Technical collection

Canalis® busbar trunking systems in exhibition centres

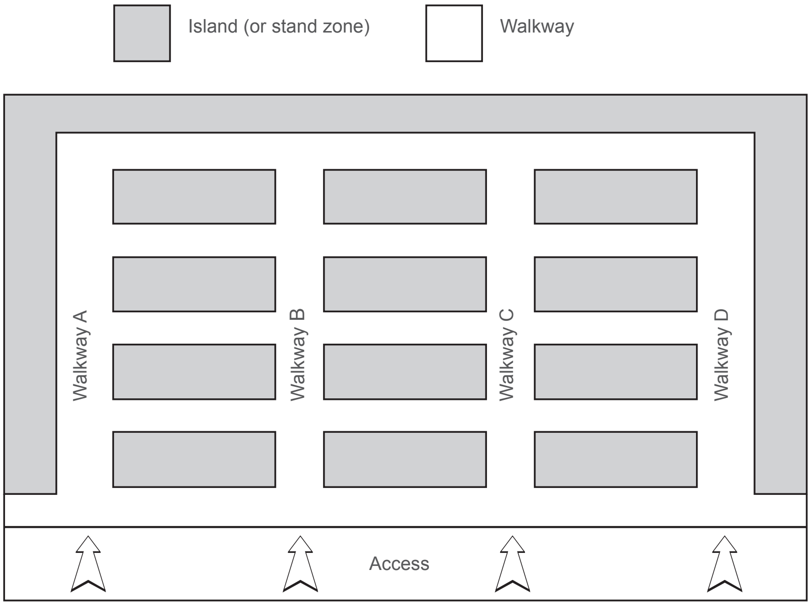
Technical application specifications

Schneider Electric

Contents

Introduction

Typical organisation of an exhibition hall



Exhibition hall

Introduction

Definition

- Exhibition centres are structures with variable surface areas that we can divide into 3 categories:
- □ Regional exhibition centres with indoor floor space < 20,000 m^2
- □ National exhibition centres with indoor floor space < 100,000 m^2
- □ International exhibition centres with indoor floor space > 100,000 m^2
- An "exhibition centre" generally includes several buildings, each of which can be divided into halls. These indoor areas are often supplemented with outdoor areas, which are also used for some exhibitions, especially exhibitions involving heavy-duty equipment such as machines and materials used for construction work.
- The buildings have a simple structure and are, more often then not, built on one level with free floor space to allow for stands to be easily set up.

Operating mode and related needs

Upgradeability and flexibility

Each new exhibition sees the creation of a new town which is different from the previous one, a town which lives briefly and intensively and then disappears. It is therefore essential that the solutions set up for exhibitors are upgradeable and flexible in order to deal with this variety of situations and the continuous modifications which take place.

Easy to operate

Upgradeability and flexibility must not be obtained at the expense of simplicity.
Easy operation means that:
- "dead time" between exhibitions, when the stands are dismantled and installed, is reduced,
- exhibitors can be offered quality service at a lower cost.

Safety, continuity of supply and compliance with standards

Exhibition halls are, by definition, buildings which are open to the public. Safety and electricity continuity of electrical supply are therefore fundamental. This is ensured through compliance with standards, international standards such as IEC 364 and/or national standards which cover buildings' electrical installations, which may be supplemented with special texts dealing with this type of premises, for example the BOP regulation "protection against fire and panic risks in buildings open to the public" for France.

Versatility

In order to meet all of these expectations, Schneider offers global solutions based on the concept of decentralised distribution using BTS (Busbar Trunking System).

Concern about maximising the premises' occupancy rate leads operating companies to accommodate other activities (cultural and sporting events, conferences, exams, etc.) in addition to their main function of organising and accommodating fairs and exhibitions.
This versatility must be taken into account when the premises are being designed.

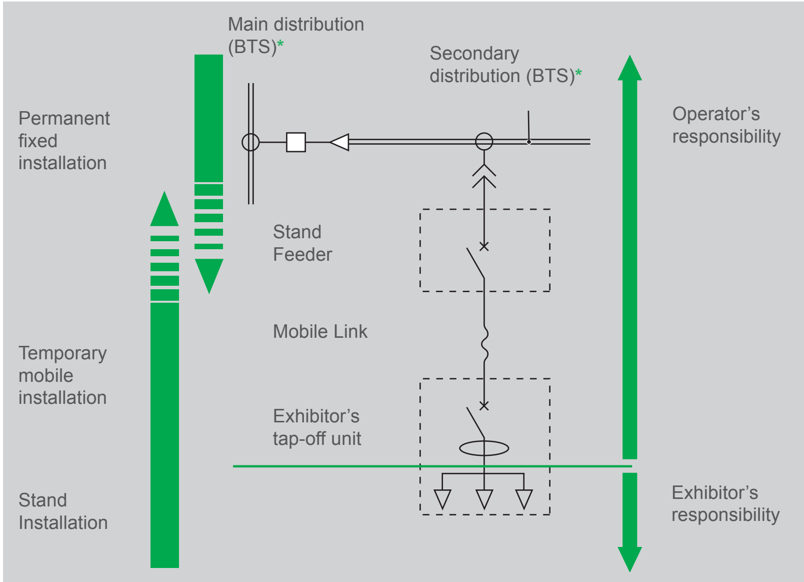
Example of an international-type exhibition centre

"Paris-Nord Villepinte" exhibition centre:
- indoor floor space: 160,000 m^2,
- number of halls: 6,
- 40 fairs per year,
- 16,500 exhibitors per year,
- 1,000,000 visitors per year.

Installation linked to the distribution of electricity to stands

General principle

Architecture of typical distribution



**BTS: Busbar Trunking System*

Installation linked to the distribution of electricity to stands

General principle

Whatever the type of solution is used for the distribution of electricity to stands, the installation structure has 2 different parts (see previous figure):

Fixed permanent installation

The fixed part of the installation ensures the distribution of energy as close as possible to where it is needed (supplying exhibitor's stands). It must be sized to meet the various situations which could arise depending on the exhibition type.

- stand floor space: 10 to 400 m² or more
- density of connections: 5 to 100 for 1,000 m²
- medium power: 20 to 150 W/m²
- power per stand: 2 kW to 250 kW.

The fixed part of the installation includes main distribution supplemented, depending on the solutions set up, with secondary distribution. Both main distribution and secondary distribution are carried out using prefabricated busbar trunking.

Temporary mobile installation

The mobile installation allows for the exhibitor's stand to be connected to the fixed main or secondary distribution.
All or part of this system is therefore reconfigured between exhibitions.
In order to simplify this reconfiguration, mobile links must be of a minimum length.

This minimum length also means that:
- voltage drops can be reduced,
- protection against indirect contact through the TNS neutral point connection can be ensured thanks to the control of the fault loop impedance.

The length of this cabling is directly dependent on the density of the fixed distribution network.

The connection leads to an exhibitor's unit fixed to the stand. This unit defines the boundary between the installation which is the responsibility of the operating company and that which is the responsiblility of the exhibitor.

The unit contains protection using a circuit breaker equipped with a residual current device:
- **In** rated circuit breaker depending on the power requested by the exhibitor.
- **IΔn** circuit breaker adapted to the stand's installation:
  - 30 mA high sensitivity for small stands,
  - 300 mA or more low time-delayed sensitivity, for large stands.

It is up to the exhibitor to supplement the system with the appropriate protection.

In order to guarantee that the solutions set up comply with installation rules, the operating limits, as well as the technical data for the different parts used in the temporary mobile installation must be clearly defined:
- Type and rating of the protection.
- Min. cross-section and max. length of cables used for mobile links.

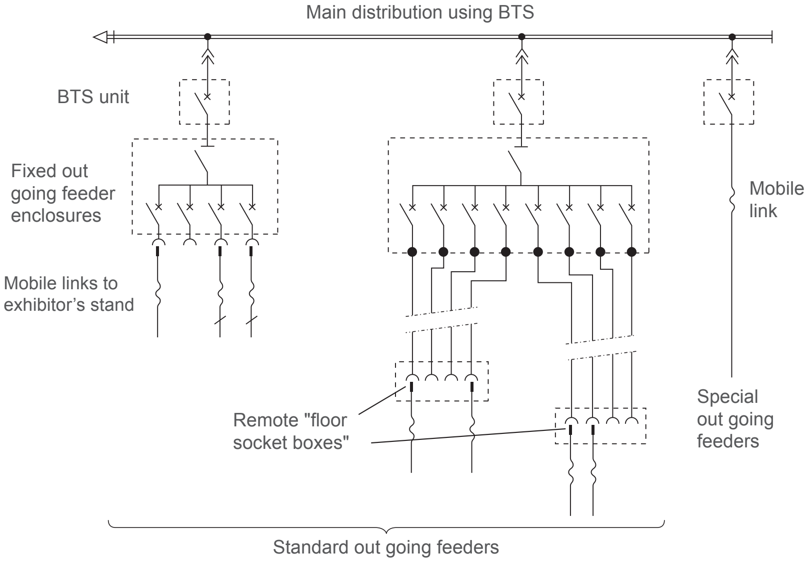
Installation linked to the distribution of electricity to stands

General principle

Stand out going feeders: standard and special out going feeders

Whether the "stand feeder" belongs to the fixed installation or mobile installation depends on the solution used.

Out going feeders connected to the fixed installation



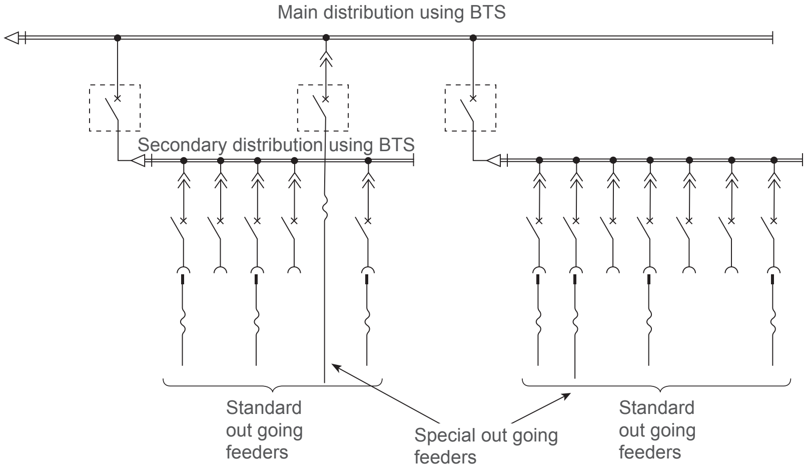
See chapter 3 for typical solutions B1, B2 and D2, where standard out going feeders are included in the fixed installation.

Several out going feeders are grouped together in one enclosure. This enclosure is either located on the hall floor, or in the adjoining premises (technical galery in the hall basement for example).
The cabling of the mobile link is carried out through power sockets. These sockets are situated on the same level as the enclosure or moved as close as possible to the stands in "floor socket boxes" inbedded in the flooring.
For currents ≥ 32 A, these sockets should be of the type with a built-in switch allowing for a break in current on load.
Supplying the stands with current from power sockets is a solution for the vast majority of cases at different exhibitions.
A solution for "special out going feeders", aimed at supplying current to high power stands, is necessary to supplement these "standard out going feeders".
The best-adapted solution to meet this need consists in supplying the "standard out going feeder" units using prefabricated busbar trunking. The "special out going feeders" are therefore set up with tap-off units which can be directly plugged into the busbar trunking.

Installation linked to the distribution of electricity to stands

General principle

Out going feeders connected to the mobile installation



See chapter 3 for typical solutions A, C, D1 and D3, where the standard out going feeders are part of the mobile installation.

This type of out going feeder is based on units which can be plugged directly into the prefabricated busbar trunking. This solution is therefore very flexible since the power and density of each out going feeder can be adapted to the real needs of each exhibition.
Nevertheless, it is preferable to define a unit rating for "standard out going feeders" in order to minimise the variety of units, the corresponding amount of stock and handling time between each exhibition. Some of these "standard out going feeder" units are preinstalled on the busbar trunking.

Installation linked to the distribution of electricity to stands

General principle

Financial optimisation of solutions

Whatever the solution chosen, whether it be stand out going feeders attached to the fixed or mobile installation, the choices which define the density and dimensions in terms of rating of the standard out going feeders are essential to minimise the total cost of the installation.

Total cost = Investment cost + Operating cost

Density of standard out going feeders

The distribution of standard out going feeders is uniform for the whole hall and their density is determined depending on the density planned for the exhibitor’s stands.

