Oil, chemical and heavy industrial processing facilities are feeling the pressure to implement modern cost-cutting networking technologies throughout their operations, including in those areas classified by the NEC as "hazardous" locations. Whether this movement is known as the Industrial Internet of Things (IIot), the Smart Factory or another buzzword, this high level of digital transformation presents new challenges with regards to safety in hazardous locations where highly specialized electrical equipment is required. However, the ROI of digital transformation cannot be ignored in helping to manage the ever-increasing load of data generated by the smart meters, sensors and other lightweight edge analytics devices deployed throughout the processing operation. With quick and accurate data analysis made possible by digital transformation, it is much easier to prioritize maintenance and identify potential hazards or failures that may put the safety, reliability, and compliance of a facility at risk.

Progressively building off this momentum, Emerson is now addressing one category largely ignored in the drive to connect every facet of a processing operation: Lighting. This whitepaper and others to follow will explain how connecting LED lighting to the network – in particular Emerson's web-based Plantweb Insight™ platform – is a highly effective way to reduce facility costs while improving the productivity, safety, and functionality of hazardous locations.

While it may be common knowledge that LED lighting is up to 65 percent more energy efficient than the traditional HID or HPS systems found in the majority of hazardous locations, plant managers may not be aware that connecting LED lighting to the network further reduces costs by as much as another 60 percent due to energy-saving controls, the ability to analyze energy consumption patterns, and the improved visibility into luminaire health monitoring that reduces maintenance requirements and production downtime. Consider this: The Department of Energy [1] estimates that only 17 percent of the installed base of industrial high-bay/low-bay luminaires is LED. Retrofitting to LED from older lighting sources would save American industry up to $3.6 billion annually. Taking the next step and applying digital transformation via connected LED lighting would save another $1.0 billion or more, as companies conserve on energy usage and identify potential maintenance issues to prevent costly failures before they occur.

The State of Hazardous Location Lighting

HID lighting is costly to replace, maintain and dispose of, and even more expensive to run since these energy-guzzling devices, which require an extended warmup period to come up to full output, are typically "always on" 24/7/365. To make matters worse, HID cannot be equipped with occupancy and daylight harvesting sensors, or programmed dimming.

HID   LED

More troubling is that the poor light quality associated with traditional high-pressure sodium lamps impacts the safety of employees, resulting in fatigue and issues with concentration, performance, and motivation. Workers receive about 85 percent of their information through their sense of sight, making lighting critical to the avoidance of slips, trips and falls, for example, that result in over 1 million visits [2] to the ER each year. Also, those tasked with the maintenance of older technology luminaires must endure extremely harsh environments, such as an offshore drilling platform or inside a refinery's processing units, that often requires standing on scaffolding while heavy machinery is vibrating the floor below and breathing dirty air.

Appleton LED lighting is the answer to all these problems, with connected LED being the best choice, one that is now in reach of plant management, thanks to Emerson.

Connected LED Lighting

So what is connected lighting? Connected lighting refers to a system of luminaires equipped with sensors that are linked to a network, allowing them to transmit and receive data.

Connected lighting has been rapidly adopted in commercial buildings where it captures valuable insights into energy usage and enables users to make real-time adjustments to lighting levels for improved efficiency, comfort and safety. Sensors attached to the luminaires can also gather data on occupancy, humidity and temperature. When combined with LED technology, a networked lighting system in a commercial building can typically pay for itself in less than two years due to better space utilization and energy savings.

Unlike in commercial settings, web-based monitoring of luminaire health or control of lighting in hazardous and harsh locations has been impossible due to a lack of robust, certified solutions. Until now.

Appleton Connected LED Lighting

Thankfully, this has changed with the introduction of the Appleton Mercmaster Connect LED Luminaire rated for Class I, Division 2 and Zone 2 hazardous locations and the Appleton Wireless Motion Sensor featuring Emerson WirelessHART™ technology. WirelessHART wireless networks and sensors are currently being used in a wide range of process measurements, usually at dramatically lower costs as compared to wired alternatives, with faster installation time and minimal disruption. If a WirelessHART network is installed, the Mercmaster Connect will join it using pre-programmed network and join keys. Even without a network, the sensor will detect motion for smart illumination of the area. If no motion is detected, the Mercmaster Connect either will turn off or dim down lighting to a pre-set level of intensity. The Time Out delay and dimming output can be programmed using an Emerson TREX™ or AMS™ platform that puts this smart, connected technology in the hands of employees, enabling them to be more efficient and have an ever-increasing impact from their work.

