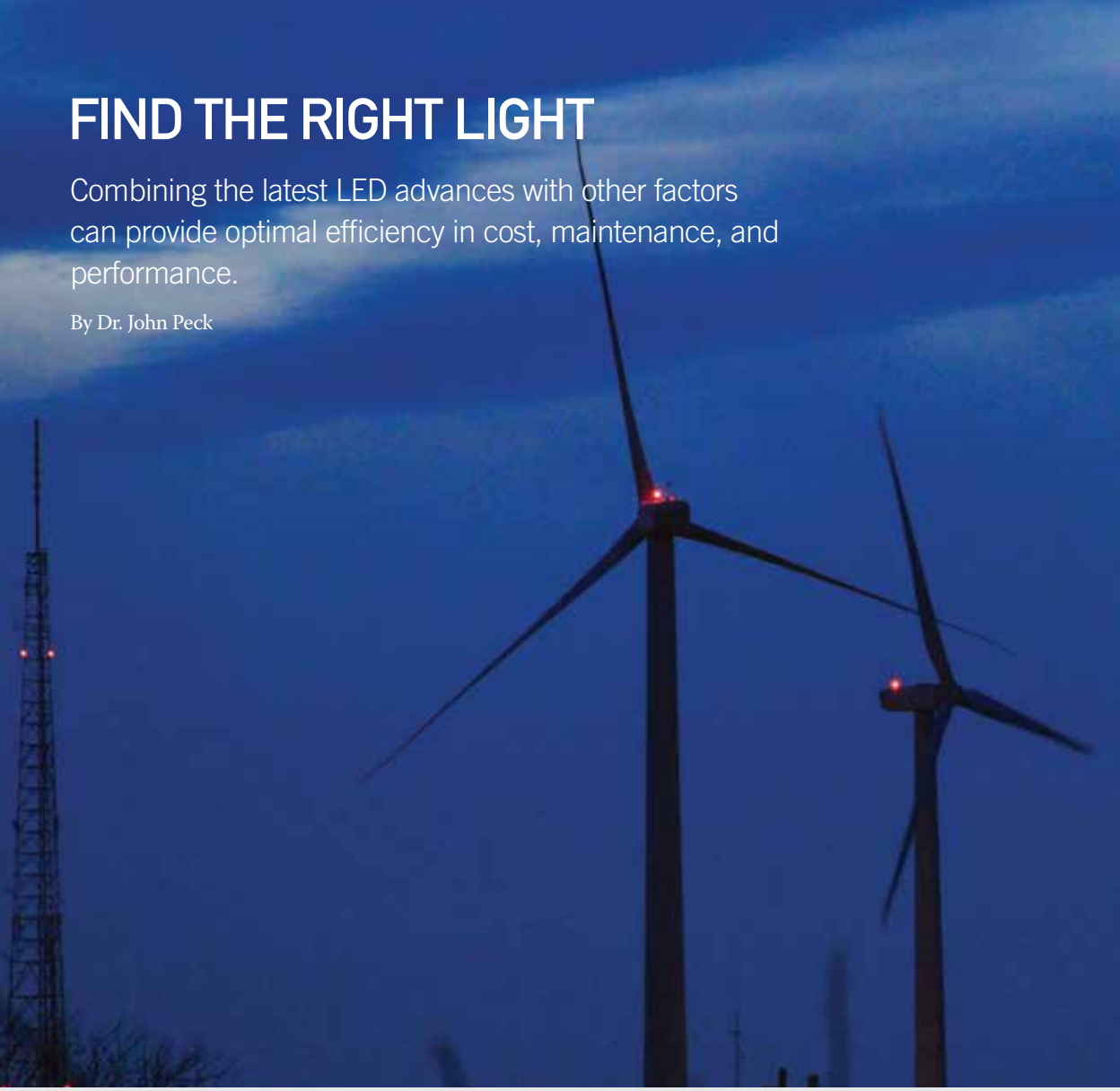
FIND THE RIGHT LIGHT

Combining the latest LED advances with other factors can provide optimal efficiency in cost, maintenance, and performance.

By Dr. John Peck



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WITH WIND POWER PRODUCTION SURGING to a new record last year and steady growth expected to continue, the need for reliable, effective, and community-friendly obstruction lighting has become a paramount concern for both the FAA and wind farm operators. LED technology has been used extensively in the wind power market for nearly a decade as a greener, more efficient, and reliable solution to FAA AC 70/7460-1K specified wind turbine obstruction lighting. New advances in longer-life, energy-efficient LED technology have made it the de facto standard for optimum performance, cost savings, and the lowest total cost of ownership.

