Green Sports Alliance Lessons from the Field

Seattle Mariners Path to LED

Author
John Hwang, CEO, Planled

Contributors
Allen Hershkowitz, PhD, President, Green Sports Alliance
Dania Gutierrez, Project Manager, Green Sports Alliance

Project Highlights

- 579 metal halide lights were replaced with 578 GigaTera SUFA LED fixtures.
- The LED lights are 20-30 percent brighter while using 60 percent fewer watts than metal halide lights.
- The more efficient LED lights will save more than $50,000 in energy costs.
- Because LED lights last longer, there are also savings in maintenance costs over the life of the fixtures.
- LED lights can dramatically improve visibility for players on the field, fans in the stands and those watching at home on TV.
- The GigaTera system is the first in MLB to offer ultra-slow motion replay without any flicker.

Collectively, the LED installation at Safeco Field will reduce power use at the venue by 784,000 kWh each season, saving more than $50,000 in energy costs annually.

Introduction

According to U.S. Department of Energy estimates, if LED lamps displaced virtually all others by 2030, total annual lighting sector energy consumption in the United States would decrease by 60%. This would amount to more than $380 billion annually in avoided electricity costs. Such a comprehensive shift to LED lighting would also prevent the release of more than 3 billion tons of CO_2 emissions.

In our ongoing effort to help inform Green Sports Alliance members and other friends about the opportunities and challenges associated with implementing energy efficiency, the Alliance is pleased to share the following case study, reporting upon the installation of LEDs at Safeco Field, home of the Seattle Mariners, in partnership with Planled and GigaTera.

Allen Hershkowtiz, Ph.D., President, Green Sports Alliance

Project Summary

In 2014, Safeco Field, home of the Seattle Mariners, became the first Major League Baseball venue to illuminate the playing field with LED lights. The Mariners partnered with Planled and GigaTera to replace outdated high-density discharge (HID)[1] lamps fixtures at Safeco Field with state-of-the-art, GigaTera LED fixtures manufactured by KMW Inc. The project was completed in December of 2014 and lit the Mariners' 2015 season.

The 578 SUFA fixtures[2] installed each use 800 watts of power. The lighting technology that the LED fixtures replaced was 579 units of 2000W and 44 units of 1000W HID fixtures. The new LED lights are 20%-30% brighter and use 60% fewer watts.

Collectively, the LED installation at Safeco will reduce power use at the venue by 784,000 kWh each season, saving more than $50,000 in energy costs annually. The LED fixtures are also expected to last over 30-years, compared with the 2-3 year life span of the old HID fixtures.

[1] High-intensity discharge lamps (HID lamps) are a type of electrical gas-discharge lamp which produces light by means of an electric arc between tungsten electrodes housed inside translucent or transparent fused quartz or a fused alumina arc tube.
[2] SUFA is the model name of the LED system manufactured by GigaTera

Initial Project Stages

The process of shifting the HID system of lighting to an LED system began with an initial discussion about improving the “work light system” at Safeco Field. “Work lights” provide lighting for non-game activities such as landscape work or cleaning the stadium. However, at Safeco the HID “work light” fixtures could not provide enough illumination to properly cover the work areas. As a result, half of the sports lighting fixtures (267 units of 2000W HID fixtures) had to be used for approximately 600 hours per year in order to provide extra lighting for work areas.

Maintenance Challenges Associated with an HID System

Challenge #1

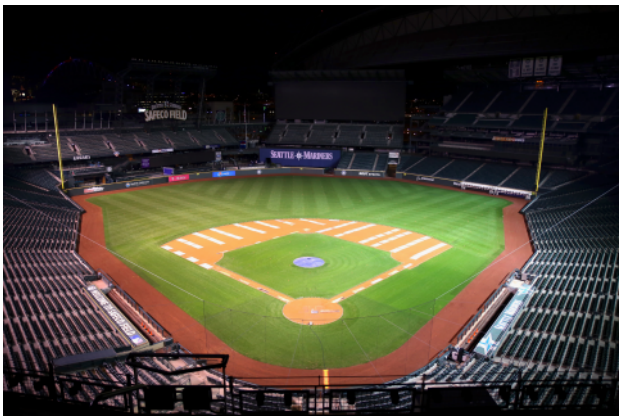
Inefficient Energy Use

The HID lighting system required a significant increase of electricity for lighting during field maintenance. Rather than using 47.5kW for the work lights, an additional 571kW of the sports lights were being used to light the maintenance activities. Because of this, approximately $25,000 was added to the original annual energy cost operation budget.