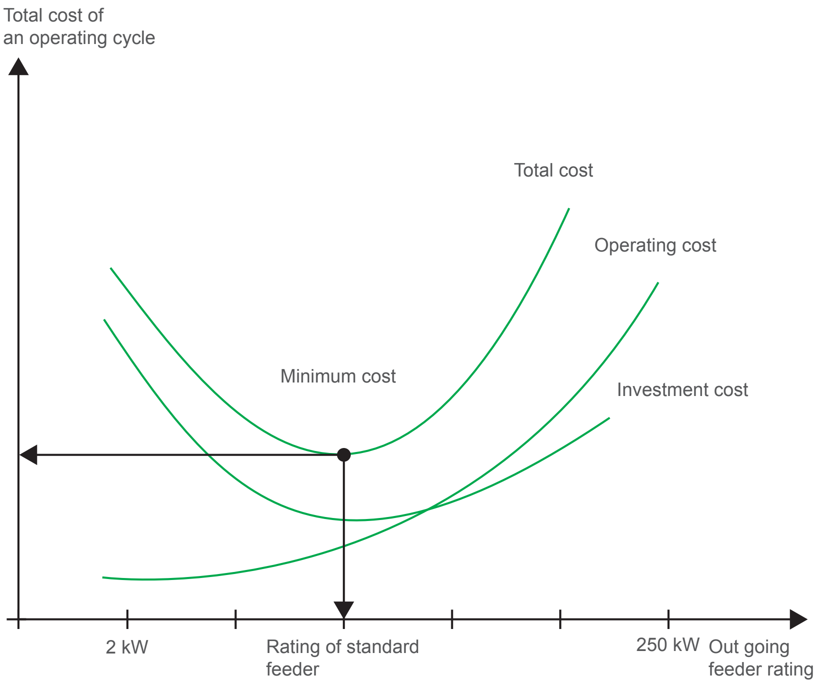
Out going feeders connected to the fixed installation
The stands’ maximum density is taken into account.
E.g.: Minimum size of a stand is 3 m x 3 m, or 1 standard out going feeder / 9 m^2.

Out going feeders connected to the mobile installation, units on prefabricated busbar trunking
Their density is determined according to the stands’ average floor space.
E.g.: Minimum size of a stand is 3 m x 3 m, but the average floor space is 30 m^2, or 1 unit installed / 30 m^2.

At each exhibition, they are supplemented either with standard tap-off units or special units with a higher rating. This solution therefore means that the number of units, both units installed and units in stock, and the investment costs involved, can be reduced.

Determining the rating of standard out going feeders

Total cost of an operating cycle



Under-rating standard out going feeders minimises investment, given that expenditure on the units is reduced, but increases the amount of special cabling and thus increasing operating costs resulting from the numerous changes which need to be made for each exhibition.
On the other hand, over-rating maximises investment without this necessarily leading to a reduction in operating costs.

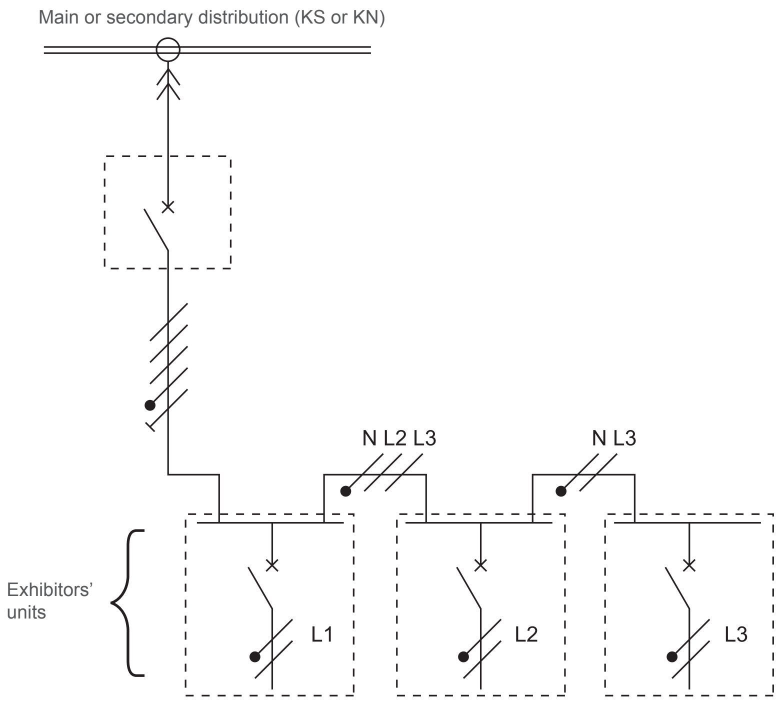
Financial analysis carried out on the basis of the previsional data for the operation of premises allows for the optimum density and rating of standard out going feeders can be determined.
An example of this financial analysis is available in appendix 1:
- Financial optimization of solutions.
- Methodology and example for determining the rating of standard out going feeders.

Installation linked to the distribution of electricity to stands

General principle

Chaining stand tap-off units for low power out going feeders

Chaining



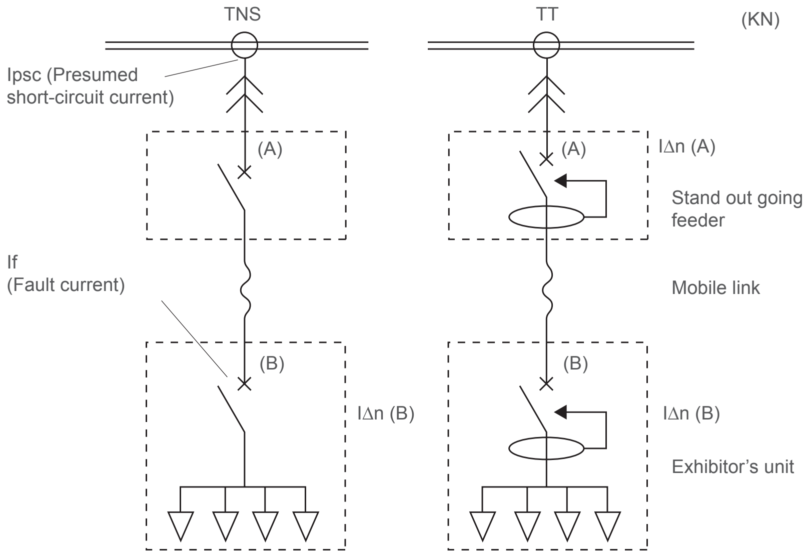
Small stands which do not need a large amount of power are generally grouped in zones, which therefore gives them a high density.
In order to limit the number of standard out going feeders and mobile connections, exhibitor's units are connected in a chain. A standard 3 Ph + N out going feeder thus supplies 3 stands in single-phase.

Installation linked to the distribution of electricity to stands

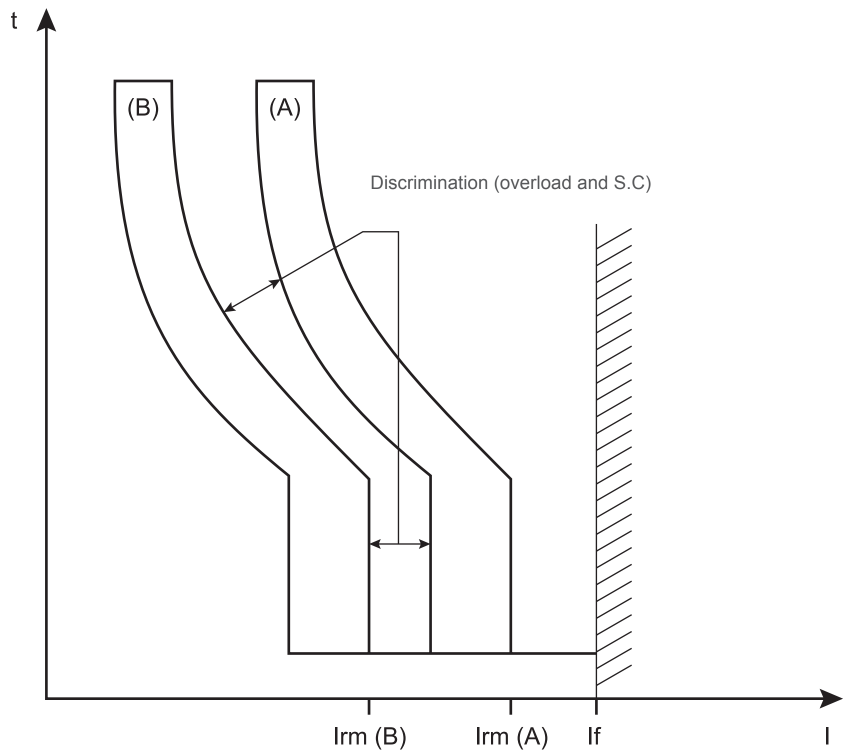
General principle

Choice of protection

Protection



Discrimination, overload and short-circuit



Installation linked to the distribution of electricity to stands

General principle

The respective types and ratings of the protection (A) of the connection and of the circuit breaker (B) must ensure the following:

Circuit breaker (A)

- Protect the link against short-circuits.
- Ensure protection against indirect contact in accordeance with the earthing system decided upon for the installation.

TNS neutral point connection

Irm (A) < If

The higher the Id, the easier it is to respect this condition.
Id depends on the impedance of the fault loop or:

- the upstream short-circuit level Ipsc.
  The distributed solution using BTS is the most appropriate for meeting this condition given its low Ph-PE impedance.
- the control of the temporary mobile link's Ph-PE impedance and therefore its minimum length and/or large cross-section.
  If this condition is not met, the circuit breaker (A) should be equipped with an RCD (Residual current device).

TT neutral point connection
Protection against indirect contact is ensured by an **RCD** combined with a circuit breaker (A).

Circuit breakers (A) and (B)

- To guarantee discrimination (overload and short-circuit) between circuit breakers A and B. In the case of a fault or overload on the stand, only circuit breaker (B) is accessible by the exhibitor and circuit breaker (A) can only be reset by the operator.

TT neutral point connection
Discrimination between **RCDs** must also be ensured as well as the circuit breakers' overload and short-circuit discrimination. This is carried out through compliance with the following 2 rules:

- current-sensing discrimination: $I\Delta n$ (A) > 2 x $I\Delta n$ (B)
  (upstream RCD (A) setting threshold > 2 times larger than downstream RCD (B) setting threshold),
- timed discrimination: Tnf (A) > Ttc (B)
  (upstream RCD (A) non-tripping time > downstream RCD (B) breaking time).

For Merlin Gerin circuit breakers, this condition is met by using successive bands which guarantee the timed discrimination between them.
Band 0 (instantaneous) – band I – band II.

Installation linked to the distribution of electricity to stands

General principle

Billing energy and metering

The amount for which the exhibitor is billed includes the energy consumed as well as the contract price for electrical connection to the stand (connection and disconnection).

The system which allows the measurement of consumption as well as its administrative management should be:

- economical in investment terms as well as in terms of operating and administrative costs
- flexible because if the exhibitor has under-estimated the power needed, the out going feeder rating needs to be increased without having to intervene on the mobile section, which is inaccessible during operation.

There are 3 possible solutions:

- Billing in real terms for the power consumed. This choice involves placing a meter on each out going feeder, reading data on the meter at the end of the exhibition and the corresponding billing. This solution is therefore very heavy, both in terms of investment and operation. It is thus only justified for high power connections.
- Billing on the basis of a contract tariff which includes several price brackets determined according to the power of the connections.
  These brackets are divided into two possibilities offered to the exhibitor: a permanent connection (the stand is supplied 24 hours a day) or a non-permanent connection (the stand is only supplied when open to the public).
  This type of billing is simple and is particularly useful for small, "regional centre" type sites, where the power of connections is limited.
- Mixed solution:
  A mixed solution, which is better suited to high power connections, is preferable for larger sites.
  This represents a compromise between the two preceding solutions:
  - contract billing is reserved for low power connections,
  - billing in real terms is used for higher power connections.

An example of the set up is available in chapter 3, "Distribution management" (page 32).

Installation linked to the distribution of electricity to stands

Typical solutions

Introduction

The most common solutions used for the distribution of electricity to stands (pages 16 to 31) as well as a control-monitoring system for managing the distribution (pages 32 and 33) are presented in this chapter.

The choice of the best-suited solution depends on:

- **The building type** – the floor space in the halls, ground-floor hall or on a particular floor, etc.
- **The type of exhibitions which will be organised** – the stands' floor space, the maximum amount of stands which can be set up, power of the connections and total power needed, other amenities distributed, etc.
- **The other activities which could be accommodated.**

The table below provides an overview of the typical solutions presented.