But with new capacity on tap for construction over the next five years, and many existing wind farms due for an upgrade, operators need to know that all LED obstruction lights are not created equal. Variations in engineering design, reliability testing, product materials and even certification can mean the difference between a high-quality, long-lasting product and one that will require costly maintenance down the road.

Wind turbine beacons are unique compared to standard beacons in that each beacon light has its own internal Global Positioning System (GPS) unit and photocell. The individual wind turbines of the

farm are located at substantial distances from each other, so running control wires between beacons is not practical. The GPS units in each of the beacons receive a clock signal from the orbiting satellites. The beacons use this clock signal to set the timing of their flash sequences. All beacons flash synchronously throughout the wind farm because they all use the same satellite clock signal.

The photocells in each of the beacons measure the ambient light level in order to transition the lights on and off for the day. It is important that the beacons transition on and off at about the same time each day, so a high-accuracy photocell that is stable throughout its life is important. Avoid the standard, and problematic, photoresist-type photocells and opt for a photocell that utilizes a communication-grade silicon photodiode for maximum accuracy and long life.

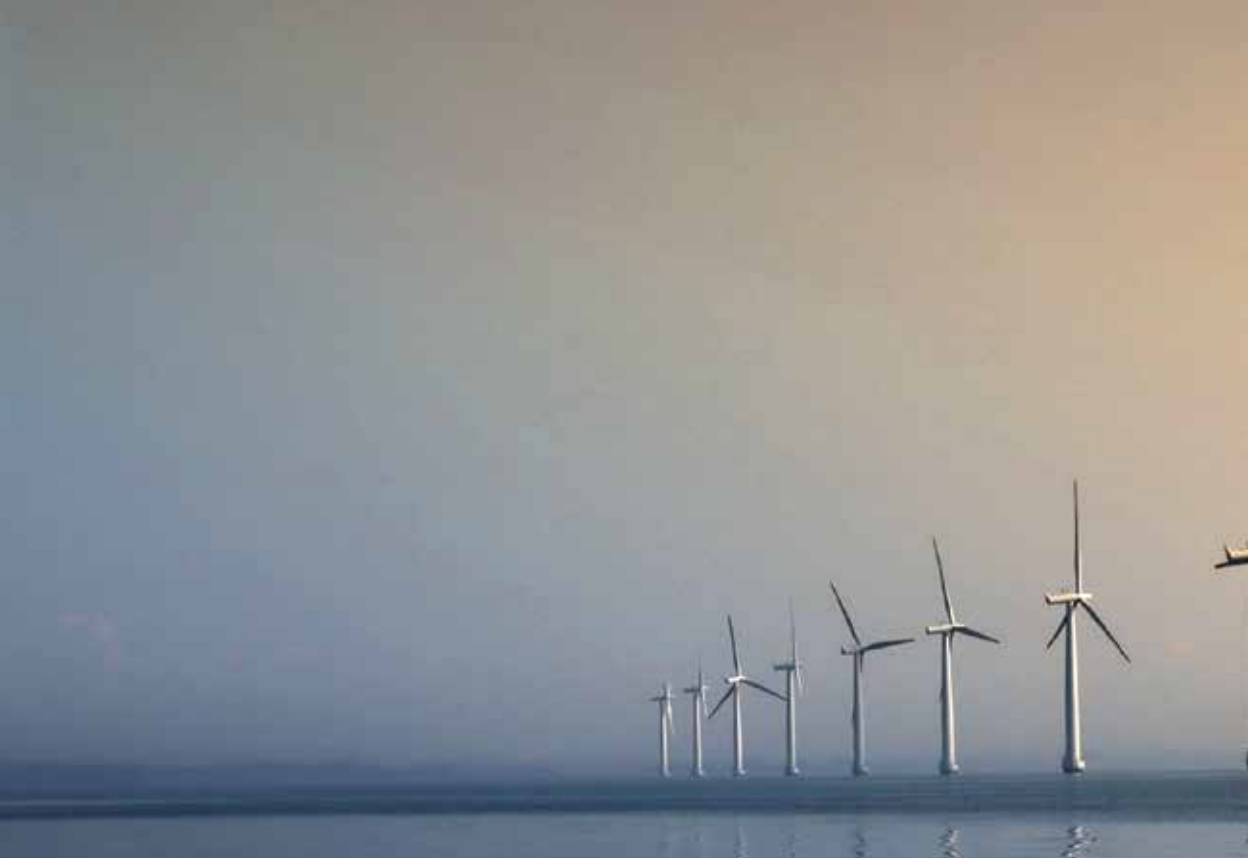
If you're thinking of an upgrade or need lighting for a new installation, here are the top ten questions you should ask any prospective LED lighting supplier to ensure you get the best product at the best value to deliver the longest life and highest return on your investment.

