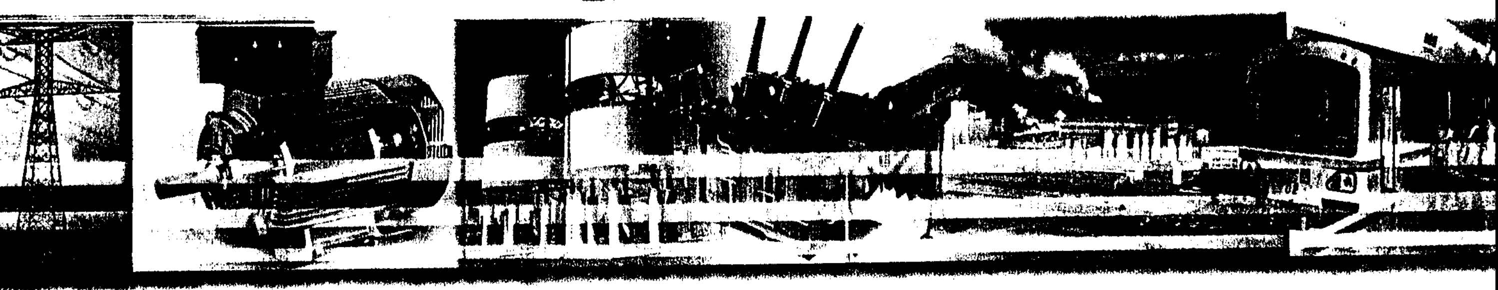

Standby lighting: a state of emergency?

Information from Cosine Developments

Emergency lighting has long been a source of both confusion and concern in South Africa. Firstly there are innumerable options where lighting duration, light output, lamp type and luminaire can be selected in any combination. Secondly serviceability is usually only established during power failures and, in many cases, it has failed to perform. There is however hope on the horizon. The new SABS performance requirements will ensure reliability and safety, and in so doing will reduce the options available. New products will also establish functionality and reduce maintenance workload through self-diagnosis.

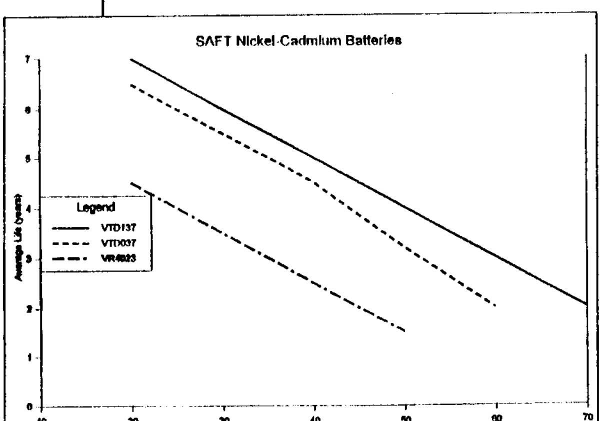

Fig 1: Averaged predicted service life of nickel-cadmium batteries (courtesy of SAFT).

Existing problems

Many emergency lighting systems suffer from both poor reliability and marginal safety for the following reasons:

■ Luminaire conversion

Until now it has been acceptable to convert almost any standard luminaire by adding emergency gear. The result is that emergency gear is shoe-horned into luminaires which originally were not intended to house any other equipment. This entirely defeats the objectives of SABS 598-1 because nine times out of ten the luminaire is now neither safe nor serviceable.

■ High ambient temperatures

Luminaires are often converted into emergency systems with little consideration for heat gain within the luminaire. This problem is compounded when the lamps are permanently switched on. In this regard compact fluorescent bulkheads are the worst offenders followed by recessed type fittings. Both the electronic control gear and the batteries are adversely affected by high temperatures.

Bear in mind that although electronic circuitry can withstand high temperatures for short durations, sustained elevated temperatures will prematurely age electrolytic capacitors and insulating plastics. Control gear should therefore not be mounted next to the ballast or lamp.

Batteries are more seriously affected by high temperature. Specifications reveal that service life is dramatically affected, lead-acid types being more sensitive. Worst case scenarios (PL bulkhead with two 9 W lamps, sustained mode, shallow opal lens and no separation between batteries and lamps/ballast) will result in nickel-cadmium batteries lasting only a few months before they expire.

■ Two-pin compact fluorescent lamps

BS 4533[9] disallows the use of fluorescent lamps with built-in starters for emergency use. This includes the popular two-pin compact fluorescent lamps that are often used for emergency lighting purposes in this country. The reasons for the ban are not clear but may stem from the difficulty in overcoming the starter impedance during lamp ignition. The result is that lamp ignition may be unreliable and, in extreme cases, lamp damage may result. BS 4533 does not, however, disallow the use of incandescent lamps for emergency purposes in spite of the overwhelming evidence suggesting that compact fluorescent lamps are more reliable. Therefore, providing that proper ignition and discharge scenarios are observed, there is no reason why compact fluorescent lamps should not continue to be used in emergency lighting in this country.

Compact fluorescent lamp (CFL) luminaires are used for emergency lighting because they tend to be cheaper than axial luminaires. However, cheaper CFL luminaires usually suffer from high heat gain through inadequate external radiating surface area, high thermal resistivity or high opacity optics. In the author's experience high temperature is the number one cause of premature failure in CFL emergency luminaires. CFL emergency luminaires are also often mounted outdoors and the combination of direct sunlight and internal heat gain limits the service life to a few months. This problem is so bad that occasionally the emergency lighting has failed before project completion.

