



Emergency lighting

for explosion hazardous areas

by Andreas Kaufmann

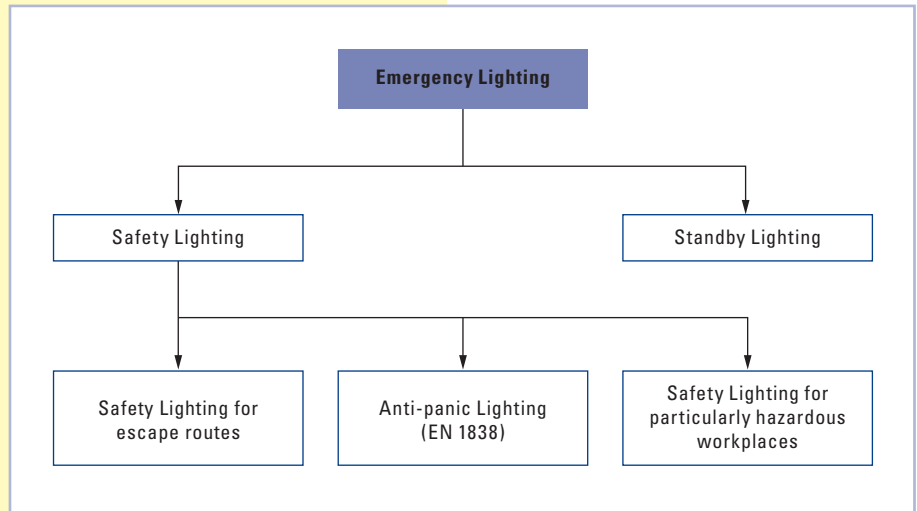


Figure 1: Division of emergency lighting into safety lighting and standby lighting

Power failures are an increasing occurrence worldwide. In the most spectacular failures in Europe and North America, the supply of power was interrupted for an extended period. In such cases finding one's way about is often difficult, or even impossible. In the majority of countries emergency lighting is therefore mandatory; this requirement applies especially to workplaces, for instance explosion protected areas and plants.

Emergency lighting is the lighting that becomes effective in a timely manner in an event of a malfunction in the supply of power to the general lighting or to apart of it. The term emergency lighting is a general term for safety lighting and standby lighting.

Here safety lighting is divided into the safety lighting for escape routes, safety lighting for particularly hazardous workplaces and anti-panic lighting, i.e. safety lighting for leaving rooms safely (Figure 1). The term standby lighting is also used in the context of emergency lighting.

Safety lighting

- Safety lighting for escape routes:
Safety lighting for escape routes makes it possible to leave a place safely and also makes it possible to find fire fighting equipment and safety equipment.
- Anti-panic lighting:
This lighting is used to prevent panic. It is therefore necessary for the illumination to be even and for the lighting to switch on quickly, i.e. 100% of the required illuminance is reached after a maximum of one minute.
- Safety lighting for particularly hazardous workplaces:
Hazardous processes that involve an elevated hazard potential require an increased illuminance that ensures the safety of the people present. A higher illuminance level is required for a brief period to safely bring the processes running to a stop.

Standby lighting

Standby lighting is lighting that ensures work can continue to be performed as usual for a certain period after a power failure, i.e. for a limited period general lighting is provided.

Various standby power sources are available for the implementation of the emergency lighting, i.e. to substitute power in the event of a power failure. Here a differentiation is made between individual batteries, battery groups and central batteries, generators or protected networks (Figure 2).

Requirements on emergency lighting installations

The requirements on the emergency lighting can be divided into lighting requirements and electrical requirements at national, European and international level. Table 1 provides an overview of the related institutions and authorities.

- Lighting requirements:
The lighting requirements at European and national level are given by the standards EN 1838 [1], EN 4844 – part 1 and 2 [2] and EN 60598-2-22 [3]. Here EN 1838 deals with the lighting requirements on the safety lighting, EN 4844 part 1 and part 2 describe the safety symbols and colours. EN 60598-2-22 covers the safety requirements and electrical requirements on the luminaires for the emergency lighting. Table 2 contains examples of the lighting requirements in relation to the illuminance, the rated operating times and the switch-on time requirements for the emergency lighting. The marking of escape routes is also regulated by EN 4844 and the German BVG A8, Ab 4.3 [4]. The following safety signs are to be used (Figure 3).