1. **Does the product carry the required federal and local certifications?**
   This seems like an obvious first step, but surprisingly, there are suppliers that actually sell non-certified obstruction lighting into the wind market. In short: buyer beware. In North America, the FAA, Transport Canada, and DGAC in Mexico all have established standards that obstruction lighting must meet. In many ways, this certification provides both quality and compliance assurance—a sort of "Good Housekeeping Seal of Approval." To reduce your risk in quality, reliability and compliance, purchase only LED systems that carry the required certifications. In fact, for operators with presence in multiple countries, it's wise to choose a supplier with products that meet ALL certification requirements, to streamline supply chain and provide installation flexibility.

2. **How well does the product perform in extreme environments?**
   Turbines are installed in some of the toughest conditions on earth—blistering heat, deep-freezing temperatures, and brutal winds can take a major toll on an obstruction lighting system. To ensure maximum reliability, be sure the product you choose is rated for performance in extreme temperature ranges. The FAA standard requires third-party performance testing at a range of -40°C/F to +55°C (131°F), and reputable suppliers will provide their temperature performance testing results.

3. **Does the product have battery backup capability?**
   Global certifications normally require 12-16 hours of battery backup capability on obstruction lighting to ensure failsafe operation in the event of a primary power outage. Look for a turnkey solution that either integrates, or is compatible with, standard battery backup systems to reduce your risk of unexpected failure, aviation safety concerns and noncompliance fines.

4. **How does the product design maximize the life of the LEDs?**
   LEDs offer superior long life performance compared to conventional incandescent and

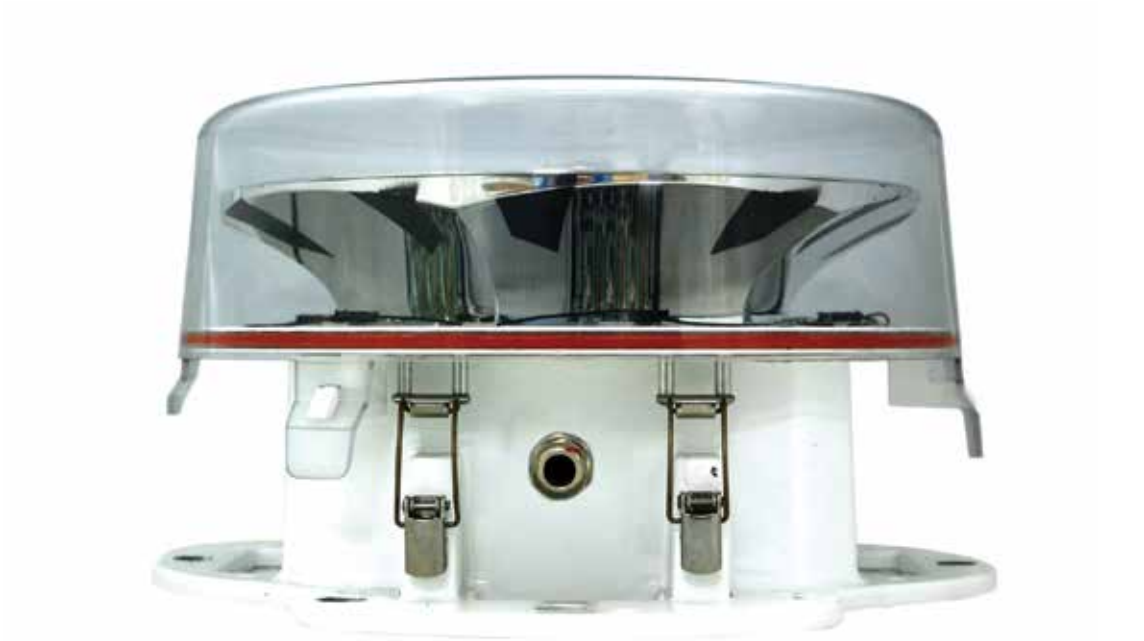


Xenon lighting, but not all LEDs offer the same lifetime. To operate at their best, LEDs require two key design considerations: thermal management and optimal drive current. LEDs produce a fair amount of heat, and dissipating this heat efficiently is a must in order to protect the fixture components and circuitry from damage. Poor thermal management within the fixture will negatively impact the performance of the system, no matter how robust the LEDs may be.