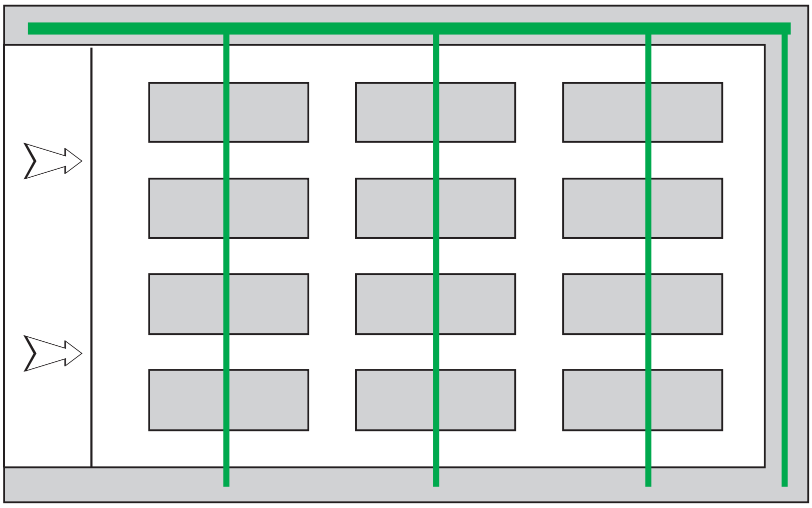
Typical solution	Description	Hall floor space P_{av}/m^2	Infrastructures
A p. 16	**Distribution through the ceiling** Main and secondary distribution using BTS	**2,000 to 4,000 m²** ≤ 50 W/m²	No special infrastructures
B1 p. 18	**Mixed distribution** Main distribution using BTS through the ceiling + floor-standing enclosures	**3,000 to 5,000 m²** ≤ 80 W/m²	No special infrastructures
B2 p. 20	**Mixed distribution** Main distribution using BTS through the ceiling + floor-standing enclosures and boxes with power socket	**4,000 to 8,000 m²** ≤ 120 W/m²	No special infrastructures
C p. 22	**Distribution through the floor** Distribution using BTS in floor service ducts	**4,000 to 6,000 m²** ≤ 80 W/m²	Floor service ducts
D1 p. 24	**Distribution through the floor** Main distribution using BTS in galleries + mobile links in floor service ducts	**6,000 to 10,000 m²** ≤ 120 W/m²	Gallery + floor service ducts
D2 p. 26	**Distribution through the floor** Main distribution using BTS in galleries + floor-standing boxes with power sockets	**8,000 to 12,000 m²** ≤ 150 W/m²	Gallery + floor service ducts
D3 p. 28	**Distribution through the ceiling** Main distribution in galleries and secondary distribution using BTS in floor service ducts	**8,000 to 12,000 m²** ≤ 200 W/m²	Gallery + floor service ducts

Installation linked to the distribution of electricity to stands

Typical solutions

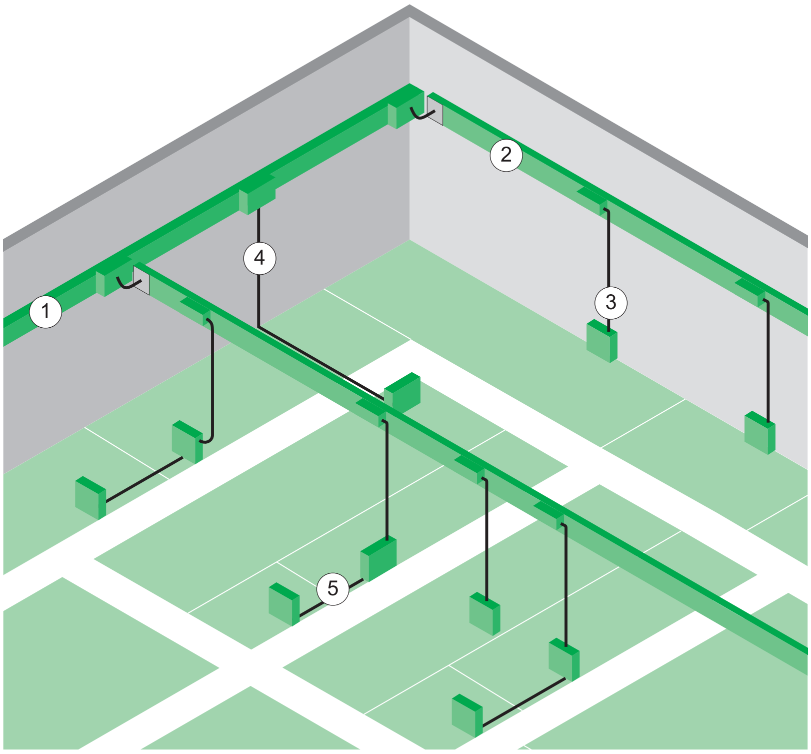
Typical solution A: Distribution through the ceiling

Main and secondary distributions using BTS



Main distribution KS BTS

Secondary distribution KN BTS



Fixed installation:

① Main distribution KS BTS
② Secondary distribution KN BTS

Mobile installation:

③ Standard out going feeder on KN
④ Special out going feeder on KS
⑤ Chaining

Installation linked to the distribution of electricity to stands

Typical solutions

This solution is best suited to regional-type exhibition centres with hall floor space of between 2,000 and 4,000 m^2 and distributed power ≤ 50 W/m^2.

BTS main and secondary distributions

Description

Fixed installation

2 distribution levels means that the entire hall can be covered:

- Main distribution set up using medium-power KSA 250 A or 400 A busbar trunking. This busbar trunking is usually set up around the hall's perimeter.
- Secondary distribution set up with low power KNA 63 A or 100 A busbar trunking. This busbar trunking is set up over the stand areas and fixed to the building's framework.

Mobile installation

Stand out going feeders are units which can be plugged into Canalis runs.
Standard out going feeders have a rating of 1 x 16 A + N (3 kW) or 3 x 16 A + N (9 kW) and can be chained to supply 3 stands.
Special out going feeders are for power ≤ to 20 kW supplied from KN Canalis runs and KN 3 x 32 A + N (18 kW) units.
For higher power, these out going feeders are directly connected onto the main KSA distribution. Two ratings of KSA (3 x 63 A + N and 3 x 125 A + N) units are generally enough to meet the needs of special high power connections.

Example:

- Hall size: 100 m x 30 m (L x l) or 3,000 m^2.
- Max. power: 40 W/m^2 or120 kW for the whole hall.
- Stand floor space: min. 9 m^2 (3 m x 3 m), average 20 m^2.
- Main distribution: 1 KSA 250 A run.
- Secondary distribution: 10 KN runs with a rating of 63 A, with a fixing centre of 9 m between each run. This distance corresponds to 2 back-to-back stands (6 m) plus the width of a walkway (3 m).

The maximum fusing coefficient between KN runs is 0.35.

Advantages and disadvantages

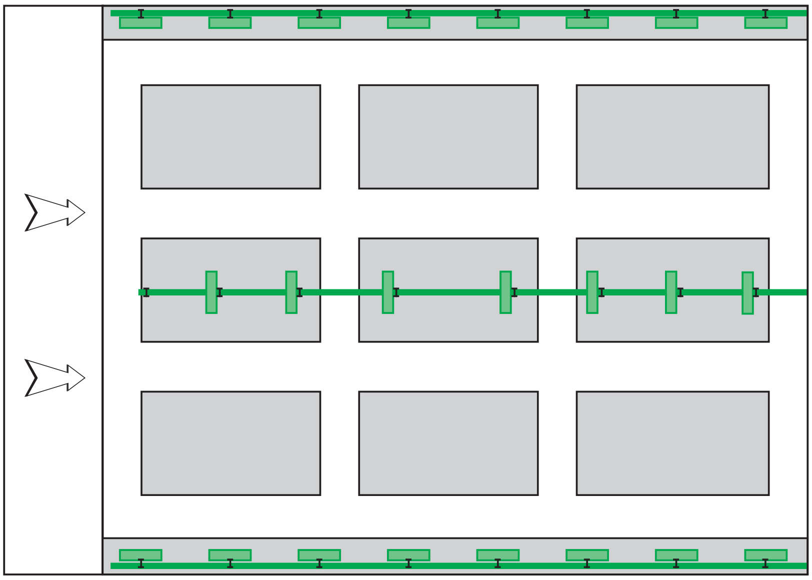
- This solution is simple and economical. The other networks, amenities and weak currents such as compressed air and the telephone are distributed in a similar way to electrical power. This solution, which does not need a special infrastructure, is suitable for ground-floor halls as well as halls on specific floors.
- The height of the secondary distribution network is limited to 4 to 5 metres to make it easier to access the units, which rules this solution out for halls with very high ceilings. This is often the case when halls are also used as sports grounds. Solutions B1 and B2 are preferable in this case.
- If a distribution network for drinking water and a network to drain waste water are necessary, they must be dealt with separately and are therefore integrated into the hall flooring.

Installation linked to the distribution of electricity to stands

Typical solutions

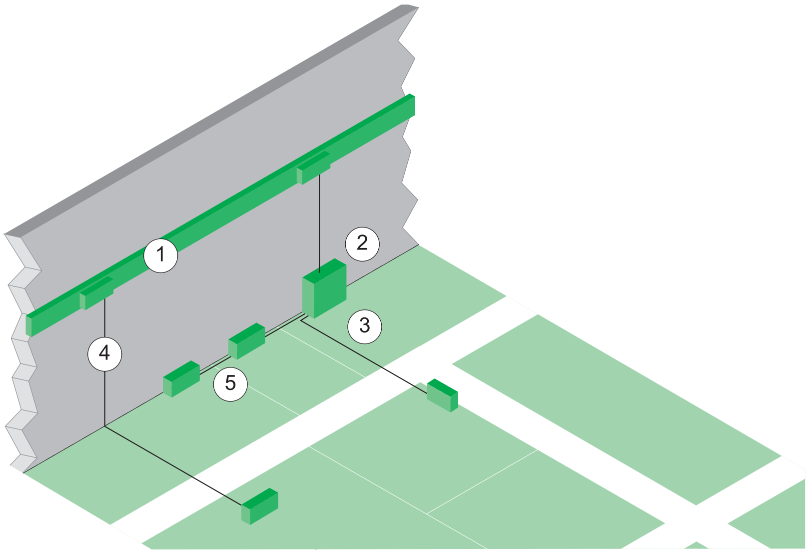
Typical solution B1: Mixed distribution

Main distribution using BTS through the ceiling + floor-standing enclosures



Main distribution (KS BTS)

Floor-connection units



Fixed installation:

① *Main distribution KS BTS*
② *Floor-standing enclosure*

Mobile installation:

③ *Standard out going feeder from the enclosure*
④ *Special out going feeder on KS*
⑤ *Chaining*

Installation linked to the distribution of electricity to stands

Typical solutions

This solution is best suited to regional and national type exhibition centres with hall floor space between 3,000 and 5,000 m^2 and distributed power ≤ 80 W/m^2.
It is also adapted for halls located on particular floors.

Main distribution using BTS through the ceiling + floor-standing enclosures

Description

Fixed installation

The fixed part of the electrical distribution includes:

- Main distribution carried out with medium power KSA 250 A to 630 A busbar trunking. This busbar trunking is generally set up around the hall.
- Enclosures which are connected to the main distribution and set up in the floor. These enclosures are equipped with protections and power sockets for supplying **standard out going feeders**. Each enclosure supplies 8 to 12 out going feeders. All of these out going feeders have the same rating, 3 x 25 A + N to 3 x 63 A + N, depending on the individual case in question. If the rating of the out going feeders is higher than 32 A, the sockets should be of the built-in switch type and should allow the out going feeder to be switched off on load.

Mobile installation

Chaining is systematically used for the cabling of low power stands in order to minimise the number of **standard out going feeders** and therefore the number of enclosures.
Special out going feeders are directly connected to the main KSA distribution in the case of power which is higher than the rating of the standard out going feeders.

Example:

- Hall size: 80 m x 50 m (L x l) or 4,000 m^2.
- Max. power: 80 W/m^2 or 320 kW for the whole hall.
- Stand floor space: min. 9 m^2 (3 m x 3 m), average 30 m^2.
- Main distribution: 2 KSA 400 A runs of a length of 80 m set up on both sides of the hall.
- Floor-connection units: eight 125 A units per KSA run to supply the enclosures with ten 3 x 25 A + N out going feeders per enclosure.

That is, a total of 16 floor-connection units and 16 x 10 = 160 sockets available for standard connection, thus a density of 1 socket / 25 m^2. This means that, given the possibility of chaining, which allows up to 3 small stands to be connected per socket, the most difficult case, where a zone only includes stands with a minimum surface area of 9 m^2, can be dealt with.

Advantages and disadvantages

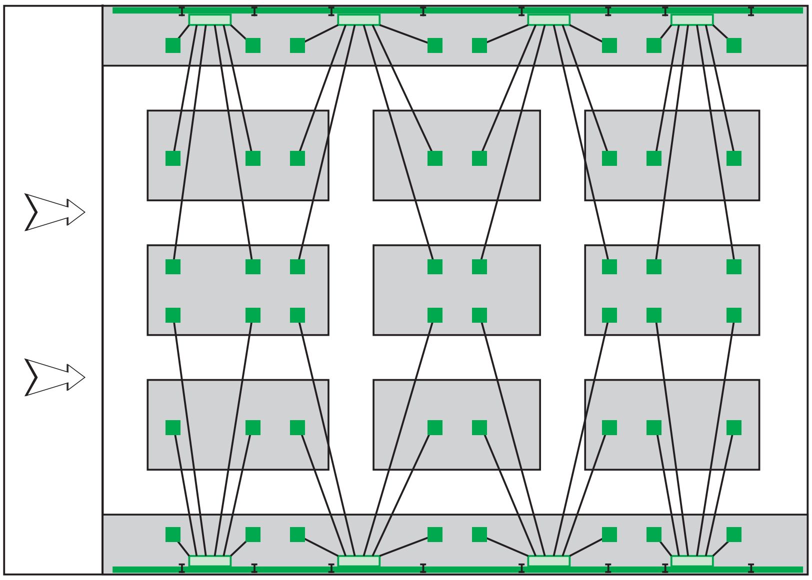
- When the BTS and the enclosures are set up around the hall, it can be used as a sports ground as indicated with typical solution A without any problems.
- Depending on the hall's floor space and the density of the enclosures, the mobile links may be long. The setting up, laying and removal of the temporary mobile installation at each exhibition can then become a difficult operation.

