SPECIAL REPORT

Next Generation LED Lighting for Hazardous Offshore Areas

Enhancing Safety and Productivity in Harsh and Hazardous Applications through LED Lighting

Has the Time Come for the Next Generation of LED Lighting?

LED Technology: Making the Commercial Case

Deciding When and How to Upgrade

The Past, Present, and Future of LEDs

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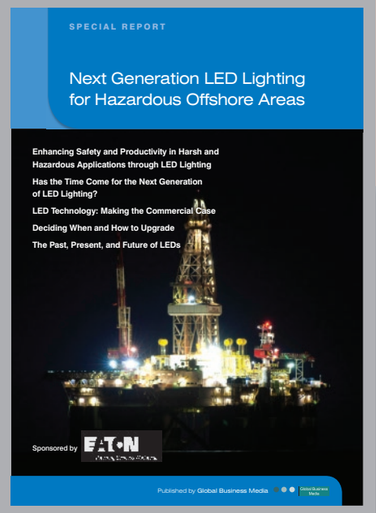

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Foreword

THE OIL and gas industry is a competitive business with operators competing with one another to discover the tiniest little advantage. It is, then, ironic that perhaps the biggest step forward could come from one of the smallest and most unlikely sources imaginable.

Since we began exploring the oceans for oil and gas, deep sea platforms have been lit in the same way, by fluorescent or high pressure sodium light bulbs designed to provide continuous, round the clock illumination across the entire facility. Perversely, though, their fundamental design leaves them profoundly unsuited to life on board a rig.

Although specifically designed and toughened for life on board a rig, light bulbs are by nature fragile. They are vulnerable to damage from high vibrations and rough impacts and they produce sparks when they ignite – none of which are ideal characteristics to have on board an oil rig.

What's truly got operators concerned, though, is their thirst for energy. This, combined with the constant maintenance requirements, leaves them looking around for alternatives and in LED (Light Emitting Diode) technology they hope they've found it.

The opening article in this Special Report looks at the benefits of LED lighting in enhancing safety in any installation and, in particular, in offshore installations, where high vibration, debris, chemicals and potential explosives are present. The selection of the correct lighting luminaires is of the utmost importance as this impacts not only on safety, but also on the lifetime and performance of light luminaires utilised in these applications. Properly chosen, LED lighting provides unique benefits in improving lighting quality and in reducing energy consumption and maintenance costs, while increasing safety, due to enhanced performance and long life.

At a stroke LEDs promise reductions in energy costs of around 50%, while providing similar reductions in maintenance. Compared with the reddish/orange tint of high pressure sodium bulbs these can produce bright, clear, white light.

In other words, they achieve that impossible dream of all businesses – using less to produce more. A lighting system consisting entirely of LEDs will produce a much improved quality of light while simultaneously reducing costs – surely the stuff of any rig operator's dreams.

But while LEDs have begun to play a significant role in industrial lighting, the same is not true of the oil and gas industry. Manufacturers still need to convince that this technology has reached a point where it is affordable and effective.

This Report will look at the available evidence to see what advancements LEDs can bring and if they really do represent the game changing technology their proponents believe them to be.

Tom Cropper
Editor

Tom Cropper *has produced articles and reports on various aspects of global business over the past 15 years. He has also worked as a copywriter for some of the largest corporations in the world, including ING, KPMG and the World Wildlife Fund.*

SPECIAL REPORT: NEXT GENERATION LED LIGHTING FOR HAZARDOUS OFFSHORE AREAS

Enhancing Safety and Productivity in Harsh and Hazardous Applications through LED Lighting

Anshuman Bhargava, Product Line Manager –
LED Lighting, Eaton's Crouse-Hinds Business

Introduction

Workplace safety is the most important aspect of any installation. Within an offshore installation, there are locations where high vibration, debris, chemicals, and potential explosives are present. These factors make the correct lighting luminaire selection of utmost importance, but also severely impact the lifetime and performance of light luminaires utilized in these applications. To ensure the highest standard of safety for both people and equipment, operations and maintenance resources are required to quickly service and maintain adequate lighting levels, sometimes in very challenging installation locations and at a very high expense. LED lighting, when properly selected, provides the unique benefits of improving lighting quality, reducing energy consumption and maintenance costs and, most importantly, increasing safety due to the enhanced performance and long life. This white paper seeks to highlight some of the benefits of LED luminaires versus traditional lighting technologies, review common misconceptions with LED technology and explore proper luminaire design and selection to maximize long life, performance and enhance the safety of any installation.

Value and Benefits of LED Lighting

Safety

LED's greatest benefit is long life, reducing downtime and cost associated with traditional lamp and ballast replacements and, most importantly, reducing the risk of hazards commonly associated with servicing luminaires installed in challenging applications. A 2009 report by the US Department of Labor Statistics noted that 605 workers were killed and an estimated 212,760 were seriously injured by falls to the same or lower levels[1]. Bearing in mind that this covers all industries, when you consider harsh and hazardous installations, especially those offshore where an additional subset of challenges is present, reducing the need for maintenance only further increases the safety of workers in the installation.