A remote box housing both the emergency control unit and batteries should be used unless there is conclusive evidence that the internal temperatures will not significantly reduce battery life or decrease system performance. Also, restricted space within compact fluorescent luminaires often precludes a tidy installation of emergency gear.

Cost is usually the sole deciding factor when selecting batteries. Lead-acid types offer the lowest cost per Joule so they are used if space permits. Nickel-cadmium types are the other popular secondary cell used. The selection of battery type and brand name, however, can have a significant effect upon service life.

Fig 1 shows the predicted (averaged) service life of various SAFT nickel-cadmium batteries when permanently trickle-charged. Evidently there are large differences in predicted service life between cell types. At 40° C the VR4023 cell would only last just over two years whilst the VTD137 cell, which is designed specifically for high temperature operation, would last about five years. Vast differences in predicted performance are also evident for different brand names [1,2,3,6].

The predicted service life at elevated temperatures of lead-acid batteries is generally worse [4,5,7] (see Fig 2). At 40° C the predicted service life is from one to three years depending upon the manufacturer. At 50° C most lead-acid batteries would last less than a year. Lead-acid batteries should therefore not be mounted inside luminaires unless tests and published data suggest otherwise. Only batteries designed specifically for use at high temperatures should be used.

■ Photometric performance

The OHS Act and SABS 0114-2 (yet to be finalised) define minimum lighting levels and emergency lighting durations during power failures. The consultant may decide that a particular installation should use a 40 W lamp and provide 20% light output for three hours during a power failure. Another consultant may specify 50% for one hour or 100% for half an hour. Combinations of lamp types, light outputs and durations are limitless. Until now it has been the responsibility of the control unit manufacturer to provide equipment to satisfy the consultant's requirements. The problem is that the control unit manufacturer usually has no control over the emergency luminaire manufacture and therefore cannot guarantee many important performance characteristics. Variations due to differences in lamps, ballasts, batteries and operating temperatures can significantly affect the predicted performance.

The control unit manufacturer may publish expected light outputs and durations but the onus must fall on the emergency luminaire manufacturer to measure performance. The lighting consultant would then rest assured that the difference between his predicted and the actual performance of the installed system will be small.

■ Maintenance

Emergency lighting is usually purchased at great expense to satisfy authorities and then forgotten - until there is a power failure. Nickel-cadmium batteries suffer from a two-step discharge rate or "memory" effect when continuously charged [1,2,3]. To counteract this problem, to increase battery life and to establish system readiness the emergency lighting should be operated on a regular basis. The batteries should also be fully discharged to establish capacity and to remove memory effects. If South African requirements move in line with global trends then regular checks and documentation (log book) may become a legal requirement [10].

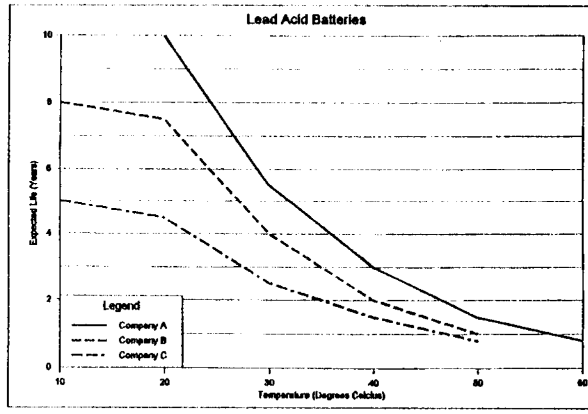

Fig 2: Averaged predicted service life of lead-acid batteries.

SABS 1464 part 22: Emergency lighting

The specification "SABS/IEC 598-1: Luminaires" governs the manufacture of luminaires to ensure quality and to reduce the risk of injury through electric shock or otherwise during usage. The SABS, following European regulations, have taken the view that emergency lighting must not only satisfy safety criteria but it must also function in the event of a power failure in order to prevent possible injury. Emergency lighting must therefore also satisfy performance criteria as detailed in SABS 1464 part 22.

This specification is currently under review, but all aspects refer to the performance of the emergency luminaire as a whole ie components such as the ballast and control unit are not evaluated individually. This makes sense because the required performance of emergency lighting systems is ultimately measured in terms of lighting durations and illuminance levels and not in terms of the individual component performances.

Emergency luminaire manufacturers will now be required to standardise on certain product lines, and consultants will only select general luminaires if acceptable emergency versions are available.

Self testing control gear

Self testing control gear has been developed for both European and US markets to assist maintenance personnel in ensuring the functionality of emergency lighting systems. These systems have built in microprocessors that autonomously conduct regular tests and report faults.

The unit automatically switches over to emergency operation to verify whether the electronics, battery and lamp are functional. A total battery discharge is also conducted so that battery capacity can be assessed and memory effects reduced. Problems are reported via an audible alarm to alert personnel, who may then assess the exact nature of the problem by deciphering a simple code or colour from the indicator lamp.

These systems offer a huge advantage over conventional systems because maintenance personnel need not interrupt mains power to establish whether the emergency lighting is functional, and there is less chance of problems going unnoticed.❑

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