Installation linked to the distribution of electricity to stands

Typical solutions

Typical solution B2: Mixed distribution

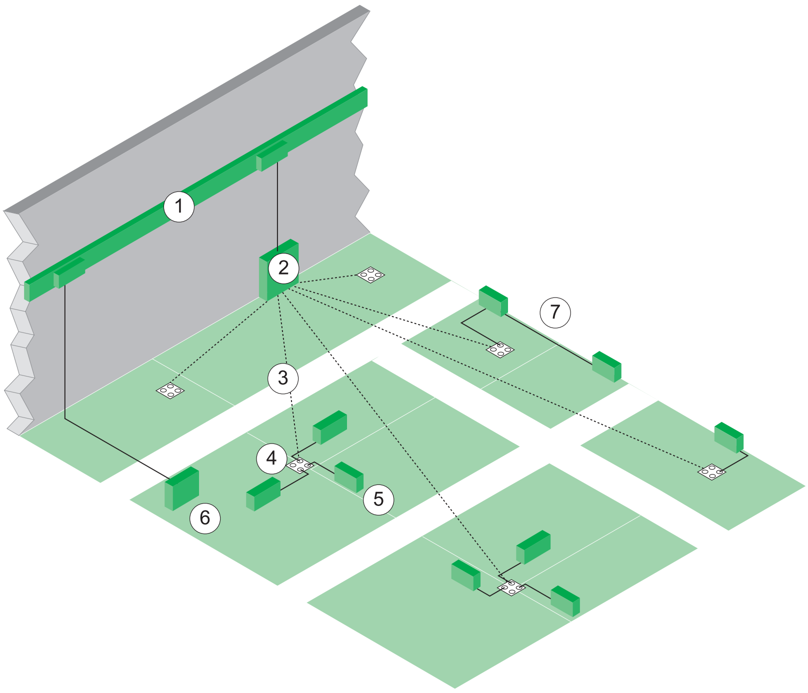
Main distribution using BTS through the ceiling + enclosure + floor-standing boxes with power sockets



Main distribution (KT/KS BTS)

Enclosures

Floor power socket boxes



Fixed installation:

① *KT/KS BTS*
② *Floor-standing enclosure*
③ *Cable in tubing*
④ *Floor power socket boxes*

Mobile installation:

⑤ *Standard out going feeder on socket*
⑥ *Special out going feeder on KS*
⑦ *Chaining*

Installation linked to the distribution of electricity to stands

Typical solutions

This solution, which is a variation on solution B1, is best suited for national and international type exhibition centres with hall floor space between 4,000 and 8,000 m² and distributed power ≤ 120 W/m². It is also adapted for halls located on particular floors.

Main distribution using BTS + floor-standing enclosures and boxes with power sockets

Description

Fixed installation

The fixed part of the electrical distribution includes:

- Main distribution set up with medium power KSA 400 A to 800 A or high power KTA 1000 A to 1600 A busbar trunking.
  This busbar trunking is generally set up around the hall's perimeter.
- Enclosures connected to the main distribution and set up in the floor. These enclosures are equipped with protections for standard out going feeders supply.
- Floor-standing boxes, distributed throughout the hall and equipped with power sockets, with 2 to 4 power sockets per box. All of these out going feeders have the same rating, between 3 x 25 A + N and 3 x 63 A + N depending on the case in question. The enclosures and boxes are linked by cable in tubing imbedded into the flooring. Each enclosure supplies 4 to 8 boxes or some 20 power sockets.

Temporary mobile installation

Chaining is systematically used for the cabling of low power stands in order to minimise the number of standard out going feeders and therefore the number of enclosures.
Special out going feeders are directly connected to the main KSA or KT distribution when the power is higher than the rating of standard out going feeders.

Example:

- Hall size: 100 m x 60 m (L x l) or 6,000 m².
- Max. power: 120 W/m² or 720 kW for the whole hall.
- Stand floor space: min. 9 m² (3 m x 3 m), average 40 m².
- Main distribution: two KSA 800 A runs of a length of 100 m set up on both sides of the hall.
- Enclosures: five 250 A units per KSA run to supply the enclosures, twentyfour 3 x 45 A + N out going feeders per enclosure for 6 floorstanding, 4-socket boxes with a lamination coefficient of 0.2.

That is, a total of 10 enclosures and 24 x 10 = 240 sockets available for standard connections, thus a density of 1 socket / 25 m². This means that, given the possibility of chaining, which allows up to 3 small stands to be connected per socket, the most difficult cases, where a zone only includes stands with a minimum surface area of 9 m², can be dealt with.

Advantages and disadvantages

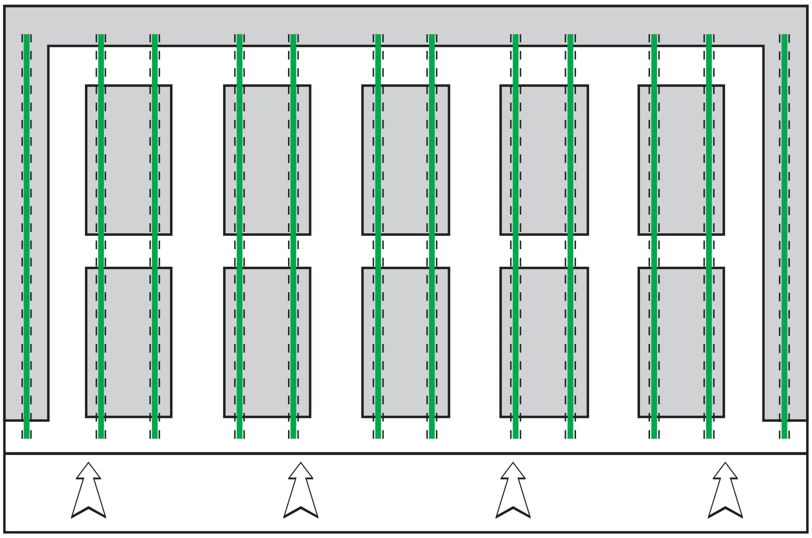
- This solution is similar to solution B1. However, incorporating floor-standing boxes with power sockets means that standard out going feeders can be placed closer to stands and therefore limits the length of mobile cabling.
- A larger number of out going feeders can be connected to each enclosure, which therefore reduces the number of these enclosures and the space that they occupy on the floor.
- Mobile links remain long for special out going feeders, especially since this type of stand is often placed in the central part of the hall. The solution consists of reducing the quantity of special out going feeders by increasing the rating of standard out going feeders, a solution which is quickly limited given the increased investment which it entails.

Installation linked to the distribution of electricity to stands

Typical solutions

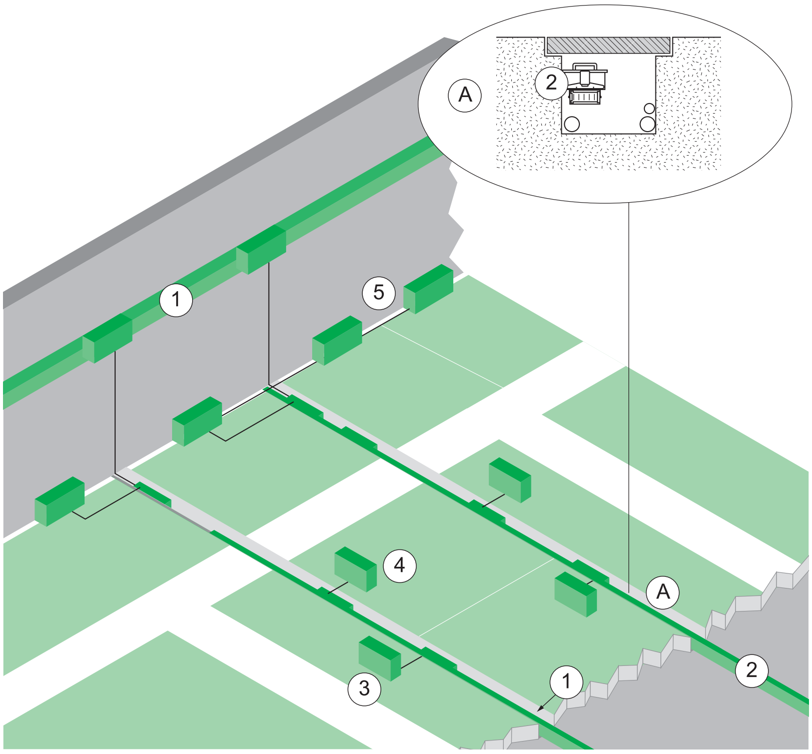
Typical solution C: Distribution through the floor

Main distribution using BTS in-floor service ducts



Distribution in in-floor service ducts (KS BTS)

In-floor service duct



Ⓐ In-floor service duct

Fixed installation:

① Main distribution (KT/KS BTS)
② Secondary distribution (KS BTS)

Mobile installation:

③ Standard out going feeder
④ Special out going feeder
⑤ Chaining

Installation linked to the distribution of electricity to stands

Typical solutions

This solution is best suited to regional and national type exhibition centres with hall floor space between 4,000 and 6,000 m^2 and distributed power ≤ 80 W/m^2.

Main distribution using BTS sets in-floor service ducts

Description

Infrastructures

In-floor service ducts are set up throughout the hall with a centre distance of 6 to 8 m.

Fixed installation

The fixed part of the electrical distribution includes distribution using KSA 160 A to 400 A medium power busbar trunking set up in the in-floor service ducts with the other networks distributed (telephone, computer, clean and waste water, compressed air, etc.). It is a good idea to have several ratings of KSA busbar trunking in order to allow the connection of special high-power out going feeders (see example below). This busbar trunking is supplied either directly by cable from the switchboard, or from main KT or KS busbar trunking raised around the hall's perimeter.

Temporary mobile installation

Stand out going feeders are units which can be plugged into KSA Canalis runs. Standard out going feeders have a rating of 3 x 16 A + N (10 kW) to 3 x 32 A + N (20 kW) with the possibility of using chaining to supply 3 stands. Special out going feeders have a rating of 3 x 32 A + N, 3 x 63 A + N and 3 x 125 A + N. The rating of the special units is limited by the rating of the KSA busbar trunking as well as the space available for installing it in the in-floor service duct.

Example:

- Hall size: 100 m x 50 m (L x l) or 5,000 m^2.
- Max. power: 80 W/m^2 or 400 kW for the whole hall.
- Stand floor space: min. 9 m^2 (3 m x 3 m), average 30 m^2.
- Main distribution: 1 KSA 800 A run of a length of 100 m.
- Secondary distribution: 17 KSA runs of a length of 45 m set up in-floor service ducts with a centre distance of 6 m, 13 runs of a rating of 100 A and 4 runs, or 1 run out of 4 of a rating of 250 A.
- Standard out going feeders: 3 x 25 A + N units, 1 unit is installed every 5 m, or one unit for 30 m^2, which corresponds to the average surface area of the stands. Stands are either supplied using chaining between exhibitors' units or by completing the existing units with additional units in high-density zones. The rating of these units can then be limited to 1 x 25 A + N.

Advantages and disadvantages

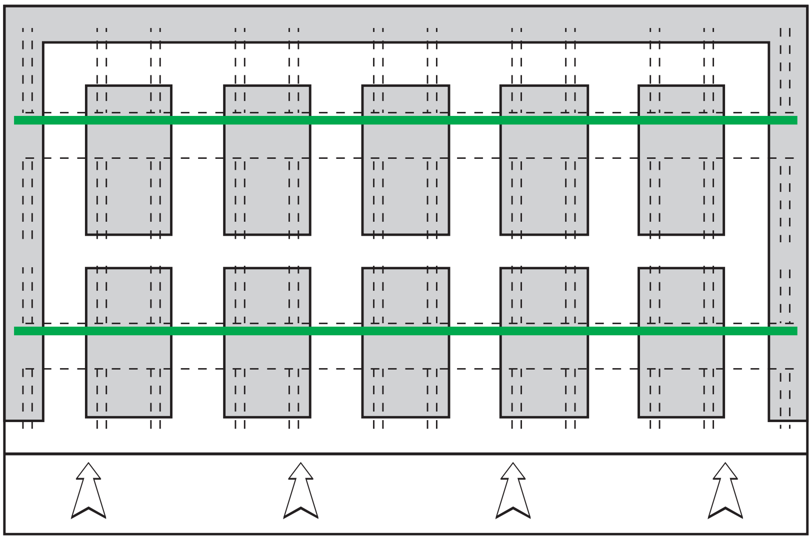
- The density of secondary distribution reduces the length of temporary mobile cabling. The flexibility brought by decentralised distribution using BTS means that the best solution can be found for the different situations encountered, such as high density of small stands and high power connections, while minimising investment.
- Discrimination between protection of the stand out going feeders and the exhibitor's unit (see pages 12 and 13) is mandatory given the difficulty of accessing in-floor service ducts during exhibitions. The limit of this solution depends on the maximum length allowed for the in-floor service ducts, a limit which is linked in particular to the waste-water-draining network.