Comparing LED required maintenance versus the maintenance of a high pressure sodium, fluorescent or metal halide luminaire, LED luminaires, when properly designed and selected, can reduce required maintenance by more than 67%. For instance, a HPS luminaire will require relamping at least every 20,000 - 24,000 hours while an LED luminaire will last 60,000 plus hours, thus creating a minimum of 2 less maintenance visits and reducing the risk of an accident by that factor.

LED luminaire construction and performance characteristics directly correlate to long life, dependable operation and safety. LED luminaires operate cooler than conventional light sources and hence result in much higher temperature codes (lower surface temperature) for safer operation around people and equipment in classified locations with combustible gases and dust. For example, Eaton's Crouse Hinds Champ VMV LED division 2 / zone 2 luminaire has a T5 rating at 55C ambient conditions versus a Champ VMV HPS division 2 / zone 2 luminaire which has a T1 rating at 55C ambient.

LED lighting is highly directional, uniform and has superior color rendering compared to conventional light sources. This results in improved workplace illumination, increased operator comfort and lighting quality especially for precision tasks in heavy industrial environments. Process areas, compressor decks, stairwells, catwalks, and walkways

Process areas, compressor decks, stairwells, catwalks, and walkways requiring high quality of consistent illumination are all examples of locations where safety can be further enhanced by using LED lighting

requiring high quality of consistent illumination are all examples of locations where safety can be further enhanced by using LED lighting.

Operational Savings

Based on a study done at several oil and gas end users, the average time taken to replace a single luminaire for maintenance or repair is 5.1 hours with a minimum of 1.9 people. The challenges of maintaining luminaires in the offshore environment are only increased with the space limitations and environmental challenges. This costly and often hazardous maintenance can be minimized by utilizing LED luminaires.

The cost and availability of energy continues to be a challenge in many areas globally. With the large installed base of HID and fluorescent luminaires around the world, LED light luminaires can provide significant energy savings. As stated by the US Department of Energy, "The total energy use of high-bay luminaires was about 1,096 tBtu in 2012. A complete technology switch to LEDs would nearly cut this energy use in half, saving nearly 483 tBtu per year. This potential saving equates to an annual energy cost savings of US $4.6 billion[2]." To illustrate further, a 175W MH industrial light luminaire that is installed in a processing plant requires 208 watts compared to an equivalent LED luminaire that requires only 98 watts. The LED light luminaire delivers a 53% energy saving in addition to three times longer life compared to metal halide. This enhances safety through reduced electrical energy load requirement. The reduction in total wattage and amperage can result in lower infrastructure costs based on lower requirements for circuit breakers, transformers and wire conductors. For example a reduction in the amperage draw of the lighting circuit by 30% or more can result in reduction of almost 1,000 gallons per year of diesel fuel used in generator of an operational rig.

Environmental

LED lighting does not contain any filaments, electrodes or mercury such as fluorescent light sources. Specialized storage and disposal is mitigated and a substantial reduction of carbon footprint is realized. In addition, LED lighting does not emit UV or infra-RED radiation which may cause material degradation of specific materials that make up lighting luminaires. LED luminaires, with their directional light, can reduce light pollution and meet Dark Sky requirements, which eliminates misdirected light and protects the natural environment and habitation from any damaging impacts of night lighting.

Common Misconceptions, Selection and Design Criteria for Harsh and Hazardous Applications

System Lifetime

One of the greatest benefits of LED technology is long operational life, but system lifetime remains a confusing and ambiguous measurement for many end-users. An HID or fluorescent luminaire utilizes a common set of lamps across manufacturers with similar lifetimes, while LED is dependent much more on system construction with ambient temperature figuring heavily into the determination of lifetime.

End of life for an LED luminaire is considered the first time the luminaire requires maintenance, which would likely be due to decreased LED component output or a driver failure, resulting in a lack of light output. By industry standards, the LED light source is considered end of life when it loses 30% of its light, or what is known as the L70 rating. The L70 rating is calculated with data provided by a LED component manufacturers LM80 report and extrapolated using an industry accepted TM21 calculator. This may or may not be the end of life for the LED light source as the light levels may still be adequate especially when you consider HID lighting is considered end of life when it loses 50% of its output.

A common misconception when considering fixture life is only accounting for the LED component or L70 rating. However, more often than not, the point of failure is the driver. The driver life is estimated using MTBF or accelerated thermal test data at elevated ambient temperatures which are then extrapolated using Bellcore or Milspec standards. It is essential to note that fixture lifetime is determined by the shorter of either LED component or driver lifetime and system construction along with ambient temperature figure heavily into lifetime.