Solution

Controlled Light Level with a Uniformly Dimmable System

The dimmable feature of an LED system offers more than sufficient light for work areas with just 20% of the sports lighting system, using only 116 kW. This resulted in reducing energy use for lighting maintenance activities by 80%.



The Safeco Field LED lighting system has been audited by Major League Baseball and meets or exceeds all league lighting requirements.

Challenge #2

Meeting MLB’s Minimum Lighting Standard

When half of the sports lights are regularly used for maintenance, the short life-span of the HID lights lowers the efficacy of the units that make up half of the sports lighting system. HID lamps are known to have a dramatic reduction in light output over a short period of time, making it difficult to maintain the originally installed output. When half of the sports lights were used 600 more hours per year, it caused the imbalance of light level throughout the field. Since MLB requires a high standard of uniformity of light level in both the infield and outfield, the Mariners had to replace the HID lamps on a more frequent cycle than originally intended.

Solution

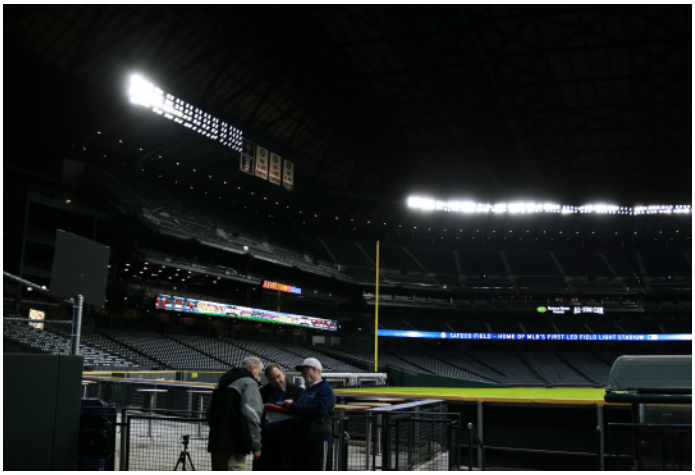
Lasting Uniformity Beyond the Lifetime of the Stadium

The U.S. Department of Energy (DOE) has established the standard for LED products in order to scientifically estimate the lifetime of LED products. The GigaTera system was tested by a DOE approved third party laboratory to ensure the longevity of the product performance.

MLB LED Lighting Audit Highlights

The MLB conducted audits of the traditional HID lighting system in April 2014 and the new LED lighting system in January 2015. In comparison to the HID system, the LED system improvement light levels across all lighting areas. Highlights from the audits include:

- 39% increase in lighting in the infield
- 28% increase in lighting in the outfield
- Overall uniformity increased by an average of 3.75%, making Safeco Field one of the most uniform ballparks in MLB
- The new system exceeds MLB's minimum lighting criteria, making Safeco Field one of the most balance and illuminated ballparks in MLB



Enhancing the Quality of Broadcasting with LEDs

HID Limitation #1: Flickering

Flickering of HID Lights at 120 Hz

All of the HID Systems for sports applications flicker at 120 Hz which is invisible to human eyes but can have a negative side effect. Veitch and McColl in 1995 found that 100-120 Hz modulation (not perceived as flicker) from fluorescent or an HID light source can reduce human performance on visual tasks, when compared to performance under light source without flickers. Poplawski and Miller (2011) point out that when event lighting requires visually intensive activities over a prolonged period of time, it should be retrofitted to a non-flickering technology.

Overcoming Slo-mo Camera Challenge

An HID system's strobing effect is eliminated with Flicker Free Technology of the GigaTera SUFA system. Broadcasted slow motion replays have been limited to 180 frames per second (fps) with traditional HID lighting systems, while properly designed LED systems can offer ultra-slow motion replay typically between 300-600 fps and up to 1,000 fps.

"All reactions I received are positive. First of all, we increased the overall light level. [With HID lighting] there were some dark spots here and there… Sometimes the pitcher's mound was too hot, compared to where the batter was so the video engineer had to do more shading. We also had to increase the light levels when the guys went into the corners to get balls. That also made it more grainy, but now we have even light everywhere...And it's really improved our ability to make nice pictures."

