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Lighting Atop Turbines Comes Into Full View

Selecting the right lighting product for your wind farm is an important decision that will affect both maintenance and operating costs.

BY PETE BRUCE

There has been an interesting evolution in the technology used in aviation obstruction lighting that is required by the Federal Aviation Administration (FAA) for marking tall structures, such as wind turbines, that exceed 200 feet in height.

The incandescent bulb, invented by Thomas Edison in 1879, is still used today to mark thousands of aviation obstruction hazards, such as towers, buildings or other structures more than 200 feet in height.

However, highly efficient and environmentally friendly technology such as light emitting diodes (LED)-based fixtures are now being installed on thousands of new air navigation hazards – including wind turbines – across the U.S.

What lighting systems do most wind turbines use? Since February 2007, when the FAA revised its standards to require only red night lights, the most common technology is LED.

The complete list of approved FAA obstruction lighting products, such as incandescent, halogen, xenon and LEDs, are listed on the FAA's Web site at faa.gov. The FAA Web site provides updated information, which the agency refers to as circulars, on marking, lighting and monitoring, as well as providing instruction on certification standards. The FAA also lists approved manufacturers, equipment and testing laboratories.

Prior to 2007, there were many xenon systems deployed, primarily because dual lighting (white lights during the day, and red lights at night) was required. LED technology did not yet exist to meet this requirement.

Lighting types

Below are examples of wind turbine obstruction lighting products, all of which are FAA-approved under the administration's Type L-864 beacons. These flashing red beacons are acceptable for nighttime marking only and operate at 2,000 candela +/- 25%. Candela is a unit of light measurement and refers to the point of light that can been seen at a distance, which, when emitted, can be seen by aircraft in various weather conditions.

> *'The FAA has strict standards for obstruction lighting on wind turbines.'*

There are three primary types of obstructing lighting technologies in the marketplace.

Incandescent. The incandescent beacon utilizes two large 620 W incandescent light bulbs to generate the FAA-required 2,000 candela. Both bulbs are required to be fully operational to meet the specification. A common misconception is that one bulb backs up the other or that the beacon is still compliant when one bulb is extinguished.

One of the advantages of this lighting type is that the initial cost of this beacon is quite low. However, the power required for operation is high (roughly 10 amps at 120 volts of alternating current), and the relatively short maintenance cycle requires a lamp change every 12 months to 24 months.

In addition, the beacon is quite large and heavy because of its cast-iron chassis and all-glass lenses. The inefficient design of the burning hot tungsten filament in the beacon bulbs consumes roughly 20 times the power of an equivalent LED fixture.

Though incandescent bulbs represent the lowest capital investment, they also have the highest power consumption and maintenance expense out of the available products.

Obstruction Lighting Products At A Glance

Technology	Warranty	Power Consumption (Watts)	Initial Purchase Cost	5-Year Preventative Maintenance Cost	Total Cost Of Ownership
Incandescent	1 Year	1,240	$1,400	$5,500	$6,900
Xenon	2 Years	145	$3,000	$3,375	$6,375
LED	5 Years	24	$3,500	$0	$3,500

Source: Flash Technology

Xenon. The evolution in obstruction lighting advanced dramatically with the xenon gas-filled tube. This, along with high voltage (more than 1,000 volts of direct current) became the standard product of choice for obstructions more than 200 feet tall.

Xenon products allowed for a substantial savings in power consumption while adding a white daytime marking option. This allowed structure owners to forgo the painting of aviation orange and white colors often required by the FAA for daytime marking.

The xenon product is well-established in all markets, including wind, telecommunications, broadcast, utilities and airports. This technology is sometimes referred to as capacitance discharge technology.

All of the components of a xenon system should be budgeted for service after two to five years of operation to extend the life of the system, while maintaining compliance with FAA regulations.

Xenon tubes require moderate capital investment and will reduce energy consumption by 84% compared with incandescent red. However, xenon tubes are complex and have many specialty parts requiring maintenance.

LED. The growing trend in marking a structure deemed a hazard to aviation navigation safety is with a fixture whose light sources are LEDs. This technology has become the standard method of lighting for newer wind farms.

A favorable return on investment is often achieved without much challenge to justify the switch to LED from older incandescent and xenon systems in service for five years or longer.

On wind turbines, LED fixtures are typically supplied as an integrated product, meaning the units come with a control mechanism, photocell for mode control, alarm and/or status advisory features, and a global positioning system device for synchronization.

Though a higher initial capital investment is required, LEDs are proven technology that provides long life cycles and the lowest maintenance expense for owners. NWP

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