Rated Life is defined as the maintenance-free life of an LED luminaire under worst case operating conditions during an always on, constant temperature environment. Economic life is the period of operation before failure. The biggest variable between rated and economic life is temperature, with rated life at a worst case temperature versus economic life where temperature will vary according to the actual installation. Economic life of LED luminaires can be substantial as indicated by the example below of the Champ VMV LED family. At ambient temperatures of 25C and 40C, useful life derived out of LED light luminaire could

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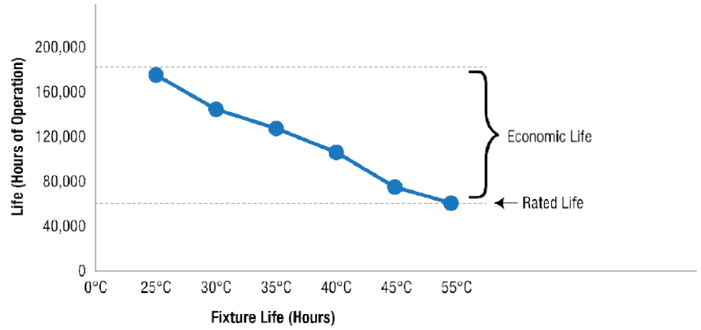


Fig. 1: Economic vs. Rated Life

be as long as 170,000 hours and 100,000 hours respectively. This is an important concept when defining the total cost of ownership with an LED light luminaire. Fig.1 illustrates the relationship between economic and rated life.

System Efficiency and Design

Efficiency helps drive both the maximum benefit of available energy as well as potentially minimizing the amount of energy required. For luminaires across all lighting sources, both in input wattage and lumens are documented, with a calculation of lumens per watt as the efficiency metric. The efficacy of an LED luminaire is the cumulative efficiency of its LEDs, heat sink, driver and optics. The system level efficacy of an LED luminaire is typically 25-30% less than the LED component due to losses from thermal, electrical and optical efficiency. For example, the LED component efficacy may be in the range of 140 – 150 lumens per watt, but after efficiency losses, the total system efficacy may measure in the range of 100-105 lumens per watt. It is important to view efficacy on a system level and this can be validated and accurately interpreted through integrating sphere and photometric test reports based upon IESNA LM79 standards.

LED luminaires operate much cooler than traditional lighting, but managing heat remains a major challenge in maximizing lifetime. To ensure long life, LED luminaires must be constructed with robust and durable heat sinks that allow maximum heat transfer from the LEDs to the ambient environment. Heat sinking, often present as fins, allows for maximum air flow and increases surface area for heat dissipation. For example, finned heat sinks serve as an excellent source for dissipating heat and lowering the junction

temperature of LEDs used in the light luminaire. Effective thermal management ensures longer life, lower lumen depreciation and minimal color shift over the life of an LED luminaire.

Drivers or power supplies are utilized to power LEDs. These devices step down incoming voltage and convert it from AC to DC. Drivers can be constant voltage or constant current output and isolate LEDs from fluctuations in current and voltage. Many drivers have surge protection, which eliminates the need for additional protection devices (i.e. fuses). Redundancy in drivers connected to multiple LED circuits ensures that a light luminaire will have a string of LEDs illuminated in the event any one of the drivers fails. LED drivers have very high power factors (PF) and low total harmonic distortion (THD) within a wide input voltage range of 120-480 VAC.

In a maintenance area where the worker must use a black, white and green wire, the low CRI will prevent the ability to discern between the black and the green wires and could result in improper installation

The most efficient power supplies will perform with a PF above 99% and a THD below 15%. These performance characteristics display how efficiently power supplies minimize interference to other electrical equipment and reduce the load on an electrical system.

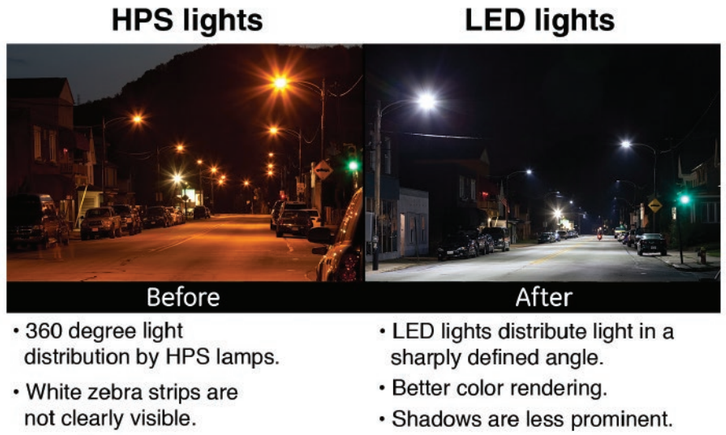
Lighting Quality and Performance

A lumen is the amount of light output in a specific angle from a light source. Often with LED luminaires the focus is on lumen output. With LED being such a directional light, it requires less lumens than traditional light sources and thus should not be compared to HID or fluorescent luminaires based on lumens. Even when comparing LED luminaries across manufacturers, luminaire construction and optics play a major role and a pure lumen to lumen comparison is not always relevant. When comparing luminaires across both traditional and LED lighting, focus should be on the usable light on the work plane determined by the footcandle or lux reading.