Similarly, drive current is a major concern. In order to achieve the specified light output, some manufacturers over drive the LEDs (often using off-the-shelf power supplies not intended for demanding obstruction lighting applications), which takes a toll on the components, produces excessive heat and contributes to premature failure. To maximize your LED obstruction system investment, look for a manufacturer that incorporates state-of-the-art thermal management technology and custom-designed power supplies specifically tailored for the challenging demands of obstruction lighting.

5. Do the LEDs come from a reputable supplier?
While there are many components in each LED flash head design, the actual LEDs are the system linchpin when it comes to maximum performance. It's wise to purchase a system from a company that specializes in LED design and manufacturing with a long history in the LED industry. Working with a supplier that has been at the forefront of innovation, industry firsts and achieving FAA certifications for their products will ensure the investment you make will result in a quality product that delivers on the long-life performance and durability benefits of LED technology.

LED obstruction technology has seen rapid evolution over the last decade. The first FAA certified L-864 (red strobe) system became available in 2001, with the L-865 white strobe following 10 years later. Last year, the first dual high-intensity white/red L-856/L-864 strobe achieved FAA certification per AC 70/7460-1K specifications. Like most technological evolutions, each new generation of LED fixture has emerged smaller, lighter, more efficient, and longer lasting—with most products now carrying a five-year industry-standard warranty. However, it's important to note that manufacturing processes often differ. Some suppliers are merely assemblers, putting off-the-shelf components together to build a fixture. More advanced suppliers custom-build the fixtures, including other critical components



such as those used in the power supply, giving these manufacturers much greater control over the system to optimize the design for maximum performance under the harsh conditions seen on wind turbines.

6. Is the product energy efficient?

As sustainable energy advocates, wind energy producers strive to "practice what they preach," implementing green operating practices wherever possible. It's no doubt that LEDs provide the greenest lighting solution for this green energy industry. Consuming as little as 4W on average, the most advanced LED beacons only sip electricity to minimize energy cost and the associated CO2 emissions. This not only reduces operating cost for overall bottom-line savings, but also amply satisfies sustainable practice initiatives for any wind operator. However, energy consumption among LED suppliers can vary. Look for the lowest-wattage lighting systems to minimize energy usage and maximize your savings.

7. Does the product offer adequate surge and lightning protection?

By their nature, wind turbines are highly susceptible to lightning strikes and other electrical discharges — and while the intense voltage levels that occur during strikes far surpasses the FAA's requirements for surge protection, the lighting system should be able to handle all types of electrical surges. Reputable suppliers will not only satisfy the FAA standards with a certified product, but can also produce test reports to show their products' resilience to lighting, including indirect and direct hits. Again, ask for the reports—a supplier with the credentials will be happy to provide them to you.

8. Is the flash head dome made from high-impact, UV-resistant material?

Many suppliers use acrylic material to enclose the flash head. Acrylic is susceptible to cracking from impact during installation or maintenance and hail or "shedding" of snow/ice off the rotor blades. Choose a supplier that uses high-impact UV-resistant polycarbonate material on the dome. This offers a higher IK (impact strength) rating and is more resistant to the adverse effects of UV rays. Use a lighting supplier that can apply an additional specialized "hard coat" to the dome to maximize UV protection, scratch resistance, and protection from chemical attack. This will provide about 10 years of protection out in the elements. Without this hard coating, the lens will show degradation after just a few years. It's also wise to make sure the product carries a minimum IP66 rating for water ingress protection, which is part of the FAA standard.