Installation linked to the distribution of electricity to stands

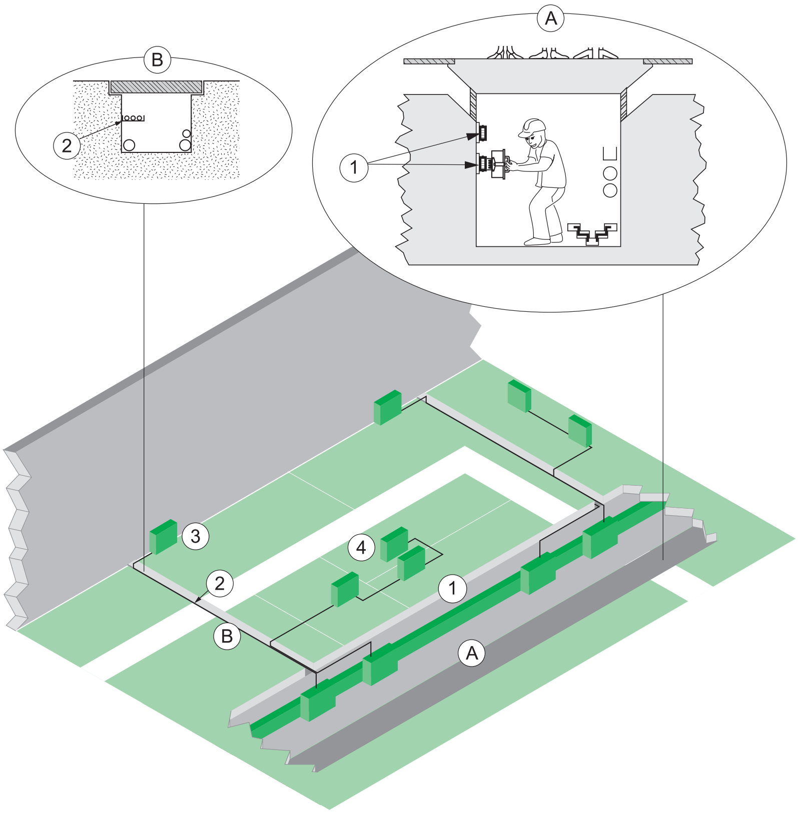
Typical solutions

Typical solutions D1: Distribution through the floor

Main distribution using BTS in galleries, mobile links in-floor service ducts



- *Main distribution (KT/KS BTS)*
- *In-floor service duct*
- *Gallery*



Ⓐ *Gallery*
Ⓑ *In-floor service duct*

Fixed installation:

① *Main distribution (KS BTS)*

Mobile installation:

② *Mobile link using cable in-floor service duct*
③ *Standard out going feeder*
④ *Chaining*

Installation linked to the distribution of electricity to stands

Typical solutions

This solution is best suited to international-type exhibition centres with hall floor space between 6,000 and 10,000 m^2 and distributed power ≤ 120 W/m^2.

Main distribution using BTS in galleries + mobile links in in-floor service ducts

Description

Infrastructures

Technical galleries are located in the hall's basement and are supplemented with a network of in-floor service ducts situated on both sides of the galleries (with a cable duct centre distance of 6 to 8 m and length of 15 to 25 m).
Galleries and in-floor service ducts are used for the distribution of all of the amenities.

Fixed installation

The fixed part of the electrical distribution includes main distribution carried out through medium or high power KSA or KTA BTS with a rating of 800 A to 1,200 A set up in galleries.
When the possibilities of permanent connection (stands supplied 24 hours a day) and nonpermanent connection (supply only during opening hours to the public), are offered to the exhibitor, this main distribution is divided into two. Two parallel busbar trunkings are installed in the gallery and the one which is reserved for non-permanent connections is controlled according to the site's opening hours by the BMS.

Temporary mobile installation

Stand out going feeders are units which can be plugged into KSA or KTA Canalis runs.
Standard out going feeders have a rating of 3 x 32 A + N to 3 x 63 A + N.
Special out going feeders have a rating of 3 x 63 A + N and 3 x 250 A + N.
The mobile links to exhibitors' units are set up using cable. They are installed in-floor service ducts just near the stands.

Example:

- Hall size: 100 m x 90 m (L x l) or 9,000 m^2.
- Max. power: 100 W/m^2 or 900 kW for the whole hall.
- Stand floor space: min. 12 m^2 (4 m x 3 m), average 40 m^2.
- Infrastructure: 2 galleries are set up along the sides of the hall. They each supply a network of 2 x 17 in-floor service ducts, (length 22 m, centre distance 6 m) laid out at equal angles from the gallery.
- Main distribution: 2 KSA 630 A runs of a length of 100 m installed in a parallel line in each gallery.
- Standard out going feeders: 3 x 45 A + N tap-off units, 4 units as well as their corresponding mobile links are pre-installed for each infloor service duct, or one unit per 33 m^2.The stands are supplied through chains between exhibitors' units in high-density zones.

Advantages and disadvantages

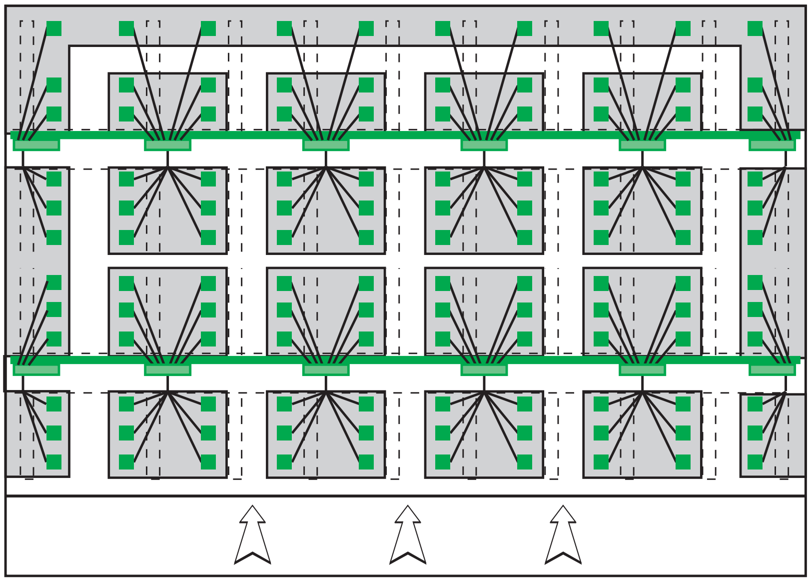
- This type of infrastructure, gallery + cable duct, gives the operator easy access to equipment.
- Installation rules limit the length of temporary mobile cabling. This constraint leads to plans for in-floor service ducts with a length of 22 m, in the example above for a maximum length of 30 m and therefore 2 galleries for a hall width of 90 m. This lay-out significantly increases costs compared with a single gallery solution (see example of solution D3).
- Fire regulations generally dictate that there should be a fire-barrier passage between the gallery and the cable duct. This lay-out is highly restricting when standard or special out going feeders need to be added to the pre-installed out going feeders. This leads to the systematic use of chaining and the over-rating of standard out going feeders in order to limit the addition of special out going feeders as much as possible.

Installation linked to the distribution of electricity to stands

Typical solutions

Typical solution D2: Distribution through the floor

Main distribution using BTS in galleries + floor-standing boxes with power sockets



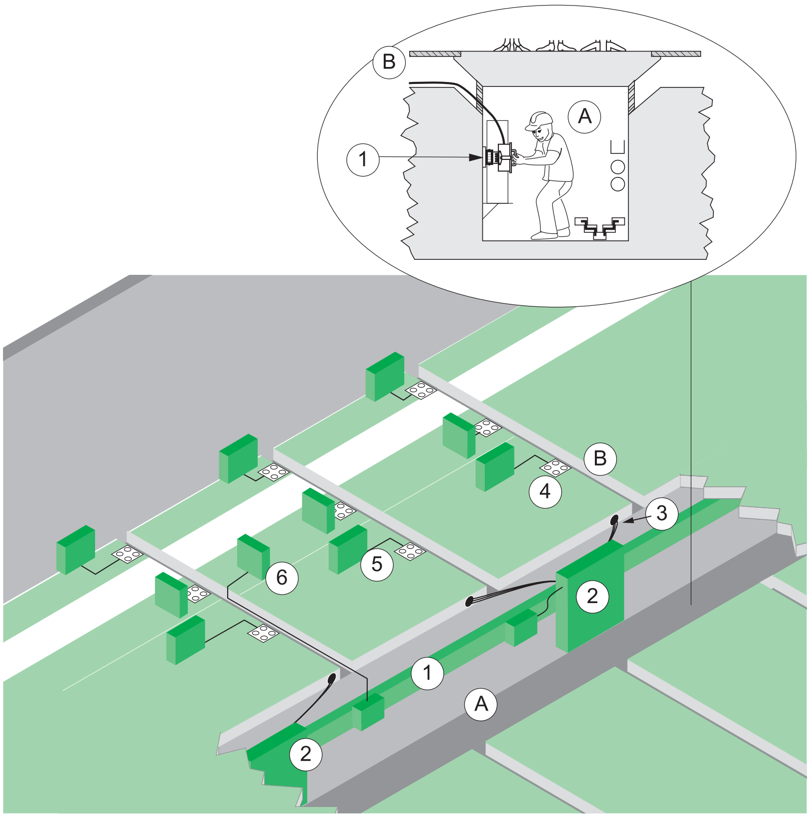
Main distribution (KS BTS)

Enclosure

"Floor socket" box

In-floor service duct

Gallery



Ⓐ *Gallery*
Ⓑ *In-floor service duct*

Fixed installation:
① *Main distribution KT/KS BTS*
② *Enclosure in gallery*
③ *Cables in tubing*
④ *Floor socket boxes*

Mobile installation:
⑤ *Standard feeder on socket*
⑥ *Special feeder on KS*

Installation linked to the distribution of electricity to stands

Typical solutions

This solution is best suited to international-type exhibition centres with hall floor spaces between 8,000 and 12,000 m² and distributed power ≤ 150 W/m².

Main distribution using BTS in galleries + floor-standing boxes with power sockets

Description

Infrastructures

Technical galleries are set up in the hall's basement. They are supplemented with a network of "in-floor service ducts" located on both sides of the gallery (in-floor service duct centre distance 6 to 8 m, length 15 to 25 m).

Fixed installation

The fixed part of the electrical distribution includes:

- Main distribution using KSA or KTA medium or high power BTS with a rating of 800 A to 1,200 A set up in the galleries.
- Enclosures connected to the main distribution and located in the gallery. These enclosures are equipped with protections for standard out going feeders supply.
- Floor-standing boxes equipped with power sockets, 4 power sockets per box. The boxes are distributed throughout the hall, close to the in-floor service ducts. All of these out going feeders have the same rating, 3 x 32 A + N to 3 x 63 A + N. The enclosure and floor-standing boxes are linked using cable in tubing imbedded in the flooring. Each enclosure supplies 4 to 8 boxes or 20 to 30 power sockets.
- This solution, where all of the out going feeders are regrouped in the gallery and standard out going feeders are part of the fixed installation, can be used in conjunction with technical and administrative management system (management of the subscribed demand by the exhibitor and energy billing). In this case, the standard out going feeders are equipped with motorised circuit breakers. If the operator wishes to manage each stand separately, chaining is not used and the density of the standard out going feeders will depend on the minimum floor space of one stand, not the average floor space.

Temporary mobile installation

Mobile installation is limited to the link between the power socket and the exhibitor's tap-off unit for standard out going feeders.
Special out going feeders are set up as in solution D1 and are units with a rating of 3 x 63 A + N to 3 x 250 A + N plugged into the main KSA or KTA distribution.
The mobile link with exhibitors' units is carried out using cable and installed inside the in-floor service ducts.

Example:

- Hall size: 100 m x 90 m (L x l) or 9,000 m².
- Max. power: 120 W/m² or 1,080 kW for the whole hall.
- Stand floor space: min. 12 m² (4 m x 3 m), average 40 m².
- Infrastructure: 2 galleries are set up along the length of the hall. They each supply a network of 2 x 12 in-floor service ducts, (length 22 m, centre distance 8 m) laid out perpendicular to the gallery.
- Main distribution: 1 KTA 1,000 A run of a length of 100 m in each gallery.
- Standard out going feeders: One enclosure allows the management of 2 in-floor service ducts with 4 floor-standing boxes per cable duct at 6m intervals and four 3 x 32 A + N power sockets per box, or twelve 400 A units per KTA run for the supply of the enclosures and 32 out going feeders per enclosure. This represents a total of 2 x 12 x 32 = 768 sockets, thus a density of 1 socket per 12 m² corresponding to the minimum floor space of one stand, for the 2 galleries.