LEDs, with their directional nature, are well suited to custom optics designed for specific types of discrete LEDs or arrays to enable uniform light distribution, higher coverage and more delivered light to the work plane with minimal light loss and spill. This, in turn, results in maximizing application spacing and minimizing the number of light luminaires required to illuminate effectively a work place. Secondary optics also result in reduction of glare in many applications which need constant human interface such as control rooms and monitoring stations with reflective computer screens. Common optics applications for industrial locations are:

a) **Type I –** Long and narrow beam distribution for applications such as aisles, catwalks, ramps, tunnels, long passageways, conveyer belts, loading docks etc.
b) **Type III –** Semicircular kidney shaped beam pattern for Narrow crosswalks or passages with wall luminaires, Tunnels with wall mount, Wall stanchion mount with 180° forward throw.
c) **Type V –** Circular beam pattern for Pendant, ceiling or stanchion mount overhead building, Processing mills, industrial plants, large buildings, warehouses etc.

According to the Illuminating Engineering Society of North America (IESNA)[3], color rendering indicates the degree to which a light source shows the true colors of the objects it illuminates. It is expressed in terms of a color-rendering index (CRI) on a scale of 0–100. The higher the CRI the truer people and objects look[4]. HPS light luminaires typically have a very low rendering rating, on the order of CRI = 22. For example, in a maintenance area where the worker must use a black, white and green wire, the low CRI will prevent the ability to discern between the black and the green wires and could result in improper installation. Therefore, if a processing area was replaced with an LED light luminaire with a CRI of 70, it would provide the workers three times more accurate color for quality checks, reading gauge measurements, and performing precision tasks. Improved color rendering provides a safer work environment and improves workers' quality of life.



Conclusions

Safety, reliability of operation and high maintenance costs of traditional lighting systems in harsh and hazardous environments such as oil and gas refineries, chemical processing plants, drilling and exploration rigs, and heavy industrial facilities have become a critical issue globally. Plant managers and engineers are facing safety concerns of frequent lighting failures and downtime in environments with extreme temperatures, explosive gases, combustible dusts and fibers, high pressure water hosing, vibration and corrosive fluids. LED luminaires provide compelling safety benefits and long-term operational cost savings driven by long maintenance- free economic life, reduced energy consumption, lower operating temperatures, enhanced electrical protection, durability against vibration, dust, corrosion and humidity, superior lighting quality, instant start/restrike and ease of installation. As a result of this increased safety and lower total cost of ownership, the trend has developed and continues to accelerate towards LED luminaires replacing traditional light sources.

As with any new technology, many misconceptions exist around the benefits of LED especially as it relates to the demanding applications such as the offshore environment. In these confusing times, where a misunderstanding can damage expensive equipment and more importantly, impact human safety, it is crucial to rely on a trusted industry partner. Eaton's Crouse-Hinds Business has over 115 years of experience in dealing with harsh and hazardous applications and our products deliver safety and reliability where it matters most. With an LED portfolio encompassing over 20 product families across multiple global standards and the largest installed base in hazardous application lighting, Eaton's Crouse-Hinds is your trusted source to enhance safety and productivity in any installation.

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Has the Time Come for the Next Generation of LED Lighting?

Tom Cropper, *Editor*

Next generation LED technology appears to offer a game changing proposition for the oil and gas market, but has the time come to make the change?

Both HID and fluorescent lamps are damaged by constant switching cycles. The more they are switched off and on, the less likely they are to endure

FOR DECADES, oil and gas platforms have been powered by lighting systems consisting either of fluorescent or incandescent light bulbs, but this system is far from perfect. The constant maintenance required to repair smashed or worn out light bulbs is a continual drain on power. Additionally, rising power prices make the search for more efficient power options an economic as well as environmental priority. A game changing solution appears to present itself in the shape of the next generation, industrial scale, LED technology.

HAZARDOUS AREA LED FLOODLIGHT INSTALLED ON A RIG

What are LEDS?

Unlike a regular incandescent light bulb, an LED (Light Emitting Diode) does not contain any filament. It is illuminated by the passage of electrons through a semi-conductor material. They are commonly used in commercial applications such as backlighting smartphones, or providing thinner and lighter televisions, but increasingly over the past five years they have been used in large scale commercial and industrial applications. When set against traditional lighting methods they have considerable advantages – even so, much of the oil and gas industry remains uncertain whether or not they offer a more affordable and effective solution than they already have at their disposal.