9. How well does the lighting system control light pollution?

The FAA specifies the minimum and maximum light intensity at zero degrees, i.e., along the horizon, for red beacons. These standards ensure

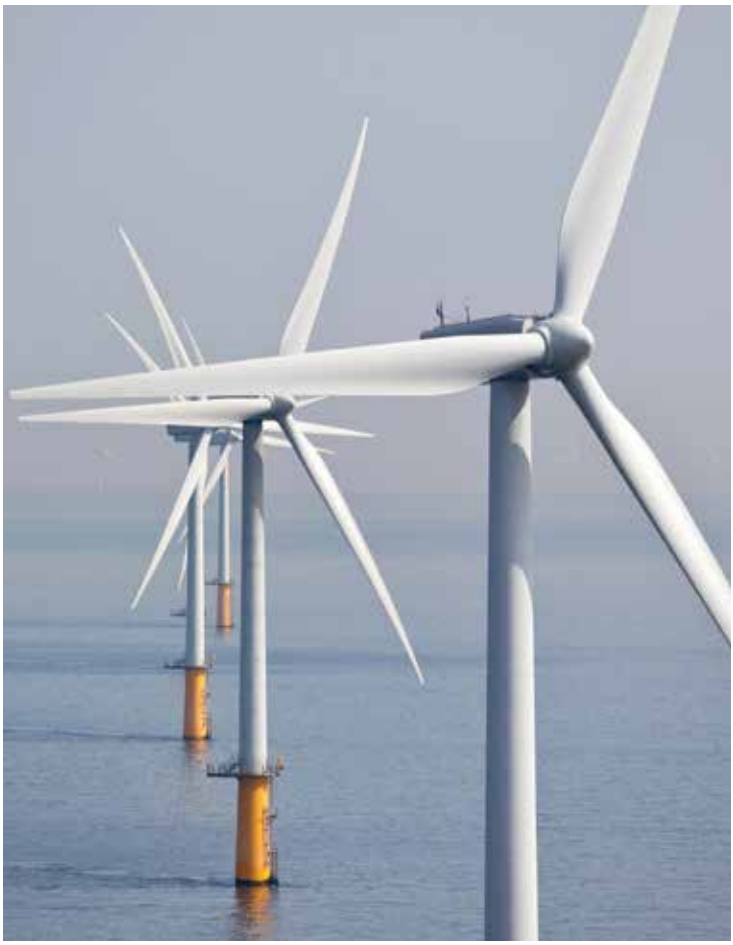
beacon lights provide the proper lighting needed to alert aircraft pilots of obstructions in their flight path. However, the FAA does not specify any limits on the maximum light intensity requirements below the horizon for red beacons since this does not affect aviation safety. But, at the end of the day, complaints about disturbing flashing lights at night will go to the tower owner, not the FAA. As a result, it behooves the tower owner to evaluate the proximity of local residents to determine if light pollution may be an issue. Therefore, preventing neighbors from filing these complaints is the responsibility of the individual purchasing the obstruction lighting system. As such, it is a good idea to request light intensity distribution charts from the obstruction lighting supplier. Many suppliers will claim "community friendly" optics but some products emit more than 10 times more light pollution compared to the best products in the market.

10. Does the product have a smooth outer lens?

This might seem superficial at first (who cares what the lens looks like, right?). But, it's actually a critical factor in the durability of the flash head. Products that incorporate optic features on the outside of the dome to direct the light, such as sharp edges and contoured shapes of Fresnel lens features, are susceptible to snow/ice buildup and accumulation of dirt and debris. On the other hand, suppliers that use internal optics design can enclose their flash head with a smooth dome that is not prone to these harsh conditions.

FUTURE LED ROAD MAP TO MEET WIND POWER NEEDS

Down the road, a number of new challenges are on the horizon for the wind energy market. As turbines grow taller, the combined tower and blade circumference are beginning to exceed FAA medium-intensity marking requirements, obligating operators to install high-intensity lighting systems. To reduce neighborhood intrusion and energy consumption, there is also a movement toward incorporating radar technology into turbine lighting systems that would trigger the signals to come on only when aircraft are in the immediate area. In addition, the FAA is now recommending visible marking for Meteorological Tower (MET) installations used ahead of wind turbine construction to determine ideal turbine placement. While the current parameters call for orange/white paint schemes, guy wire sleeves and marker balls, these all must be maintained and replaced, causing many operators to consider whether signal lighting might be a better option.



From a forward-looking perspective, the very nature of the LED systems design provides much more flexibility for innovation to meet these evolving needs and specifications. The combination of maintenance savings, energy efficiency and more precise optics and controller technology of LED obstruction lighting is already providing bottom-line savings and payback/ROI in as little as two years. Coupled with a customizable design that supports a road map for continued innovation, LED lighting is certain to remain the technology of choice for the wind energy market.