Advantages and disadvantages

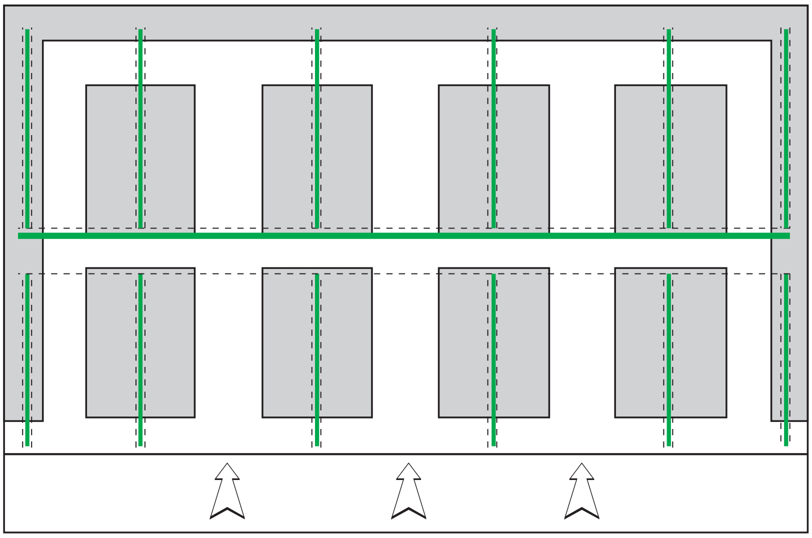
- The setting up of standard out going feeders is extremely simple while in operation.
- Nevertheless, the disadvantages pointed out in solution D1, such as limited length of mobile cabling and firebreak passage between gallery and cable duct, are also the same for special cabling. The solution consists in reducing the quantity of special out going feeders by increasing the rating of standard out going feeders, a solution which is quickly limited given the increased investment which it entails.

Installation linked to the distribution of electricity to stands

Typical solutions

Typical solution D3: Distribution through the floor

Main distribution using BTS in galleries + secondary distribution using BTS infloor service ducts

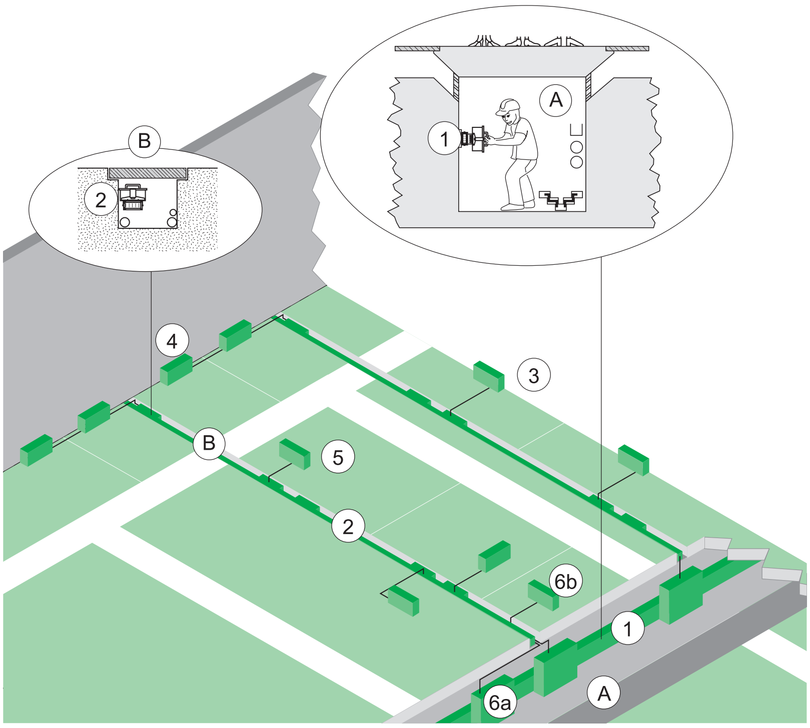


Main distribution KT/KS BTS

Secondary distribution KS BTS

In-floor service duct

Gallery



Ⓐ Gallery
Ⓑ In-floor service duct

Fixed installation:

① Main distribution KT/KS BTS
② Secondary distribution KS BTS

Mobile installation:

③ Standard out going feeder
④ Chaining
⑤ Special out going feeder in-floor service duct (< 125 A)
⑥ Special out going feeder in gallery (< 400 A)

Installation linked to the distribution of electricity to stands

Typical solutions

This solution is best suited to international-type exhibition centres with hall floor space between 8,000 and 12,000 m² and distributed power ≤ 200 W/m².

Main distribution using BTS in galleries and secondary distribution using BTS in-floor service ducts

Description

Infrastructures

Technical galleries are set up in the hall's basement. These galleries are supplemented by a network of in-floor service ducts located on both sides of the gallery (in-floor service duct centre distance 6 to 8 m, length 25 to 50 m).

Fixed installation

The fixed part of the electrical installation includes:

- Main distribution using KSA or KTA medium or high power BTS with a rating of 800 A to 1,600 A set up in the galleries.
- Secondary distribution using medium power KSA 160 A to 400 A busbar trunking set up in the in-floor service ducts with the other distributed networks (telephone, computer, clean and waste water, compressed air, etc.). It is a good idea to have several ratings of KSA busbar trunking in order to allow for the connection of high power special out going feeders (see example below).

Temporary mobile installation

Stand out going feeders are units which can be plugged into Canalis KSA runs.
Sandard out going feeders have a rating of 1 x 32 A + N to 3 x 63 A + N.
Special out going feeders have a rating of 3 x 32 A + N to 3 x 250 A + N. The rating of the special units is limited by the rating of the KSA busbar trunking as well as the space available for its installation in the in-floor service duct.

Example:

- Hall size: 100 m x 90 m (L x l) or 9,000 m².
- Max. power: 150 W/m² or 1,350 kW for the whole hall.
- Stand floor space: min. 15 m² (5 m x 3 m), average 40 m².
- Infrastructure: 1 gallery is set up along the length of the hall. It supplies a network of 2 x 17 in-floor service ducts, (length 44 m, duct centre distance 6 m) laid out perpendicular to the gallery.
- Main distribution: 2 KTA 1,200 A runs of a length of 50 m in the gallery.
- Secondary distribution: 2 x 17 KSA runs of a length of 40 m set up in the in-floor service ducts, 2 x 13 runs with a rating of 160 A and 2 x 4 runs, or 1 run out of 4, with a rating of 400 A.
- Standard out going feeders: 1 x 45 A + N units, 1 unit installed every 5 m, or one unit per 30 m². The supply of stands is carried out by supplementing the units already in place with additional units for high-density zones.

Advantages and disadvantages

- This solution presents the best compromise between investment costs and operating costs (see appendix 1, financial optimization of solutions)
- The density of the secondary distribution keeps mobile connections to a minimum, reduces voltage drops and guarantees the control of the impedances of fault loops.
- Eliminating cables in-floor service ducts and replacing them with BTS increases safety in the case of fire.

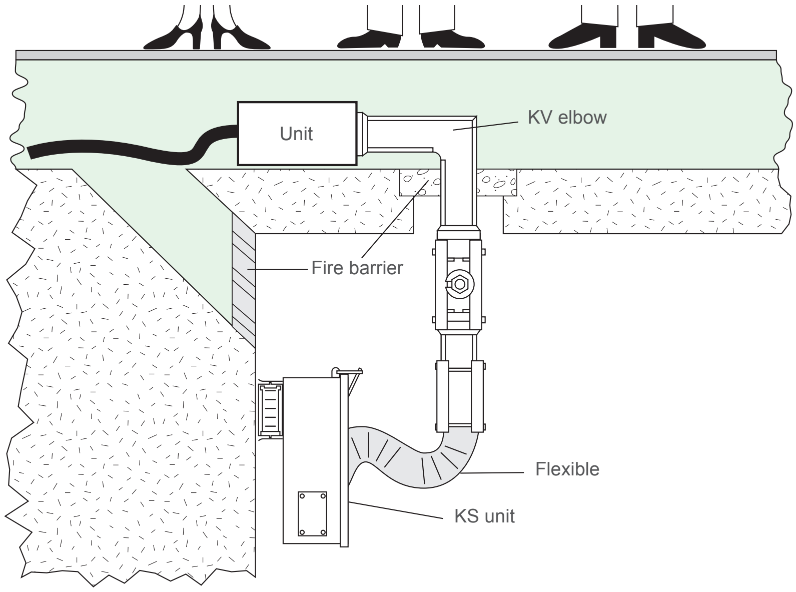
Installation linked to the distribution of electricity to stands

Typical solutions

Main distribution using BTS in galleries and secondary distribution using BTS in the in-floor service ducts (continued)

Adaptations for special needs

High power special out going feeders



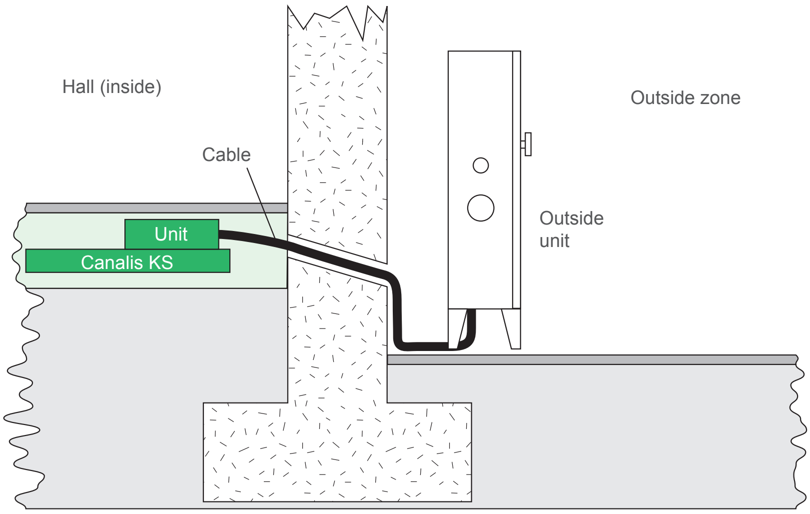
As previously mentioned, the majority of special out going feeders are set up using units which can be plugged into the BTS set up in the in-floor service ducts.
Nevertheless, the power of these out going feeders is limited by the rating of the BTS.
For high-power special out going feeders, the fact that they are not often needed does not justify the over-rating of the BTS in the in-floor service ducts, even if, as is the case in the example, it is limited to one run out of 4.
These out going feeders are supplied from the high power BTS located in the gallery.
The solution then consists of including hoppers between the gallery and in-floor service ducts.
They are usually sealed into the flooring. When a special connection is needed, the flooring is replaced by an element which includes a medium power KV busbar trunking elbow with a supply unit. The whole system is supplied by a KS unit equipped with a flexible KV element.
This lay out:

- means that it can be set up safely and quickly.
- respects the fire barrier passage between the gallery and in-floor service duct.

Installation linked to the distribution of electricity to stands

Typical solutions

Cabling stands outside the hall



For sites which have outside exhibition areas located very close to the hall, this solution means that the need for stand connections can be easily met without setting up a special distribution network.
The connections are carried out using an enclosure directly supplied by a unit set up at the end of the BTS in the in-floor service duct.

Installation linked to the distribution of electricity to stands

Typical solutions

This solution complements solutions C and D3, which have already been described. It combines a control-monitoring system using bus with the distribution using BTS and thus meets the management needs of the distribution of electricity to stands:

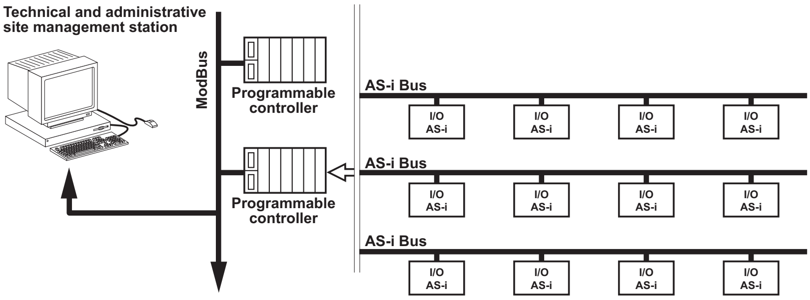
- Rating and controlling the subsribed demand by the exhibitor.
- Metering the power consumed for billing "in real terms".

