COSINE DEVELOPMENTS

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Maintenance of emergency lighting systems

Due to current legislation, there is a huge drive to install emergency lighting in all public places where failure of normal power could result in disorientation and panic. The emergency lighting systems chosen depend upon the specific applications but most use batteries. In general, the emergency lighting system is installed primarily to satisfy legal requirements with little regard for maintenance.

In the past emergency lighting systems were installed in new buildings to satisfy the Fire Department and after the first inspection then neglected. However, the Occupational Health and Safety Act (Act 85 of 1993) states that emergency lighting must be kept in good working order and tested at least three months. It is now prudent to ensure that system maintenance is considered during the design phase.

The industry standard emergency lighting system consists of a battery pack and an emergency control unit built into the luminaire (See **Figure 1**). The luminaire is then fed by an extra permanent live connection to charge the batteries and detect power failures. The extra connection enables the luminaire to be used for both normal and emergency lighting (so called *maintained* operation). This option is preferred to motor generator sets because they will be activated when the power supply failure is restricted to a particular circuit or floor (SABS 0114-2). The emergency luminaires may be installed in shopping malls, airport departure halls, banking halls, restaurants, sports stadiums, warehouses, *etc*.

Figure 1

Periodic luminaire maintenance requires re-lamping and, if necessary, reflector cleaning. It is generally accepted that emergency luminaire batteries need to be replaced every three years assuming that the batteries were mounted in the coolest part of the luminaire. The battery

replacement could coincide with the re-lamping exercise thereby defraying costs but replacing batteries is usually considerably more time consuming than replacing lamps often because no consideration was given before mounting the batteries initially.

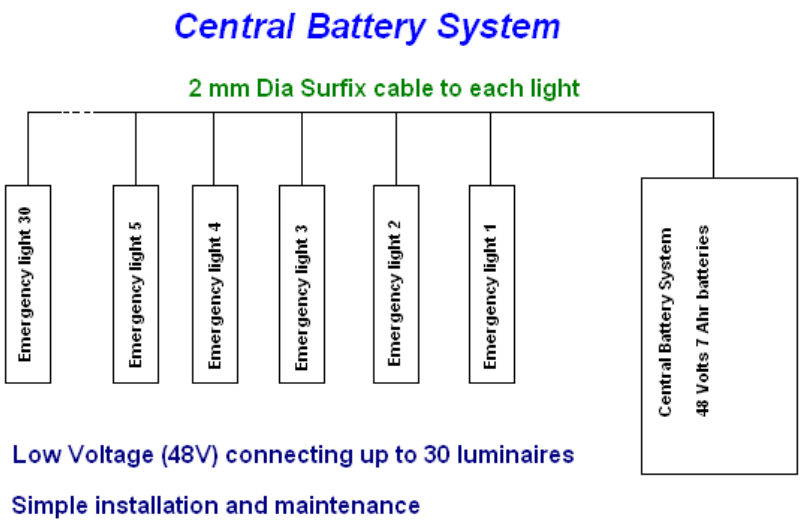

Figure 2 : A centrally supplied emergence lighting system

A strong case is therefore made for centrally supplied emergency luminaires where a central battery is connected to satellite emergency luminaires via a low voltage cable feed as shown in **Figure 2**. It will be shown that:

- Initial costs are comparable to self contained luminaires.
- Battery costs are considerably lower.
- Maintenance costs are reduced.
- Reliability is improved due to a dramatic reduction in battery ambient heat.

Initial Costs

A cost comparison between self contained emergency luminaires and central battery systems will begin with the installed costs. In most cases it will be the initial outlay that will determine system selection and maintenance issues, not the concern of the developer, often take a back seat. For the purposes of this cost comparison it is assumed that the luminaire electronic ballast, etc. is identical in system types.

The additional wiring requirement for self-contained emergency luminaires is a connection to a permanent live feed to charge the batteries and sense power failures. The additional wiring requirement for a central battery system is a low voltage cable connection (2mm Surfix) to each satellite luminaire. The marginal cost premium of the Surfix cable over the single permanent live feed (usually 1.5mm) and the labour costs associated with installing each system is usually not significant and will therefore be ignored.

Self-contained emergency luminaires each require the fitment of a battery pack. Assuming the cost of a typical battery pack to be R40.00 (6V 2Ahr) and the cost of a central battery

system (charger plus batteries) to be R1000.00 then a break even cost is attained when the central battery system has 25 satellite luminaires. As a maximum of 30 satellite luminaires can be connected to each central battery it follows that installed costs can be further reduced.

Battery Costs

High ambient temperatures inside the luminaire require the use of nickel-cadmium batteries in self-contained emergency fittings. The capacity of these batteries is usually 2Ahr (6V). This translates to an energy capacity of 43.2kJ and as each battery costs R40.00 the specific energy cost is approximately R1 per kilo-joule.

Centrally supplied systems do not require high temperature batteries and sealed lead-acid types may be used. A typical 12V 7Ahr battery has an energy capacity of 302kJ. As each battery costs R80.00 the specific energy cost is approximately 26c per kilo-joule or roughly a quarter as much as the nickel-cadmium types.

Therefore the battery costs in central battery systems can be significantly lower than those in self-contained emergency luminaires.

Maintenance costs

The battery packs inside self-contained emergency luminaires will require changing every three years. This operation will be time consuming and costly because often:

- Only qualified personnel may perform service on mains powered equipment.
- Luminaires are often mounted in high ceilings.
- Maintenance often interferes with normal workplace activities.
- Batteries are often initially fitted with no consideration given to later replacement (fixed by nut and bolt or with adhesives).
- Each luminaire must be tested after battery replacement.

In the case of a centrally supplied emergency lighting system the only effort required is to replace the central battery pack (no qualified personnel are required because the battery pack operates at 48Vdc).

Maintenance costs of central supplied emergency luminaires are therefore dramatically lower than those of self-contained units because, besides the lower costs of the batteries, the effort required to replace the batteries is significantly less.

It should also be borne in mind that premature battery failure may occur in both systems. In the case of a centrally supplied system the only remedial action would be to replace the battery in the easily accessible base station whereas the effort required to replace the faulty battery in a self-contained emergency luminaire will often be arduous.

Reliability

The current industry practice of cramming emergency lighting gear into small luminaires is well documented [1,2]. The worst offenders here are compact fluorescent bulkheads in stairwells where battery life is often limited to mere weeks due to the high temperatures

inside these fittings. In all maintained self-contained emergency luminaires the batteries must contend with elevated ambient temperatures due to the heating effects of the lamps and control gear. The service life of a nickel-cadmium battery is reduced by one year for every 10° C rise in ambient temperature and so the effects of high ambient temperatures upon battery life are always negative, even with “high temperature” nickel-cadmium types.

The predicted service life of a sealed lead-acid battery at normal ambient temperature (25^0C) may approach five years whilst the predicted service life of a “high temperature” nickel-cadmium battery operating in an ambient temperature of 50^0C may only be three years. As the system reliability is determined mainly by the battery service life it has been shown that the centrally supplied system is inherently more reliable than self-contained emergency lighting luminaires.

Figure 3: A Central Battery Base Station

Summary

It is clear that the case for centrally supplied emergency lighting systems should be investigated as its initial cost rivals that of self-contained units and it also has the benefit of lower maintenance and battery replacement costs.

References:

[1] *Standby lighting: A state of emergency?* S. Marais, Electron Journal June 1998
[2] *Compact emergency luminaires- beware*! S. Marais, 45th SANCI AGM and Congress