Mercmaster Connect LED Luminaire
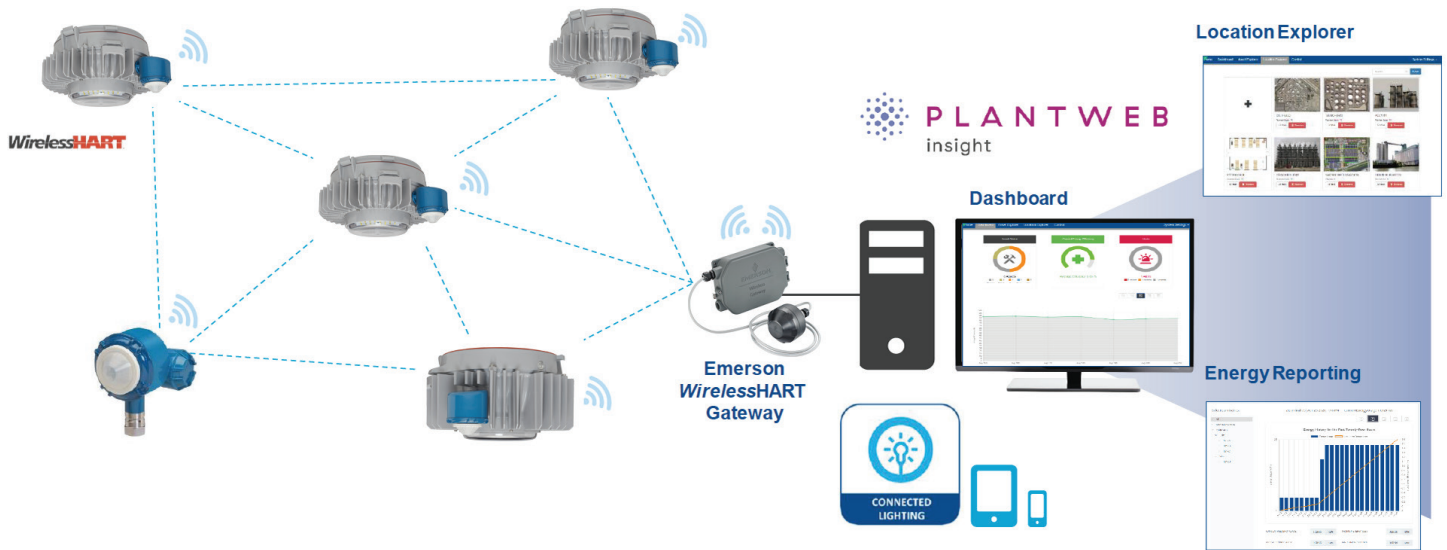
Commissioning LED lighting inside Plantweb Insight lets you monitor facility energy usage
and detect occupancy, harvest daylight and schedule for optimal efficiency

Plantweb Insight Configurable Controls

Emerson Plantweb Insight and the Connected Lighting App
— which allows a facility manager to configure controls for
Appleton Mercmaster Connect luminaires without the need
for any additional programming — takes the pressure off so
they can focus on the productive tasks that they are good at.
It lets them better utilize energy consumption with calculated
insights from a lighting status algorithm based on decades of
experience and analytics.

Three core controls deliver improved energy savings and
enhanced safety.

1. **Occupancy Detection:** The WirelessHART sensor
    leverages passive infrared technology to detect motion
    of human-sized objects, triggering all grouped lights to
    maximum brightness to ensure safety. The selectable
    Fresnel lens focuses detection only in the area under
    the luminaire.

2. **Daylight Harvesting:** This popular feature provides
    you with the flexibility to program Mercmaster
    Connect luminaires to take advantage of natural light,
    both indoors and outdoors. By measuring ambient
    levels the sensor will automatically trim light output to
    maintain optimal brightness in specific locations.

3. **Scheduling:** Time-based controls let you schedule
    up to four time periods per day per group. Ideal
    for parking lots and streets, this control features a
    network time stamp to keep all luminaires in sync.

According to the Lighting Control Association (LCA), on
average, occupancy detection generates energy savings of
24%, daylight harvesting saves 28%, and time scheduling
saves 23%. Unlike legacy luminaires, Appleton Mercmaster
Connect LEDs can also be dimmed, a strategy that the LCA
documents as capable of saving an additional 36% on energy
consumption. When used together these controls may
reduce lighting-related energy costs by up to 60% more than
just using LED luminaires.

Plantweb Insight Energy Analysis

Plantweb Insight is also responsible for providing analysis of energy and facility usage data collected at each of the luminaires. This means that a change in energy consumption can be immediately compared to historical use over the past year, month, week, previous 24 hours or previous 8 hours. Once the time period is analyzed, Plantweb Insight lets you track results against your energy efficiency goals across the entire facility, in a zone, or within a single group of lights for faster decision making. Plantweb Insight summarizes energy calculations for internal and corporate review.