On the safety sign, the arrow indicating the direction may also point to the top or bottom corner of the door to make the escape route clear, e.g. stairs. The positioning of escape signs luminaires is stipulated wherever there are emergency exits and on exits along escape routes (BGR 216 [5], EN 1838). In terms of safety luminaires, the escape route must be illuminated at every corridor junction, interruption or change in direction. It is also defined that stairs and level changes on escape routes must be illuminated. Along with shape and position, the safety signs must be of a defined colour; they must have a white graphic

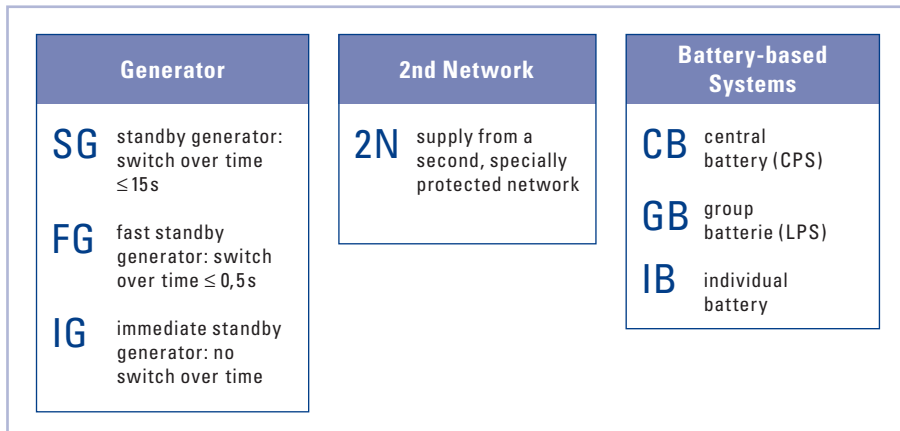


Figure 2: Alternative systems for the implementation of standby power for the emergency lighting

	Electrical requirements	Lighting requirements
international	IEC	ISO/CIE
European	CENELEC	CEN
national (German)	DIN/VDE	DIN

Table 1: Overview of the international, European and national authorities that define the lighting requirements and electrical requirements for emergency lighting systems



Figure 3: Standardized safety signs for escape routes

symbol and a green background. The average luminance for the sign must be 200 cd/m², where the recognition distance (E) is given by multiplying the height of the safety sign (h) by the distance factor (z). The distance factor is 200 for internally illuminated safety signs and 100 for externally illuminated safety signs for escape routes.

➤ **Electrical requirements:**

The electrical requirements are regulated in EN 50171 [6] and EN 50172 [7].

Possible solutions for power supply of the emergency lighting

As described before, 3 alternatives are available for the emergency lighting: Emergency lighting using generators, a protected network or battery-based systems. In practice, essentially battery-based systems are in use for safety lighting, individual battery supplied luminaires and groups of luminaires or central battery systems.

Redundancy favours individually supplied safety luminaires, as each luminaire operates separately and is independent of wiring in emergency operation. They are used predominantly where the number

of luminaires required is low or in large installations to avoid installation effort, which otherwise may be necessary. These luminaires will still function even if the electrical wiring system is destroyed. A disadvantage is the high maintenance effort for the individually supplied luminaires.

Group and central battery systems are useful if a large number of safety luminaires are required that are to be monitored centrally. The high level of convenience and reduced maintenance effort are in favour of the central battery system. The advantages of the solutions discussed are given again in an overview in Table 3.

The luminaires for the emergency lighting are fed either from the AC network or the battery network from the group or central battery system. A three-phase circuit from the main distribution is laid to the emergency lighting system for the AC network. This network feeds the emergency luminaires, provides system control and charges the battery block. The battery network supplies the emergency luminaires via circuit modules in the event of the failure of the AC emergency lighting network

The emergency lighting circuits can be allocated different operating modes via the control unit, for instance maintained operation, non maintained operation with emergency lighting blocking or also mixed operation. With maintained operation, the emergency luminaires are operated from the AC network for the emergency lighting system. In the event of a power failure, the battery network automatically takes over the supply of power. With non maintained operation, the emergency luminaires are only switched on in the event of the failure of the AC network and are then supplied from the battery network.