The Arguments Against

LEDs currently occupy around 18% of the market, but the consensus is that this will grow in the medium to long term. According to a report from McKinsey, LEDs will represent 60% of the general lighting market by 2020[1]. A study from Goldman Sachs[2], on the other hand places it much higher at 70%. Whichever figure you take, it's clear that LEDs are in for marked growth in the next few years, but will this be mirrored in the oil and gas industry?

Currently, LEDs have struggled to gain the same foothold in oil and gas as in other industries. Some put this down to the natural caution of an industry which demands the latest technology but will only commit to something with a track record. Others put it down to the sheer task of making the switch. Each platform requires tens of thousands of LEDs in multiple areas of the rig. One estimate suggests there is a total of five million light bulbs[3] which need to be replaced. Dismantling an existing system in favour of LEDs represents a considerable cost both in terms of installation and down time.

Any new technology represents a risk. Why abandon a tried and tested formula in favour of one that is yet to be proven? The stakes could not be higher.

Arguments in Favour

Against this, though, we have to measure multiple benefits:

The biggest driving factor is the constant maintenance requirements of conventional lighting solutions. An offshore oil rig is exposed to multiple challenging conditions such as corrosive elements in water and air, continuous vibrations and shocks and fire risk. The design of fluorescent and incandescent light bulbs is fundamentally flawed for operations on board rigs. The filaments can easily be damaged and operators on those rigs experiencing more extreme conditions often report that lighting solutions fall some way short of their rated design.

In comparison, LEDs contain no moving parts and are more durable, withstanding shock and working better against corrosive elements. Their ability to ignite spark free also has obvious benefits when located close to flammable elements.

Both HID and fluorescent lamps are damaged by constant switching cycles. The more they are switched off and on, the less likely they are to endure. This creates a dilemma; do you seek to maximise the lifespan of bulbs by leaving them on 24/7, or do you seek to reduce energy use by turning them off?

Energy Efficiency

LEDs have already been put to use in many industrial applications, where they have demonstrated huge energy savings as high as 80%. An LED might expect to consume 150w of power compared to 400W for a high pressure sodium light bulb and offer double the energy efficiency of fluorescents and 80% that of incandescents.

The more electricity any facility uses, the higher the energy saving, making them ideal for oil rig applications.

With pressure mounting from both the public and governments for the oil industry to improve its green credentials, LEDs have become even more attractive. Because of their ability to reduce dramatically energy consumption, they are regarded as green sources of energy[4]. Furthermore, because they contain no hazardous chemicals, their disposal represents less of an environmental threat.

Superior Performance

As well as being more durable and energy efficient, LEDs boast considerable performance advantages. In general terms an LED can emit more than double the amount of light than its fluorescent counterpart.

50,000 LUMEN LED FLOODLIGHT REPLACES 1500W HID EQUIVALENT AT 65% REDUCTION IN ENERGY COSTS

Most importantly of all, the light produced is cleaner, sharper and of better overall quality as opposed to the poor quality, reddish glow experienced with conventional lighting.

This has clear benefits in terms of safety. At the most basic end of the scale, better lighting reduces the risk of slips, trips or falls while at the upper end, it can be more effective in alerting passing shipping and guiding in helicopters. Inadequate lighting has been a major complaint of pilots for decades, and LEDs play a major role in reducing the risks of past accidents[5].

Taken together, the overall case appears irrefutable. Such is the performance differential that people increasingly see LED technology as representing a game-changing step forward in lighting technology. They promise multiple simultaneous benefits reducing costs, improving safety and bringing down carbon emissions. In the past, the technology has been held up by high initial costs, but we have now reached a situation where costs are coming down as the sophistication of the technology increases. It truly does appear that the time has come for LED technology to step into the light.

LED Technology: Making the Commercial Case

Tom Cropper, *Editor*

How manufacturers of next generation LED technology are seeking to prove the commercial case for change.

Although any bulb comes with a rated service life, the rigours and challenges on board an oil rig mean lights often fail to reach their predicted life span

WHILE THE demands of lighting an oil and gas platform have not changed over the decades, LEDs promise to meet and exceed these requirements to a level HID systems can never manage. They are more durable, provide better quality light and consume less energy. Even so, the industry is a long way from adopting LEDs as the norm. If there is one factor that will change this situation more than any other, it's proving the commercial case.

Operating Cost

Oil rigs consume huge quantities of energy. Power is normally supplied through diesel generators consuming on average 20 – 30 M3 of diesel each day[6]. Of that, approximately 20% is accounted for by the demands of lighting the facility. With fuel prices demonstrating a general upward trend, managing energy costs has become a top priority.

In addition to this, maintenance represents a continual drain on production and profits. Bulbs are prone to breakages and every blackout needs immediate remedy. Although any bulb comes with a rated service life, the rigours and challenges on board an oil rig mean lights often fail to reach their predicted life span. Maintenance is a round the clock proposition and with every power failure rigs experience frustrating and costly down time.

