

The LED Revolution

By Dr Nick Ward FRIN AFNI CEng CITP

Director of Research General Lighthouse Authorities
of Great Britain & Ireland (GLA R&RNAV)

Background

The last 50 years have seen a complete revolution in light sources for aids to navigation and the General Lighthouse Authorities of the UK & Ireland (GLA) have been at the forefront of these changes. Half a century ago most buoys and many lighthouses used gas mantles and acetylene gas cylinders. These gradually gave way to electrification in the 1950s, using incandescent (filament) lamps. The lamps in major lighthouses could be up to 3.5 kW and more than a foot high, this could be where the expression ‘more heat than light’ came from!

In the 1980s, coinciding with widespread automation, these large, specially made filament lamps were replaced by much more efficient, commercially available discharge lamps, in particular mercury vapour, or MBI lamps. These gave a better, whiter light, using less than a third of the power.

During the 1980s, trials with solar power with electric filament lamps on buoys led to increased reliability and a final move away from gas. Then in the 1990s, the 1 kW and 400 W MBIs in lighthouse rotating optics were replaced by much lower power discharge lamps (35 or 70 W), making conversion to solar power possible, even on major lighthouses, with enormous savings in running costs and maintenance, compared with constant-running diesel generators. Since discharge lamps could not be switched on and off rapidly, flashed lights in fixed optics still used filament light sources, but these were changed to clusters of halogen lamps, giving longer life and better optical characteristics.

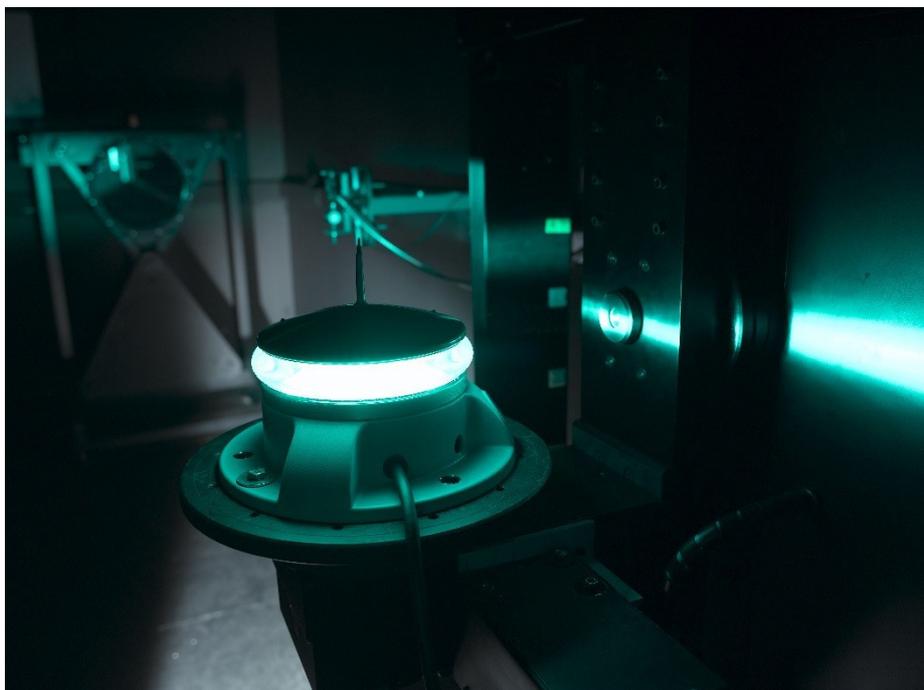
However, the real revolution occurred from the beginning of the 21st century with the introduction of Light Emitting Diodes (LEDs). These gave greatly extended life, more efficiency and flexibility of design, allowing LED arrays to be designed to match existing optics. LEDs were first introduced on buoys, where their reliability and long-life immediately paid dividends in reduced maintenance costs. They are now being installed in lighthouses, allowing further reductions in supporting infrastructure, such as solar energy systems, which have become the preferred option on all remote sites.

More recently, sector lights have been replaced with LED arrays, designed to meet the particular requirements of stations, in terms of sector cut-off, whilst giving much better colour recognition, without the inefficiency of coloured light filters.

LED Lights on Buoys

LEDs have well defined colour characteristics, so that white, red and green lights are much more readily distinguished than their incandescent predecessors. They also have ‘square’ flash shapes, with a sharp on and off transition, making lights more conspicuous and easier to identify, even in poor visibility. These advantages are particularly important on buoys, which are also subject to pitch and roll motion caused by waves.

In addition to the longer life, which reduces maintenance visits, the size and weight of LED lights are much less, making replacement easier, especially on a buoy at sea.



A green LED buoy lantern being tested on the light measurement facility at the Trinity House Depot, Harwich, on the east coast of England.

LED arrays on Lighthouses

Arrays designed by GLA R&RNAV have replaced conventional light sources in many rotating optics, giving a better match between the shape and size of the source and the optic, which in many cases was designed for a much larger filament lamp, or in the older ones for a mantle or wick.

Where shorter ranges are acceptable, commercially available lanterns with circular arrays of LEDs and annular lenses are used in flashing mode. These are simple to install and maintain, by replacement. However, their output still needs to be measured to ensure that operational performance meets published service

levels and this is a specialised service provided by R&RNAV to the GLAs and sometimes other lighthouse authorities.



A Research & Radio Navigation (R&RNAV) LED array light source inside a lighthouse optic.

LED Sector Lights

Filament lamps have continued to be used in sector lights because the lenses were often specially designed for each station, to provide the required cut-off and to fit in to the lighthouse structure, often a purpose-built window. Use of LED arrays has allowed the replacement of many of these special lamps, because the design of arrays is flexible and, as with buoys, there is no need for light filters to produce the required colour. Efficiency, cut-off accuracy and life are all greatly enhanced as a result.

Benefits of LEDs

The main drivers for the introduction of LED sources have been improved performance and efficiency. The performance of the lights has been verified by viewing trials, on-site measurement and testing under controlled conditions on the R&RNAV light ranges. However, the economic benefits have also been very significant and have contributed to the ability of the GLA to reduce overall operating costs. Whenever the use of new, more efficient light sources enabled conversion to solar power, the savings in running costs and carbon footprint have been very substantial. LED sources have been particularly valuable because of their flexibility of design and long life. On offshore sites, it has been imperative to move away from on-site diesel generation, as this not only entailed high fuel costs, but also high transportation costs, particularly when the usual method was by helicopter with underslung fuel bags. The savings in each

of these cases have been of the order of £10,000 and 15 tonnes of carbon per year.

Conclusions

There has been a steady progression in light sources over the history of lighthouses and buoys, but the last two decades have seen the greatest leap forward in both performance and efficiency. This progress, led by the GLA, is likely to continue, enabling them to meet their common mission statement: ‘To deliver a reliable, efficient and cost effective aids to navigation service for the benefit and safety of all mariners’.