Type of illumination	Required illuminance	Ratio of the highest to the lowest illuminance (E _{max} / E _{min})	Rated operating time	Switchover time for the safety lighting
Safety lighting for escape routes with a width up to 2 m	1 Lux on the centre line of the escape route. (Wider routes can be considered as several 2 m wide strips)	40:1	At least 1 hour	50% of E _{min} within 5 seconds. 100% within 60 seconds
Safety lighting for particularly hazardous workplaces	10 % of the general lighting. However at least 15 Lux	10:1	To suit the length of time during which there is a hazard for people	The required illuminance must be present continuously or achieved in 0.5 seconds
Anti-panic lighting	At least 0.5 Lux on the open floor area (areas at the edge with a width of 0.5 m are not taken into account)	40:1	Minimum 1 hour	50% of E _{min} within 5 seconds. 100% within 60 seconds
Standby lighting	If standby lighting is used to take over tasks of the emergency lighting, all relevant requirements in this standard must be met. If the standby lighting generates a level of lighting below the minimum for the general lighting, it is only allowed to be used to shut down or end a work process.			

Table 2: Overview of the lighting requirements on emergency lighting



The main components of every central battery system are the ECS microprocessor-controlled control unit, the heart of such a system, the charger modules, the battery, the 3-phase monitoring unit, and the circuit modules.

The WFZB series central battery units from R. STAHL (Figure 4) meet the continuously increasing requirements on safety technology in a sensible and economical manner. The freely programmable system with its flexible design permits straightforward installation with the advantage of optimal adaptation to the different operation variants including general lighting. A high level of safety and redundancy is achieved due to separate plug-in modules. This situation applies both to the final circuits and to the charger modules in 19" design. The current in the final circuits and in the safety and escape sign luminaires connected is monitored, or the luminaires are addressed individually and automatically checked every week.

The WFZB central battery systems comply with the requirements on the safety power supply system for safety lighting as per EN 50171, EN 50172, EN 50272 [8] and DIN 5035 Part 5 [9]. They feature the following characteristics:

- 19" cabinet system with hinged frame and 19" rack either as floor-mounted distributor in conjunction with a modular battery cabinet or a battery rack, as well as in the form of a combined cabinet with electronic device and sealed battery compartment as per EN 50272
- automatic, microprocessor-controlled ECS test unit as per EN 50172 Part 1, 6.4.3.10
- continuous monitoring of the function of all components by the integrated monitoring and test system
- indication and non-volatile storage of all relevant data with date and time
- indication and print out of all test results over the last 4 years
- freely programmable 19" final circuit modules UM 3 · 4A (ILS)
- individual switching per final circuit on the front
- individual luminaire monitoring or current monitoring
- redundant primary switched mode 19" charger modules EL with 1.25, 5 or 10 A. →



Figure 4: WFZB central battery system from R. STAHL

Advantages of individual supply	Advantages of central supply
Low installation effort	High level of convenience due to central operation
Increased functional safety due to integral supply	Central luminaire function monitoring
Low investment costs	Automatic event documentation with four-year memory
Price advantage with small number of luminaires	Long service life of the central battery (≥ 10 years)
Maintenance-free NiCd battery	Low maintenance effort
Segmenting of the safety luminaires to different phases of the electric circuits	No power limit
Low effort for expansion	Malfunctions can be signalled at any location

Table 3: Overview of the advantages of individually supplied emergency luminaires and the supply of emergency luminaires with central battery systems



As an option, address modules with ILS technology (intelligent lighting control) can be used in the luminaires; in this way up to a maximum of 20 safety luminaires and escape sign luminaires can be combined in one final circuit. In this case the allocation of the type of operation (NMO, MO, switched steady light) can be programmed as required using the ECS central unit.

Safety luminaires can be switched together with luminaires for the general lighting using the existing switching contact L' without major effort. This feature saves, among other aspects, long wiring routes and reduces the installation effort (Figure 5).

The miniature sub-station (Figure 6) in the series WFZB-UVS4 is an ideal addition to the WFZB central battery system. It is used by fire section to reduce the final circuits with function retention cable.

Current monitoring is installed in the miniature sub-stations as standard. 2 by 2 luminaire circuits can be programmed as required using the main unit. The load rating is limited to a maximum of 2.4 A (2.750 W). The mini sub-stations can be implemented in E30 or E90 enclosures.

Along with the central battery system combined with the miniature sub-stations, group battery systems can also be used in some applications. These systems have a compact design. The systems can be installed centrally or decentrally, e.g. by fire section. As standard, they have circuit monitoring as per EN 50172 and addressing is optional. The version of the WZB-6-48 compact system from R. STAHL is characterized by the following technical parameters:

- › 6 final circuits at 150 Watt each; freely programmable for NMO/MO/switched steady light
- › mixed operation
- › protection per final circuit for network and battery
- › 2 redundant, primary switched mode charger modules 48V/2..5 A,
- › protection for network and battery
- › 6-off LSM 230 (lighting switch interrogation, 230 V input)
- › individual luminaires (addressing or circuit monitoring self-calibrating), programmable, ILS technology
- › RS 232-PC interface incl. software (single licence)
- › interface to central computer
- › function monitoring/fuse monitoring per final circuit
- › electronic test log > 4 years
- › networking of up to 63 systems via central computer: ZRM
- › optionally also available in E30/E90 enclosure.