Management of the distribution of electricity to stands

Control-monitoring system using bus

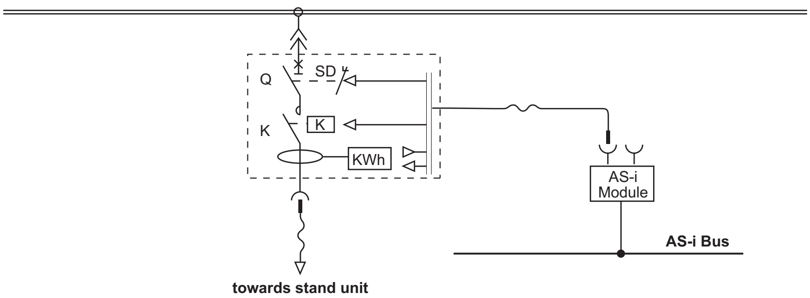
Description

Architecture of the control-monitoring system



An AS-i bus cable is laid out in the in-floor service duct parallel to the KSA busbar trunking.
AS-i 4I/4O modules are connected to the bus at regular intervals (4 to 5 meters).
The AS-i modules communicate with a programmable controller located in the gallery and the whole system is linked to the site's technical and administrative management systems through a control network (ModBus for example).
Two exhibitor's out going feeder units are managed per module.

Structure of exhibitor's out going feeder units



Each "exhibitor's out going feeder" unit is equipped with:

- For standard out going feeders, one protection per circuit breaker with a fault indicating switch.
- For special out going feeders, one protection per motorised circuit breaker.
- A totalling power meter with pulse output.
- A flexible link for connection to the AS-i module.

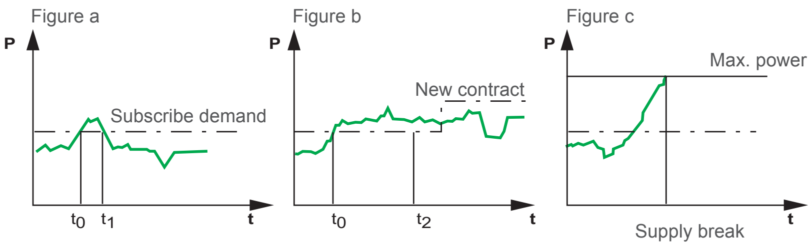
Installation linked to the distribution of electricity to stands

Typical solutions

This global solution, main and secondary distribution using BTS and control-monitoring system using Bus:
- Ensures the large availability of the installation.
- Significantly reduces operating costs:
  - assembly and disassembly costs between each exhibition
  - maintenance costs during each exhibition
  - administrative costs for the billing of the energy consumed.
- Provides the best service for the exhibitor.

Operation

The impulses emitted by the exhibitor's energy meter, of a frequency proportional to consumption, are counted by the controller and integrated to determine the power reached.
The subscribed demand by the exhibitor is directly parameterized for each out going feeder by the management system and is no longer defined by setting the circuit breaker's overload protection.
This data is used in the billing of the energy consumed, as well as to compare the requested demand and the subscribed demand in real time.
If the power goes over the limit, the operator can:
- Authorise it if it only lasts a limited amount of time (t_1 time delay parameters can be set) and is accidental (Fig. a).
- Suggest a contract which is better-adapted to the exhibitor's needs when the power repeatedly goes over the limit or for a long period of time. (t_2 time delay parameters can be set). All of this without a break in supply, contrary to what occurs when the subscribed demand is limited by the circuit breaker (Fig. b).
- Break supply to the stand by automatically opening the contactor when the overstepping level is excessively high and/or incompatible with the installation and could cause the circuit breakers to trip for example (Fig. c).



Installation linked to the distribution of lighting electricity and management

Needs and operational modes

Exhibition hall lighting must be designed so that it can be adapted to different activities

Main uses: fairs and exhibitions

The stands have their own lighting when the hall is open to the public. Strictly speaking, the lighting is only necessary over the walkways and the lighting level required is usually between 400 and 600 lux. The lighting level can be reduced (150 to 200 lux) for zones where stands are set up, which are greater than 2/3 of the hall's surface area.
In the case of the hall being only partially occupied, changing the lighting zones should allow for the lighting to be limited to the occupied zones.
When the hall is not open to the public, a minimum amount of lighting is required for the surveillance of the premises. It can be limited to the main walkways.

Other activities

Some activities (for example sporting events), need specific adapted lighting as well as the normal hall lighting.
During special events, when all or part of a hall is used by a single customer (conference, sales launch), special lighting requirements are taken into account by this customer. The connection is then carried out on the stand distribution network.

Lighting installation

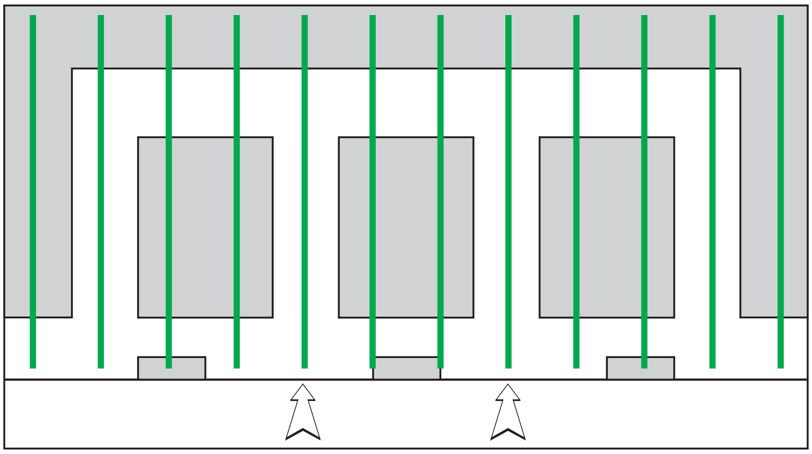
Lighting sources

The lighting sources used are:

- either fluorescent lamps (2 x 58 W or 3 x 58 W luminaires),
- or metallic iodide-type discharge lamps.

Lighting runs

Setting up lighting runs



Stand zone

Main walkway zone

The main walkways are generally laid out on a central axis. Their layout is fixed, whatever the type of room. The lighting runs are set up parallel to these main paths. This lay out means that the level of lighting can be adapted according to the needs of the different zones:

- walkway zones with full lighting,
- stand zones with reduced lighting (1/3 of lighting for example).

Whatever the type of luminaires may be, the lighting runs are made up with KBA or KBB Canalis, which ensure the supply and support of the luminaires.

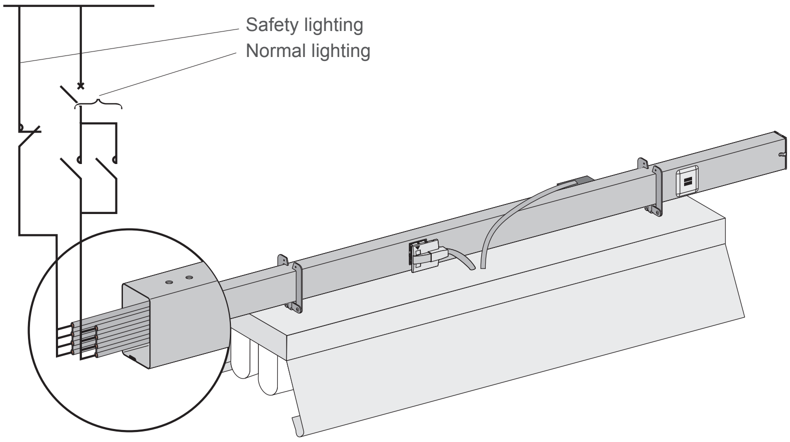
Installation linked to the distribution of lighting electricity and management

The choice between KBA and KBB depends on the weight of the luminaires and the possibilities for fixing them to the building's structure (KBA centre distance ≤ 3 m, KBB centre distance ≤ 5 m).

These runs have a 3 Ph + N polarity, which means that:
- voltage drops can be reduced (compared with single-phase runs),
- luminaires can be controlled by 1/3 (1/3 per phase) and lighting levels can therefore be adapted.

KBB Canalis with 3 Ph + N double flat top is installed when one part of the luminaires is also used for safety or flood-lighting (see following figure).

Safety and flood-lighting



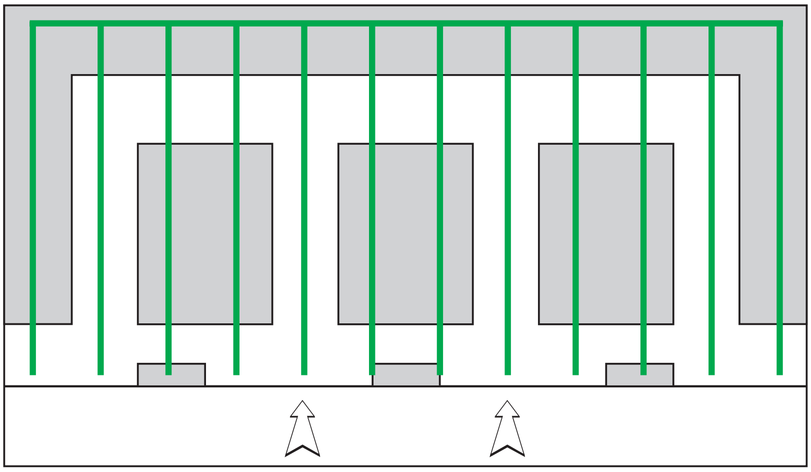
This type of luminaire equipped with fluorescent lamps includes an accumulator battery and needs two separate supplies:
- one for normal lighting,
- permanent supply for safety lighting, for charging up batteries.

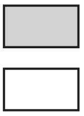
Installation linked to the distribution of lighting electricity and management

Lighting installation (continued)

Supply to and command of lighting runs

Setting up medium or high power BTS





The supply of lighting runs is carried out using low or medium-power prefabricated busbar trunkings (KN Canalis up to 100 A, KS Canalis 160, 250 or 400 A).

Advantages

Compared with a centralised solution of the lighting switchboard type with the runs being supplied by a cable on a cable tray, this decentralised distribution solution through BTS:

- **means** that advantages can be drawn from the **weak impedance** of the main busbar trunking, up to close proximity of the lighting run,
- **keeps cable lengths** to a minimum in the low-power section (1 to 2 m link between units set up on the main duct and the feed unit on the lighting run),
- therefore significantly **reduces voltage drops** and the value of fault loop impedances,
- thus **garantees protection** against indirect contact. The fault current levels are compatible with the magnetic tripping thresholds of standard circuit breakers:
- □ both design and installation the system are simpler,
- □ all of the lighting units are identical,
- □ protection is provided by standard circuit breakers,
- □ installation costs (supplies and labour costs) are minimised.

For C60 type modular circuit breakers:

- **standard breaking capacity** (type N) is **reinforced** thanks to its use with the upstream circuit breaker.
- **standard tripping curve** (curve C), is **sufficient** given the good control of fault loop impedances.

See example in appendix 1.

Installation linked to the distribution of lighting electricity and management

Lighting management using DALI

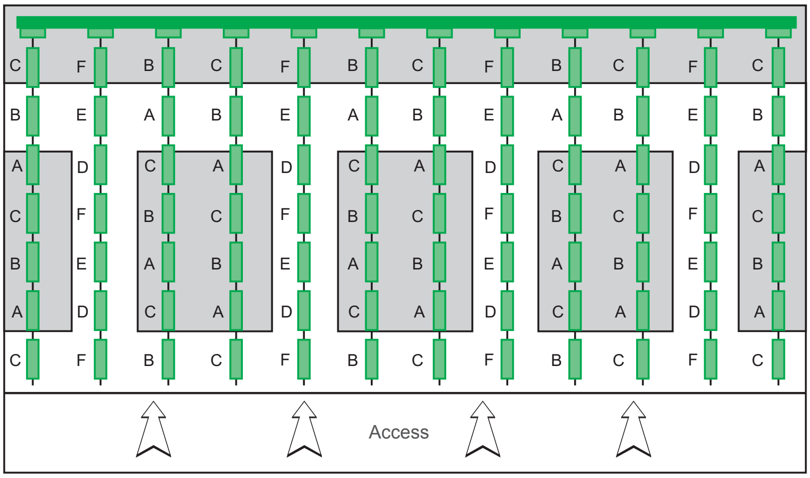
Distribution of luminaires between the "walkway" zone and the "stand" zone

Walkway zone includes luminaires "DEF".

