and-play DC system.

Couple these power benefits with capabilities offered by either digital RF (e.g., ZigBee wireless) or power line carrier (PLC) device controls, and the result is a new platform with the promise to deliver near-wireless capability all around, eliminating the need for battery-powered switches and controls.

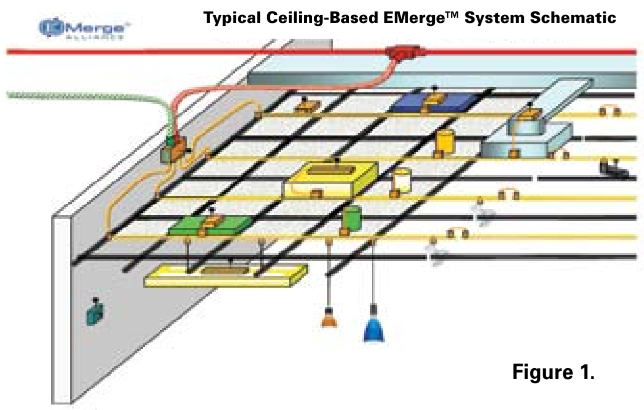

Figure 1.

By providing convenient direct access to safe power, such a system could:

1. Make it easier and less expensive to install lights and other devices and to repurpose them in renovations without re-wiring.
2. Help future-proof and dramatically reduce upgrade costs for new technologies such as LEDs.
3. Promote sustainability with simpler system devices that have fewer materials (no AC-DC conversion circuitry) and with reuse of interoperable, plug-and-play devices.
4. Facilitate the direct connection and more efficient use of energy from solar, wind or other native DC alternative energy sources.
5. Allow facility technicians to quickly and safely move or re-install devices without the need to shut down branch power lines or significantly interrupt occupants.

To fill in the blanks on a couple of technical issues, it's important to know the following:

- To avoid resistive power losses in a low-voltage DC system, run lengths are likely to be kept purposely short and wire gauges generous.
- Offsetting the wire gauge and additional conductors for bus structures needed to achieve plug-and-play flexibility, no ground wire would be necessary and control signal wire could be all but eliminated.
- Class-2 power limited circuits can only carry 100VA according to NEC limits, so DC circuits are likely to be deployed in spider or hub-and-spoke wiring topologies rather than traditional home-run linear branches used in line-voltage AC systems. DC power feeds from renewable energy sources are likely to use Class-1 wiring due to their higher voltage. These feeds should be able to bypass centralized DC-to-AC inverters, filters and isolation switches and go directly to decentralized DC-DC step-down devices to feed local busses.

AN ALLIANCE

To address this set of goals and challenges, there's work to be done before industry players can all be singing from the same sheet of music. What's needed is a combination of commitment, cooperation and coordination between like-minded companies in the fields of commercial building power, control, infrastructure and devices toward the development of an open industry standard.

Having worked behind the scenes on this concept for the last several years, a group of companies recently announced the creation of the EMerge Alliance. The founding members were Armstrong World Industries, Johnson Controls, Nextek Power Systems, OSRAM SYLVANIA and WAVE. Now involving more than 30 companies, including many in the lighting industry, the Alliance is leading the creation and deployment of a new power, control and device-level technology standard for commercial interiors, developed around the distribution and use of safe, low-voltage DC power.

Membership to the Alliance is open, with tiered rights and privileges. Representation is given at the organization level with one vote per organization, depending upon membership type.

Current work toward an EMerge standard is focused on the selective and scaleable distribution of 24-V DC power within common infrastructures already present in commercial interiors, as well as improvements in the optional use of on-site alternative energy by providing for more direct and efficient connections between these sources and interior electrical loads, such as lighting.

The belief is that this new commercial technology standard will also provide a platform for innovation to create even more energy-efficient and individually controllable devices for the future, including new forms of specialty and general lighting devices.

In essence, the Alliance is focused on the nexus of today's top priorities for building owners—energy savings and adaptability. An open, collaborative standards-based approach provides opportunities for a broad array of organizations—including manufacturers, lighting designers, engineers and owners—to get involved.

Brian T. Patterson is chairman of EMerge Alliance and general manager, new business development for the Building Products Division of Armstrong World Industries. He has also held guest professorships in business management at Long Island University and Susquehanna University.

Paula D. Ziegenbein is an applications marketing manager with OSRAM SYLVANIA, Inc., where she is responsible for driving the integration of lighting application expertise into the sales process, through the development of advanced content for sales-focused product and application training. Ms. Ziegenbein has a Bachelors of Science degree in Electrical Engineering from the University of New Hampshire, where she also concentrated in Illumination Engineering.

e-mail a letter to the editor:
ptarricone@ies.org