Among all devices, lighting has one of the highest shares of energy consumption in the industrial sector. In fact, lighting accounts for approximately 20% to 30% of the electricity consumption in manufacturing plants. By switching towards more energy efficient lighting technologies like the Appleton Mercmaster Connect combined with Plantweb Insight, a considerable amount of energy can be saved, leading to higher profits while improving productivity or employee safety.

Additionally, Appleton Connected lighting can help organizations meet or exceed sustainability targets as responsible members of the global community. Any decrease in energy consumption benefits the environment by reducing the consequences of emission production. Almost 80% of the world's electricity is produced from the combustion of fossil fuels. The gases being produced by burning fossil fuels are "greenhouse gases" which contribute to global warming, ozone depletion, acid rain, and other negative impacts. Appleton Connected lighting helps organizations face the challenge of striking the appropriate balance between meeting business objectives and being good stewards of the environment.

Plantweb Insight Luminaire Health Status

The upkeep of luminaires can be difficult in the best of situations, but when an electrician must contend with an explosive atmosphere, harsh weather and towering heights, the simple task of relamping becomes very dangerous. Ultimately, lowering lighting maintenance to a minimum is the foremost goal in hazardous locations, one that is made possible with the Appleton Mercmaster Connect and Emerson Plantweb Insight solution.

LEDs have proven to be most reliable lighting source requiring the least amount of maintenance. Compared to HID and fluorescent luminaires, LED lighting offers many more years of maintenance-free service before replacement or relamping is needed. Appleton Mercmaster Connect luminaires teamed with the Plantweb Insight platform push

Mercmaster Connect LEDs help maintenance staff focus on larger projects, saving you time and money

the potential for fewer failures far beyond what was once thought possible. The WirelessHART sensor incorporated inside the Mercmaster Connect can self-diagnose and issue alarms to let the user know to conduct preventive maintenance to avert failures before they occur. Maintenance personnel can be immediately dispatched, preventing losses from downtime. This quickly adds up — it is just one of countless examples of Plantweb Insight ensuring equipment is ready to meet production demands.

Plantweb Insight generates a walkdown list of Mercmaster Connect luminaires with their location for a plant's maintenance team to assess operating conditions. It will remotely alert maintenance staff of any problems in a luminaire including connectivity status, internal electronic faults, end of life, over temperature and water ingress. No longer are maintenance teams required to conduct tedious manual rounds in dangerous areas to check the status of a luminaire. Instead, a check on the Plantweb Insight dashboard lets them monitor the health of each and every Mercmaster Connect in the facility.

Predictive maintenance made possible by real-time diagnostics means fewer lighting issues, less downtime, improved safety and a far more productive workforce. Combined with running the Mercmaster Connect's Occupancy Detection control to ensure lighting is only "on" when personnel are present, this predictive maintenance can extend the operating life of the luminaire up to twice that of a non-connected version, mitigate recordable incidents and quickly identify any assets requiring attention.

Plantweb Insight Map Based Commissioning
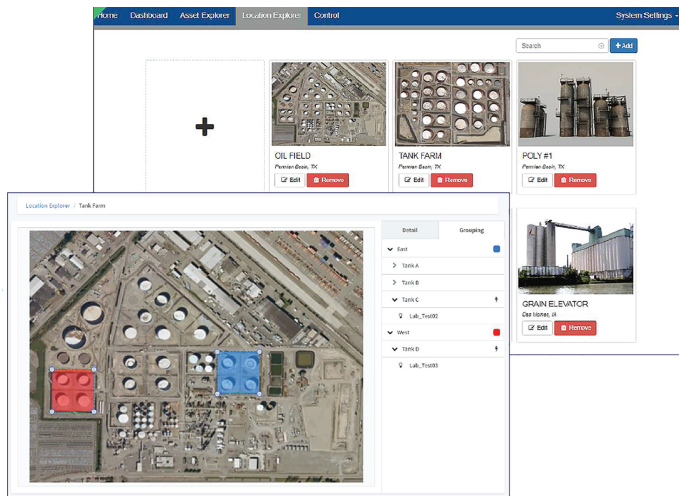
Commissioning is recognized to be one of the more difficult issues of connected LED lighting systems, especially a wireless system. It can be a complex process with multiple challenges along the way, and multiple competencies are needed to perform it properly.

To meet this challenge, Plantweb Insight features a facility map-based commissioning tool that allows operators to simply upload a photo of their facility showing its various rooms and then assign Mercmaster Connect luminaires to each area. A quick click on a particular area makes it easy to create logical groupings and to assign customizable controls. The simple, user friendly interface has the potential to drastically improve several different aspects of lighting management.