A Compelling Case

It is here that lighting operators believe they have their pressure point, and it is one reason why so many manufacturers see oil and gas as representing a huge growth opportunity. Just looking at the ratings of LED products illustrates the scale of potential savings on offer.

Most LED products have an L70 rating which means you can expect them to run 60,000 – 70,000 hours before light output reduces by 30% of maximum capacity. Some of the most advanced boast ratings of up to 100,000 hours with performance often improving in cold temperatures. Compare that with expected ratings of around 20,000 for conventional fluorescent based products and straight away you have a three to five fold reduction in maintenance. Better still, the construction of LEDs is more robust meaning they are less prone to breakages and other unplanned failure.

In terms of energy consumption, we witness another sizable gulf. A 150W LED can emit as much, if not more, light than a 400W high pressure sodium tube. They demonstrate an energy efficiency improvement of around 50% on fluorescents and up to 80% over incandescents. They also offer 100% brightness on startup and sacrifice no life span when turned off and on, meaning operators can shut down lighting in some areas during off-peak times.

Resistant to Change

Even so, for all the apparent benefits, oil and gas remains far behind other industries in adopting LEDs as the go-to technology. This is partly due to the work involved replacing millions of light bulbs world-wide with LEDs and also the inherently conservative nature of the oil and gas industry. Operators are juggling a delicate balancing act; on the one hand they want the latest and most advanced technologies, but on the other they are reluctant to commit to anything that does not have a long and reliable track record. Before making a change they want to be certain that new technology is effective and that it works better than what they have already.

Most of all they need to believe the higher upfront cost of installation will rapidly be offset by long term cost savings. These costs can be summarised as follows:

- **Downtime:** the time spent offline during the replacement of light fittings.
- **Risk:** the danger that, once installed, the system experiences glitches resulting in down time and replacement.
- **Installation cost:** The upfront expense of switching to LEDs. For many years this has been the major obstacle to change in other industries.

LED LIGHTING DESIGNED TO REPLACE TRADITIONAL LAMP TECHNOLOGIES IN ALL LIGHTING APPLICATIONS (TARGETED, GENERAL, HIGH-BAY, FLOODLIGHTING, LINEAR)

However, there are signs that LED technology has reached a defining moment in its lifecycle – one where the costs are coming down, and as a result, so has the payback period. From a situation in which payback could take as long as 10 years, many sources estimate that any system pays for itself within five years. Small wonder that so many experts are predicting a rapid rise in the LED market in the next few years[7].

Working in the Real World

If there is one demonstration that will convince the doubters it's to see LEDs delivering on their promises in the real world, and among those early adopters we already have just that. When Mexico's largest oil company PEMEX decided to replace existing lighting with LED technology they experienced a 66% reduction in energy consumption[8].

Another major oil refinery in the US replaced incandescent sodium bulbs with LEDs which provided the same amount of light as a 100W bulb by drawing only 50w of energy. In total the refinery has reduced its energy usage by $34,668 while decreasing annual maintenance costs by $766,647[9].

Such figures make compelling reading, but on top of this we also have to consider other, less easily measured factors, which nevertheless have an impact on bottom line performance.

The superior light quality of LEDs contributes to increased productivity and worker wellbeing while also reducing the risk of slips, trips and falls. This in turn reduces the danger of small damages claims made against the operator, and the reputational impact of a high accident rate.

In the end, any decision about whether to switch or not is a numbers game. There is a temptation to be conservative, making the change only when the status quo becomes uncomfortable. Certainly the majority of those operators who have chosen to upgrade to LED have done so either because energy or maintenance costs have started to bite. However, all the evidence gathered so far suggests that the cost savings are real and the payback could be earlier than initial estimates and the earlier you make the change, the bigger the potential savings. The old saying is true – it pays to fix the roof while the sun is shining.

Deciding When and How to Upgrade

James Gooding, *Staff Writer*

The argument in favour of LED technology appears compelling, however the efficacy of any system depends on the way in which it is installed.

Those firms that have nailed LED supplies specifically for oil and gas installations hold a substantial lead over those who have yet to fully grasp a hold of the sector

IT'S NOT what you do it's the way that you do it, so the old song goes, and these are pertinent words for any rig operator considering the installation of LED lighting systems. This technology has already demonstrated its transformative potential in terms of economic, environmental and safety benefits, but the key word here is 'potential'. This is a market at a stage of considerable flux and development, in which there are substantive quality differences between the best in class and the rest. Taking into account that an LED lighting system is designed to give many years of continual use, decisions made at this point have a profound effect on the long term success or failure of the installation.

Locations of Lighting Solutions on Board the Rig

The average oil and gas platform contains tens of thousands of individual light bulbs in multiple locations around the facility. Each area requires its own specifically tailored solutions from interior lighting and signage to exterior rails, helidecks, warning lights for shipping and much more.