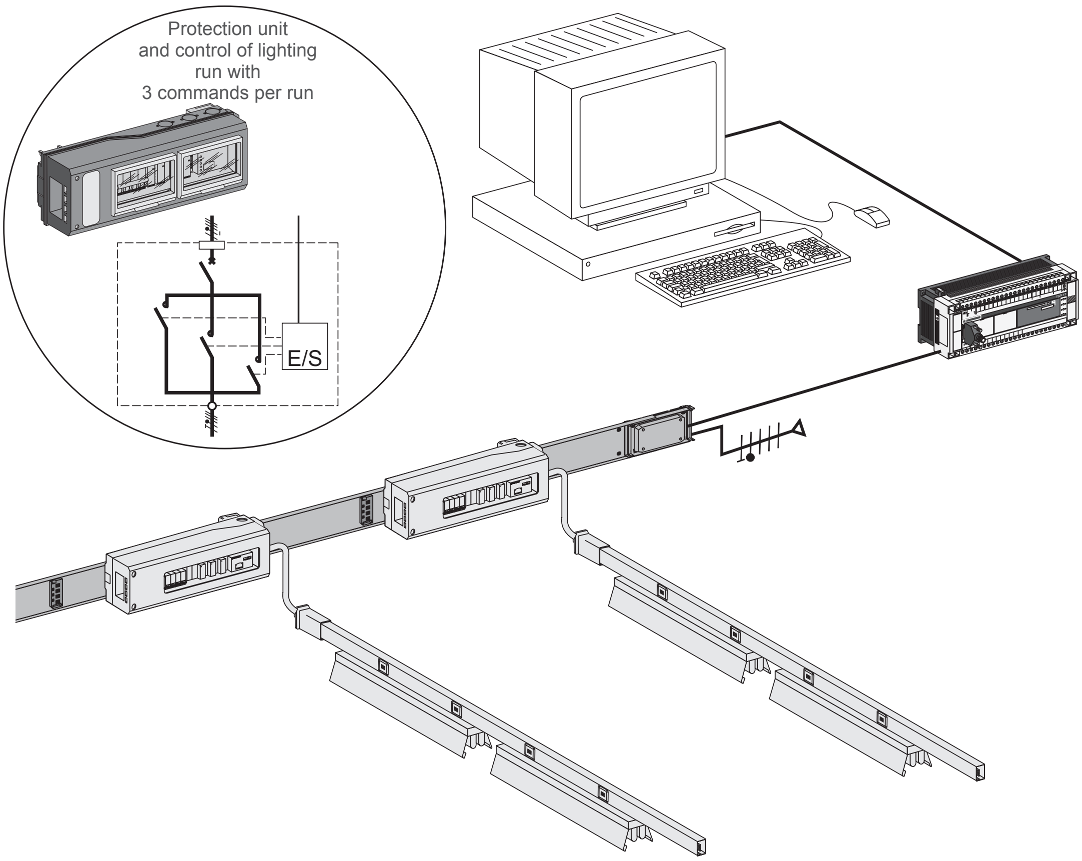
Stand zones includes luminaires "ABC".

Stands

Walkways



Lighting management using DALI



Installation linked to the distribution of lighting electricity and management

Lighting management using DALI (continued)

The design

To meet lighting management needs, lighting levels and adapted zoning according to the type of exhibition, DALI supplements the distribution using prefabricated busbar trunking. The DALI design, a global solution for lighting distribution, control and management, combines communication through bus with Canalis decentralised distribution.

The DALI bus

- It is either included in the main busbar trunking with KNT,
- or laid out parallel to KS and set up in this case using KBA busbar trunking.

The units

The lighting run feed and control units ("run unit"):

- protect the lighting run using a **circuit breaker**,
- includes the **DALI module** connected onto the bus. It includes 3 outlets which mean that 3 separate circuits can be piloted on the lighting run and therefore that up to 3 levels of lighting can be controlled,
- have **contactors**.

The central control unit

The DALI central control unit is an industrial controller equipped with the **"DALI lighting" software package**, the parameters of which can be set by the user.
It allows:

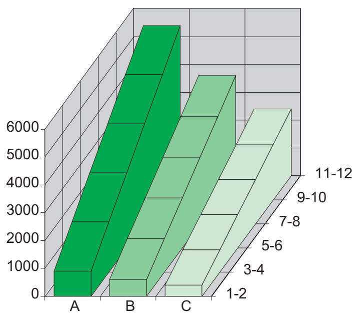
- the **design** and **modification** of **lighting zones** and the **different lighting levels**. To do this, the output groups must be defined (all of the luminaires which are simultaneously commanded). These groups are joined together to constitute a lighting zone (a zone with 3 lighting levels therefore includes 3 groups),
- **programming the occupation times** (to automatically pilot lighting).

Optimising maintenance operations

Adapting lighting levels causes large disparities between luminaire operating times.
Hour meters measure the operating time of each group and allow:

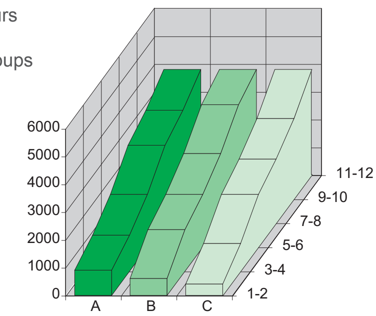
- **management of the rotation** of the groups to ensure a balance in operating times,
- **programming of preventitive maintenance operations** for the replacement of all of the lighting sources.

Without group rotation



0 to 6,000: operating hours
1 to 12: operating month
A, B and C: luminaire groups

With group rotation



Appendix 1: Financial optimization of solutions

Mastering operating costs is essential so as to guarantee the competitiveness and profitability of exhibit grounds.
The operating costs for assembling and disassembling mobile installations that supply exhibitor stands is a considerable part of operating costs.
All solutions for the electrical distribution of stands should take these operating costs into account and thus lead to the use of a global cost approach.
Global costs = Investment costs + Operating costs.
This appendix presents the methodology for this approach, which is supported by an example for determining the rating of standard connections.

Methodology and example for determining the rating of standard connections

Methodology

Investment costs are divided up between the cost of fixed installations and the cost of mobile installations.
The cost of the fixed installation does not include standard outgoers when they are connected to it (example: cabinet sockets or floor socket boxes).
The cost of the mobile installation includes:

- all stand outgoers, standard outgoers and special outgoers. e.g. for BTS enclosures, the installed enclosures plus the enclosures in stock.
- Mobile links between the stand outgoers and the exhibitor's enclosure.
- Exhibitor enclosures.

Operating costs primarily include the costs for mobile installation assembly and disassembly between each exhibit.

Investment costs for the fixed installation
+ Investment costs for the mobile installation
+ Operating costs for the mobile installation
= Global costs

The goal is thus to minimise global costs. A good comprehension of the projected operating costs is needed to conduct the study (see example).

Example:

1. The different ratings of outgoers are defined by taking into account needs as well as technological thresholds such as circuit breaker ratings. In example 5, the ratings that were used are: 3 kW, 10 kW, 45 kW, 100 kW, 250 kW.
2. For these different ratings, the unit cost of investment and operation are estimated according to whether the outgoer is a standard or special one (table 1 - page 40).
3. Exhibits are classified in categories that allow for diverse situations to be taken into account. Each category is characterised by the number of installed and connected enclosures, the average stand surfaces, the minimum stand surface and the distribution of connections using the outgoing rating.

In example 3 the categories that were used are Fig 2.1, 2.2, 2.3 - page 40. The hall's surface area is 6000 m^2. This data allows:

- For a type 1 exhibit where the number of stands is considerable, estimation of maximum stand density and thus of the number of standard outgoers to be installed.
- For the 3 exhibit types, calculation of investment costs: quantity and cost of installed enclosures for standard outgoers and the cost of establishing a stock of enclosures for special outgoers.

4. Power distribution for stand outgoers on an operating cycle - Fig 3- allows for operating costs to be calculated. So as to be representative, this distribution must take into account the rate of certains exhibits, twice a year exhibits for example. This is the case in the example where there is a 2 year cycle.
5. Simulation of global costs is conducted by successively taking each rating as a standard outgoer rating, standard outgoer ≤ 3 kW, standard outgoer ≤ 10 kW, standard outgoer ≤ 45 kW, etc.

In the example, global costs are obtained for a standard outgoer rating of 10 kW.

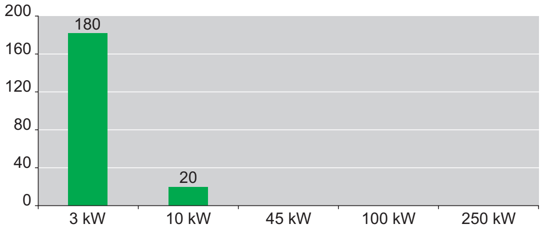
Appendix 1: Financial optimization of solutions

Methodology and example for determining the rating of standard connections (continued)

Table 1: Investment costs and assembly/disassembly costs per enclosure rating

Enclosure ratings	Investment		Operation		Global costs	
	Unit cost in Euro		Assembly/disassembly per unit in Euro		Per unit in Euro	
	Standard	Special	Standard	Special	Standard	Special
3 kW	100		20		120	
10 kW	250	300	30	120	280	420
45 kW	600	700	50	200	650	900
100 kW	1500	1700	80	320	1580	2020
250 kW	4000	4500	120	480	4120	4980

Figure 2.1: Significant number of stands and low outgoer power

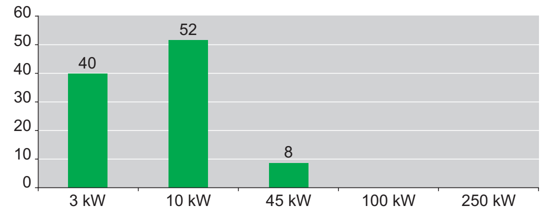


200 installed enclosures

Average stand surface area = 30 m²

Minimum stand surface area = 15 m²

Figure 2.2: Average number of stands and medium outgoer power

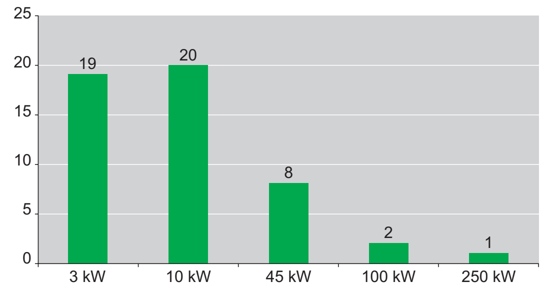


100 installed enclosures

Average stand surface area = 60 m²

Minimum stand surface area = 15 m²

Figure 2.3: Low number of stands and significant outgoer power



50 installed enclosures

Average stand surface area = 120 m²

Minimum stand surface area = 15 m²

Appendix 1: Financial optimization of solutions

Figure 3: Distribution of stand outgoer power on an operating cycle

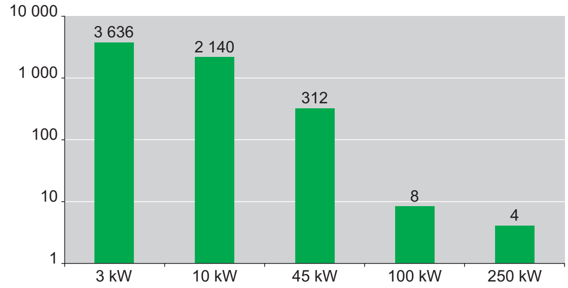
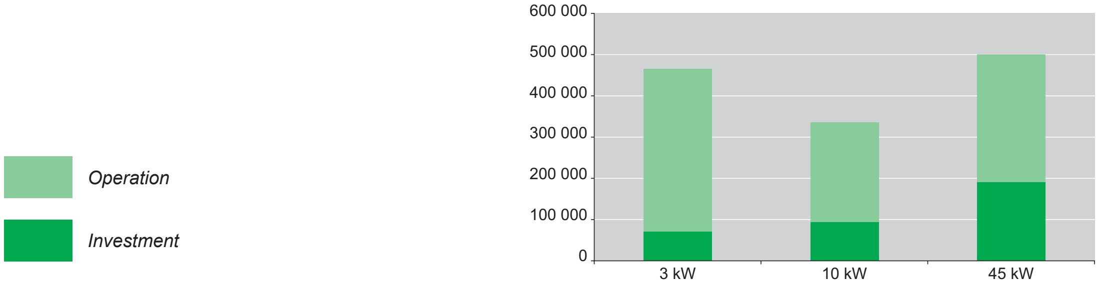


Figure 4: Simulation of global costs per standard outgoer rating



References

Canalis installations on the exhibit grounds

Country	Town-Site	Years	Type of BTS
Sweden	Stockholm	1980-1999	KN - KS
	Goteberg	1975-1999	KL - KU - KS
	Jonkoping	1975-1999	KU - KRA - KS
	Sollentuna	1975-1999	KU - KRA - KS
	Malmoe	1980-1999	KS - KH
	Lulea	1985	KS
Spain	Barcelona	1995	GTC - GMP
United Kingdom	Birmingham - NEC	1974	KH - KRA - ILine - I Line 2
	London - Wembley Arena	1979	KS
	London - Alexander Palace	1989	KS
	London - Olympia	1985	KS
	London - Earls Court	1985	KS
Belgium	Brussels - Foire du Heysel	-	-
Austria	Vienna- Wiener Messe	-	-
Norway	Oslo - Norges Varemesse	-	-
	Oslo - Inforama	-	-
Germany	Dusseldorf	-	-
France	Paris - Parc de Versailles	-	-
	Paris - Parc de Villepinte	-	-
	Strasbourg	-	-
	Metz	-	-

Schneider Electric Industries SAS

35, rue Joseph Monier
CS 30323
F- 92506 Rueil Malmaison Cedex

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Capital social 896 313 776 €
www.schneider-electric.com

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