Mark Engelbrekt,
Seattle Mariners TV Director

LED Solution:

Non-Flickering Next Generation Technology

In order to make sure that GigaTera's new system can offer the flicker free environment for both improving playing conditions and broadcast quality, the following tests were implemented:

High Frame Rate Camera Testing at Planled Experience Center

Planled R&D Team created a replica of a baseball field and basketball court with SUFA modules to test high frame rate recording quality with camera engineers from the Seattle Mariners and Portland Trailblazers. Testing engineers confirmed that there was no sign of flicker up to 960 fps.

Field Testing at Safeco Field

Industry experts measured the flicker rate with a portable Flicker Analyzer and reported 0.2% flicker rate, lower than the suggested industry minimum standard of 2%. This is a significant improvement from the previous HID system, which had a flicker rate of 52%.

Enhancing the Quality of Broadcasting with LEDs (cont'd)

HID Limitation #2: Color Quality

Low Color Quality for HD Broadcast - HID systems lack the color content necessary for broadcast engineers to deliver realistic images for viewers at home. In order to overcome the distortion during the transmission of images, color engineers have to manipulate the recorded images with artificial painting through a digital editing process.

LED Solution

108 Red Stitches of an official MLB Baseball - Taking the color rendering index from 63 (HID) to 80 (LED), for the first time in MLB history we were able to match the onsite experience of the game to what is broadcasted to the fans at home. Players and coaches have commented that they can clearly see the movement of the ball better as white became more crisp and red stitches became clearly visible.

HID Limitation #3: Stray Lights

Issues of Glare and Light Pollution with HID - The omni-directional nature of an HID system creates unwanted stray lighting that can blind players and add to light pollution.

LED Solution

Improved Optics with Human Centric Design Strategy – The GigaTera system uses individual narrow beam reflectors to contain the distribution of light without any unwanted spill over. By working closely with MLB, Human Centric Lighting Society and the Lighting Design Lab, the design team was able to spread out the cluster of concentrated glares. This optimized the playing condition for the players and the vertical views from all camera positions.

"The benefits of converting to LED lighting are across the board, from enhancing lighting in the field of play to supporting the Mariners long-established sustainability goals...the GigaTera fixtures represent the latest in LED technology."
Joe Myhra,
Vice President Ballpark Operations,
Seattle Mariners

References

J.A. Veitch and S. L. McColl, "Modulation of fluorescent light: Flicker rate and light source effects on visual performance and visual comfort," Lighting Research and Technology, vol. 27, no. 4, p. 243, 1995.

M. Poplawski and N.J, Miller, "Explore flicker in solid-state lighting: what you might find, and how to deal with it," 2011.
Poplawski and Miller 2011

The photo above illustrates the light pollution caused by an HID system (top) compared to an LED system (bottom). *(Photo courtesy of McKinstry)*

"In my last few years as a player, I had difficulty seeing the baseball. Now in Safeco Field I can tell that the home plate area is brighter. I wish we had these lights when I played."
Edgar Martinez, former player and batting coach,
Seattle Mariners

About the Green Sports Alliance

The Green Sports Alliance leverages the cultural and market influence of sports to promote healthy, sustainable communities where we live and play. We do so by inspiring sports leagues, teams, venues, their partners and millions of fans to embrace renewable energy, healthy food, recycling, water efficiency, species preservation, safer chemicals and other environmentally preferable practices. Alliance members represent more than 330 sports teams and venues from 20 different sports leagues and 14 countries.

About the Planled and GigaTera Partnership

The partnership of Planled and GigaTera is challenging the limits of sustainability and productivity. Planled, a relentless innovator in the scientific and human effects of light, found an equally inventive manufacturer in GigaTera. Together they shook up 2015 by teaming up to make the Seattle Mariners and New York Yankees the first two LED lighted stadiums in MLB. Players, fans and broadcasters have all endorsed the biggest lighting change to America's favorite pastime in the last half-century. The LED conversion also presented the teams, along with corporate and industrial customers, savings of up to 70% and priceless performance benefits. The Planled and GigaTera partnership is built on the basic concept of elevating light to its highest potential in sustainability and the human experience.