Aside from the on-platform requirements, operators should examine the potential of LEDs to improve lighting on board supply vessels, submersibles and all kinds of FSPOs. LEDs can be used all over the vessel, providing shatter and splash resistant lighting for the deck, deeper light penetration for navigational lights, and quieter and cooler operation for the bridge or the cabin. As with platforms, the cost of overhauling fittings for incandescent lights and replacing them with fittings for LEDs represents a considerable upfront expense. But, on the other hand, reduced running costs means that they payback over time with improved lighting performance, enhanced visibility and reduction of the risk of accident.

The Choice of Provider

The market is in fluctuation, experiencing rapid development not only in size and scope but also in the sophistication of the products. Those firms that have nailed LED supplies specifically for oil and gas installations hold a substantial lead over those who have yet to fully grasp a hold of the sector.

A firm such as Eaton's Crouse-Hinds Business, for example, has opened its own multi-million dollar, 60,000 square foot innovation centre dedicated specifically to research into LED technology[10]. This enables it to test and develop cutting edge products and innovations, which are designed to maintain its lead position in what is a highly competitive sector.

Aside from product development, the centre plays a role in educating and training potential or existing customers. Courses are run enabling oil rig professionals to develop their understanding of LED technology, its benefits and the best way to operate products.

This is a key, but much under-estimated, factor in the relationship between an operator and supplier. It is not simply a case of delivering the product, but also providing ongoing support, advice and assistance.

An example of this can be seen when Shell embarked on an extensive renovation and enhancement program across its North Sea facilities, and employed Eaton's Crouse-Hinds Business to deliver explosion proof luminaires. Aside from delivering the product, the suppliers provided small hand held booklets to give information on operations, maintenance and repair. For older workers used to operating with existing systems, adapting to new technology represents a considerable switch in terms of their state of mind. The more support available in operating new technology, the better it will be deployed when the time comes.

A Step Up in Comparable Products

Operators are not looking to reinvent the wheel. Their lighting requirements are the same as they always have been, but what they need are products which can perform the same task but better. For this reason much of the output from the leading manufacturers are simply step forwards of existing fluorescent lighting technology.

An example of this can be seen with Eaton's Crouse-Hinds Champ VMV LED[11] series which is designed to exhibit the same durability and reliability as the existing Champ Luminaire. Where the new product thrives, however, is in its ability to provide the longer life and energy efficiency common to LED technology. This is useful in helping facilities meet challenging new environmental standards and regulations.

In addition to this, the new Champ LED series offers superior temperature ratings and enhanced visibility full spectrum lighting – ideal for providing a safer working environment in hazardous and industrial locations. Its ability to provide instant full temperature illumination with no warm up also gives it an edge over its predecessor.

The Champ LED product was used by Eaton's Crouse-Hinds alongside the Vaporguard series to replace the existing High Pressure Sodium (HPS) lighting structures at a major oil refinery in the USA. After several years of compound maintenance costs, the refinery sought a system which could simultaneously bring down these costs while providing a cleaner environment for workers.

The LED replacements managed just that, providing cleaner light and a substantial reduction in energy usage. According to Eaton's Crouse-Hinds, the Champ LED produces the equivalent lighting levels of a 100W bulb with just 50 W, while the Vaporguard, with explosion resistant technology, promises a reduction of 85%. In total, the refinery reduced its total energy usage by $34,668 while decreasing annual maintenance costs by $766,647.

FACILITY IN BRAZIL AFTER AN LED RETROFIT

Hazardous Environments

Any offshore oil rig will require products rated to withstand extreme and hazardous conditions – namely areas containing combustible or corrosive gasses, liquids, dusts or fibres. Any lighting installation should adhere to applicable hazardous area ratings where products are directly exposed to combustible elements, and be explosion proofed (able to contain internal combustion).

This is an area in which LEDs exhibit a clear technical advantage over fluorescent or incandescent fittings. Their internal construction is more robust leaving them less prone to breakages or shock and they offer spark free ignition – an obvious benefit when hazardous chemicals are in the area.

Conclusion

The LED market has reached a level of maturity where the technical specifications of systems can cope with the unique demands of oil and gas exploration. What's more, the scramble among lighting manufacturers to gain a best in class reputation is driving development and innovation meaning that LEDs is one of the fastest moving areas of technical evolution. Today's products are leagues ahead of those in operation just a few years ago and the chances are future generations will exhibit a similar step forward. For operators, it's a case of choosing the right product for the right situation.

The Past, Present and Future of LEDs

Jo Roth, *Staff Writer*

The LED market is earmarked for considerable and rapid growth. This article examines some of the key developments and innovations taking place around the industry.

Some manufacturers have placed the costs of replacing faulty bulbs at anything up to $1,000, once man hours, shut down and special equipment are all factored in

LEDS HAVE been around in one shape or form ever since 1907 when Henry Round discovered that inorganic materials could light up when an electrical current was passed through them, but it wasn't until the sixties that the first LEDs of any type made it to the market. It was even more recent, in the 90s, that the first white light LEDs appeared. However, it is in the last few years when the first LEDs outputting 100 lumens or more per Watt appeared that they've become usable on a large industrial scale.