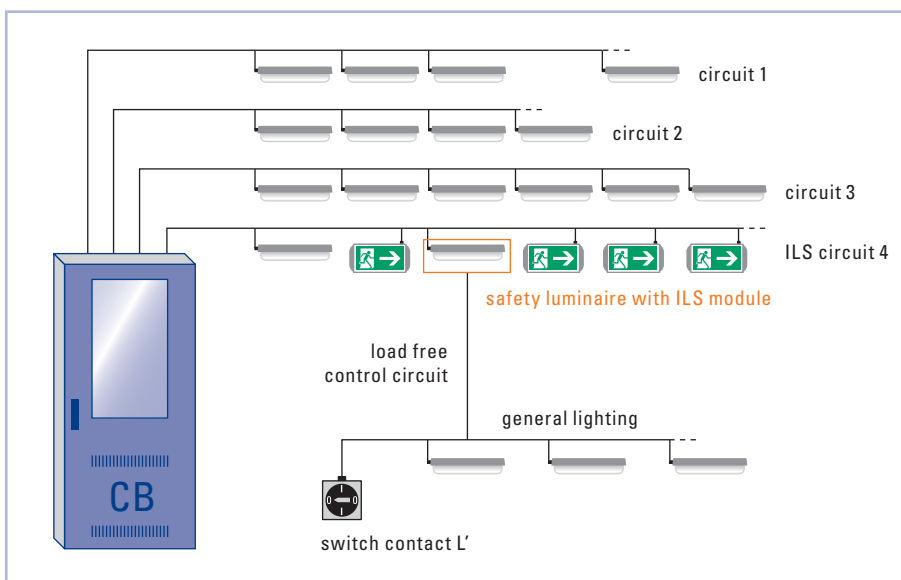


Figure 5: Illustration of the usage of ILS modules in combination with a central battery system and safety luminaires and escape sign luminaires



Figure 6: Miniature sub-station in E30 enclosure



Figure 7: Central unit that enables the central battery system to be individually configured and monitoring tasks to be performed

The ZRM is a central computer; this is a microprocessor-controlled central monitoring unit incl. PC workstation software for monitoring, controlling and programming one or more central battery systems, sub-stations and/or group battery systems in the WFZB series (Figure 7).

In this case it is possible to read and archive the test logs saved electronically, as well the device configurations. It is also possible to enter arbitrary text for device, circuit and luminaire designations. The central unit is equipped with an RJ 45 interface for connection to a network.

The system is easy to operate and configure using 5 menu keys on the monitoring unit. The most important functions can be simply and efficiently polled and configured using the 4-line plain text display and 6 function keys.

The function of the emergency lighting and the selection of the explosion protected luminaires must always be correct. For this reason, planning requires extensive specialist knowledge and experience, as numerous regulations and requirements must be taken into account.

Along with the requirements related to explosion protection, among other aspects the physical situation for the lighting system and appropriate circuit configuration are crucial. Furthermore, the division of the luminaires into the operating modes (non maintained operation, maintained operation or a combination) must be defined. The circuit modules and the battery capacity must be configured and selected as a function of the number of emergency luminaires and their power rating. In some circumstances, further system networking is planned or intended, in this case the related interfaces are also to be defined.

Maintenance costs can be significantly reduced by using central battery systems in industry. However, attention must be paid to professional planning, especially in relation to the selection of the explosion protected luminaires.

References

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EN 4844-2 Safety marking – part 2: Overview of safety signs + corrigendum: 2001
- [3] EN 60598-2-22; Luminaires part 2-22: Particular requirements. Luminaires for emergency lighting: + corrigendum: 2008-11
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- [6] EN 50171; Central power supply systems + Corrigendum: 2001
- [7] EN 50172; Emergency escape lighting systems: 2004
- [8] EN 50272-1 and -2; Safety requirements for secondary batteries and battery installations Part 1: General safety information; Part 2: Stationary batteries
- [9] DIN 5035-5:1987-12 Innenraumbelichtung mit künstlichem Licht; Notbeleuchtung