Because facility images can be uploaded with a simple mouse click, there is no need to use complex software or to memorize locations of individual devices. Having a map in front of you also removes the need to rely on knowledge of the area itself. Zones and groupings can be color coded to better navigate luminaire installations and to track exactly what is happening with each.

Another challenge of commissioning a wireless connected lighting system is the limited strength of standard mesh network coverage. This is further complicated in an industrial setting where densely packed equipment weakens wireless signals and blocks the ability of sensors to detect motion. Standard 2.4-GHz wireless transmission requires maintaining Line of Sight (LoS) between the sensor and the client. Even

though the wireless connection might still get through due to signal penetration and obstacle reflection, the reduction in signal strength can affect the stability and overall throughput.

Equipped with an internal WirelessHART radio, the Mercmaster Connect can strengthen the WirelessHART network and minimize choke points without the use of batteries to ensure better signal reception by avoiding LoS problems. When in standalone operation, it can strengthen the network in the LAN. In doing so, it makes the deployment of additional process, reliability and safety measurements to your plant significantly faster and less expensive.

Appleton Wireless Motion Sensor

In the event that equipment on the plant floor is shading the Mercmaster Connect luminaire's motion sensor from a critical control station, a separate Appleton Wireless Motion Sensor can be installed at that control station to address gaps in the sensing footprint. Pairing the Mercmaster Connect with the Appleton Wireless Motion Sensor expands coverage so you maximize energy savings and luminaire service life. Simple to install and control, the Appleton Wireless Motion Sensor is a WirelessHART, battery-powered and intrinsically safe device that can be placed virtually anywhere to coordinate all the lights in the area come on together.
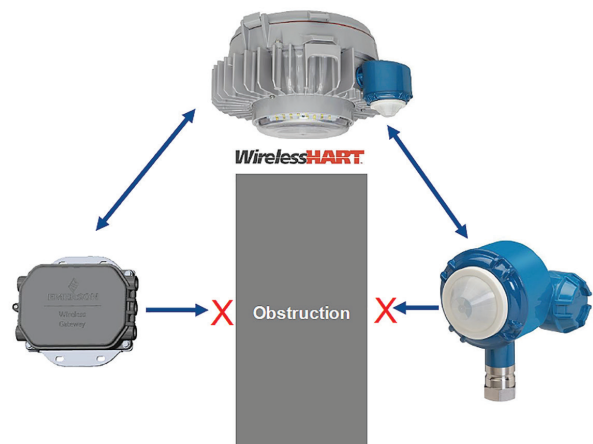
Better Visibility of Lighting Assets

Mercmaster Connect luminaires integrate directly with existing Emerson WirelessHART networks and the Plantweb Insight platform through the Connected Lighting app. In all, Emerson Plantweb Insight supports over 20 more different apps. Plantweb Insight is at the heart of the Plantweb digital ecosystem, Emerson's leading IIoT portfolio. Engineered with pre-built, industry-accepted analytics, it transforms sensor data into actionable insights.

After downloading the Connected Lighting app, the user can perform numerous tasks remotely, away from hazardous locations and potentially explosive gases, liquids and dust — from anywhere. With a quick glance at a PC, laptop, tablet or Smartphone, they can see the operating status of every Mercmaster Connect LED luminaire in a facility, how much energy is being used, and be alerted when maintenance is required without entering the hazardous location where the luminaires are installed.

Conclusion

Until now, hard-wired lighting controls have been expensive to install, complex to operate, and were unable to be modified after being deployed. Legacy controls were unable to provide warnings on premature luminaire failure.

Cabling was expensive. Dimming wasn't possible. Sensor reliability was questionable. For these reasons and many others, installing a control on hundreds, if not thousands, of luminaires in a hazardous location made little economic sense. Now all that has changed. The Mercmaster Connect solution is a major milestone in industrial lighting's evolution. When you retrofit your plant's inefficient HIDs with Appleton Mercmaster Connect luminaires, you get the built-in control you need to maximize energy efficiency, along with the ability to collect data wirelessly and generate actionable information to make the decisions that lead to measurable operation improvement.

Digital transformation is one of the leading initiatives that have the potential to increase business opportunities by connecting related products and systems together. This convergence of devices and systems allows for significantly more data to be gathered, which in turn empowers managers to make faster, more informed decisions.

① US Department of Energy: "Adoption of Light-Emitting Diodes in Common Lighting Applications" August 2020
② National Floor Safety Institute: "Slip and Fall Facts" January 2021

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