With that power output has come a significant growth in the use of LEDs. Most estimates place the current share at around 18% of the overall general electric market, but several studies agree that the next five or six years are set for remarkable growth. According to a study by McKinsey, LEDs will incorporate 60% of the overall market by 2020. Price Waterhouse Cooper predicts, meanwhile, a 40% growth per year through 2016. LEDs, they say, have reached a turning point and could follow a similar trajectory to solar panels, which experienced average 66% per year rise over the past three years[12]. However, an over investment into production led to a surplus of solar panels and a dip in prices with the result that some manufacturers are struggling to be profitable.

Within this overall trend for LEDs, the oil and gas market – both for on and offshore facilities – represents something of an undiscovered country. Thus far, market penetration of LEDs lags far behind other industrial applications, but the potential benefits are vast. Energy costs and maintenance of power generation equipment represent two sizable and continuous costs for the oil and gas market.

Some manufacturers have placed the costs of replacing faulty bulbs at anything up to $1,000, once man hours, shut down and special equipment are all factored in. Lighting also accounts for approximately 20% of the overall power consumption of any oil or gas facility.

When you consider that LED lights promise to extend lifespans by up to 80% and more, and reduce costs by anything between 50% and 90%, this new technology looks like a compelling proposition. Factor in the environmental benefits of reduced light pollution, carbon emissions, and the fact that they contain no hazardous chemicals such as mercury, and it is small wonder that so many editorials are being run promoting the switch to LEDs.

A Perfect Storm

Conditions certainly seem to be right for the adoption of LED technology. The safety of conditions on board offshore oil rigs has been a cause of growing concern over the past few years. The surface of an oil rig is a hazardous environment with workers often forced to venture out in poor weather conditions, low visibility and at night. Like any workplace, the operator of an oil rig has an obligation to provide a safe environment for its staff and good, clear, lighting is a key part of that. Fluorescent bulbs are prone to failure and breakages leaving areas in the dark and with LEDs providing a significant step forward both in terms of light quality and reliability, there is an argument to say that operators have an obligation to install the best possible lighting technology.

It is air travel, though, that has dominated safety over the past few years after a series of helicopter disasters. This places additional pressure on the quality of lighting on the helideck level. Here, the better reliability, brightness, range and penetration of LEDs represents a significant boost. The value of helideck lighting was highlighted in a questionnaire put to pilots in the nineties in which they ranked helideck lighting as being the fourth most important factor in guaranteeing safety. The responses suggested that current helideck lighting was inadequate; perimeters were hard to distinguish and the glare from floodlights often blinded pilots. The recommended changes suggested included yellow LED[13] strip lights outlining the perimeter around the central illuminated 'H'.

LED TASKLIGHT REPLACES 100-200W INCANDESCENT, PROVIDING 20 TIMES THE LIFE AND 85% REDUCTION IN ENERGY COSTS

Coming of Age

More importantly, LED technology has now reached a point where quality is high enough for large scale industrial application, while solutions have become affordable enough to make the financial proposition worthwhile. Current estimates suggest that the general payback period has reduced to 3 years or less from 10 in just a few years and that figure is arguably lower for high power consumption operations such as offshore drilling. This creates a unique moment of opportunity for lighting companies where the product they are developing offers real value for end customers. But, as yet, there are relatively low levels of take up.

There is a huge gulf to be filled, and much like the Gold Rush of the 1800s there is a mad scramble to fill it and become the acknowledged market leader. For this reason, the leading manufacturers are devoting substantial sums and resources into developing cutting edge technology. The result is that the new generation of LED applications provide increasing levels of performance and quality.

It's with this in mind that we find Eaton's Crouse-Hinds Business opened a 60,000 square foot LED research centre to trial and develop new technologies. This state of the art multi-million dollar facility houses research, development, design, validation and manufacturing of the very latest and cutting edge LED technology for every area of business or industrial application.

In multiple labs and R&D facilities, teams of mechanical, electrical, thermal, optical and reliability engineers work with industrial designers, technicians and manufacturing personnel to produce the next generation of LED solutions.

The results of their work can be seen in a range of specialist LED lighting solutions for every part of an offshore platform. For the most part this simply involved producing lighting products which do the same job better, but there are exciting innovations on the horizon such as the use of solar power LEDs. Although incorporating only a tiny fraction of industrial LED products currently, they do have some potential, particularly in further reducing energy costs and carbon footprint, while also producing a reliable and renewable backup to conventional lighting systems.

This competition between manufacturers has led to a rapid expansion in the quality and sophistication of products on offer. The result is that the calculation that rig operators make when assessing the viability of LED lighting technology is progressively becoming heavily weighted in its favour.

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