

Transport for London

London Underground



Guidance Document

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Electrical Guidance – Supporting 1-066 and 1-069

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Introduction to Electrical Guidance Document

This document is intended to support the LU category 1 electrical standards, 1-066 Lighting of London Underground Assets and 1-069 Low Voltage Electrical Installations.

Part 1 of this document supports 1-066 and part 2 supports 1-069.

The electrical guidance document provides more detail around the intent of clauses that can be found in the category 1 standard as well as providing guidance on how to apply the standards and what considerations need to be taken into account when designing or installing systems.

Included in this document is also good practise that London Underground has built up which it is hoped will help to avoid repeating mistakes or relearning lessons as well as assist with facilitating operational and maintenance needs and tasks and potentially reduce the cost of project or remedial works.

If you have any feedback on this document, this should be addressed in the first instance to the Principal Electrical and Mechanical Engineer.

If you have any questions relating to 1-066 or 1-069 or the guidance document then please do not hesitate to ask the Principal Electrical and Mechanical engineer for clarification – you could save a lot of effort, money and time!

Remember: IF IN DOUBT – ASK

Part 1 – Supporting 1-066

1 Guidance on Requirements

1.1 General Requirements

1.1.1 Platform Train Interface

It is intended that the general lighting highlights the platform train interface area. The illuminance can reduce from the platform edge zone to the back wall in a uniform manner as long as the values in schedule 1 are met. The aim of this is to prevent the over lighting of platforms, but maintain the highlighting of the highest risk area.

It is important that the Platform Train Interface (PTI) is sufficiently well illuminated to enable train operators and platform despatch staff to see this area clearly. This is a significant safety factor since obstructions in the PTI need to be identified easily. Because it is possible to operate some LU stations in a degraded mode with only emergency lighting operational, and since trains may need to be evacuated under emergency lighting conditions, it is preferred that the emergency lighting installation also permits train operators to view the platform train interface area via any mirrors provided. This should however be evaluated in the context of the risk reduction value with respect to the cost of providing additional emergency lighting for the PTI, and advice should be sought from LU engineers where there is any doubt.

1.1.2 Emergency Lighting

Historically, London Underground relied upon independence of electricity supplies in order to provide security for emergency lighting at sub-surface stations. When LU had its own generating capability, independence was achieved by taking a second street supply from the utility provider (now known as a Distribution Network Operator – DNO), since the LU power station was not connected to the National Grid. When that arrangement prevailed, LU adopted a “1 in 4” arrangement for emergency lighting, three adjacent light fittings being fed from the 3-phases of the LU LV supply, and the fourth being fed from the DNO supply. The requirement for a minimum of 15lux replaced the requirement of 25% or 1 in 4 when the LU power station was closed, although in practice this revised criterion has proved inflexible in designs and led to over lighting of emergency lighting designs. Hence now either the traditional “1 in 4” approach or 15lux average approach are acceptable, provided that all areas have emergency lighting of sufficient level to facilitate safe evacuation. However it should be noted that the average 15lux is to be applied for the entire length and width of escape paths. Borders of up to 600mm around obstructions, alcoves, seating areas etc do not need to meet this requirement unless that area is part of the escape route.

It should be noted that in the majority of sub-surface stations, the Local Emergency Supply (LEPS) is provided by an Off-Line Battery Inverter (OLBI) on which there is a section in *part 2, 2* of this guidance document. Designers and installers need to be aware that certain types of lamps such as discharge lamps cannot be supplied from an OLBI due to the possibility of stroboscopic effects and re-strike times – or the possibility that the luminaire may not re strike at all.

It is good practise to physically separate OLBI and their associated distribution boards from the distribution boards and intakes for the Central Emergency Power Supply (CEPS) in order to ensure compliance with the requirement in BS 5266 to keep emergency loads separate from normal loads.

The Regulatory Reform (Fire Safety) Order 2005 requires that all permanently occupied places must have emergency lighting.

In areas not specifically covered by the standard in terms of stating emergency lighting requirements, the requirements of BS 5266 apply.

Where only one luminaire is needed to meet normal lighting requirements, this luminaire may also be used to meet emergency lighting requirements, it is not necessary to fit separate luminaires where one can do both jobs. However illuminated emergency signage cannot be considered to fulfil the normal lighting requirements.



It should also be noted that a single fitting supplied from CEPS only or from LEPS only would not meet the requirements of BS5266 as in both cases if only the normal supply to the fitting were to fail, the CEPS or LEPS supply would not come on line.

In the majority of existing installations, compliance with clause 3.2.10 could be achieved by supplying a proportion of the lighting concerned from the Powerlink supply and the remainder from the DNO supply. These two supplies are not necessarily independent.

At surface locations even during a power failure leaving only emergency lighting provision there is a higher chance of borrowed light or daylight being available. Generally people feel safer and have a better feel of their bearings at surface or above ground locations, therefore emergency lighting requirements are less onerous than below ground. Emergency lighting above ground should highlight the appropriate exit routes and assist with the negotiation of obstacles.

The emergency lighting arrangements on surface stations tend to be very different to those at sub-surface locations. In general, there is not a central system and many surface stations only have a single DNO power supply. This may make UPSs viable for providing emergency supplies to emergency lighting at these locations - part 2 of this document explains why they are not usually viable for this purpose at dual fed locations.

Sub-surface locations have no benefit of ever receiving borrowed light from other sources in the event of power failure and people tend to be more uncomfortable about their surroundings underground – particularly in the event of there being very little or no available light. Therefore an element of emergency lighting in underground locations is to provide people with reassurance – ‘anti panic’ lighting.

The primary function of emergency lighting is still to highlight the designated escape paths and lead people to safety. Generally, there are more obstacles in an underground environment than in a surface one – for example stairs, escalators, corridors, changes of direction, concourses etc which require a higher level of emergency lighting in order for people to avoid slips and trips or to avoid falling over others who may have slipped or tripped for example if an escalator comes to a sudden halt.

It is preferred that in sub-surface stations, LEPS provision is solely provided by the OLBI (or UPS unit if there is no OLBI) as this facilitates maintenance and significantly eases the inspection and testing requirements for the emergency lighting system.

At surface stations, as the number of emergency fittings tends to be smaller and there is more flexibility with regard to how testing and inspection of such fittings can be achieved, then self contained battery packs are viable, however if an OLBI or UPS is available then this should be used where possible. Where self-contained emergency lighting is installed, it is preferred that a self-testing regime or centrally controlled testing facility is provided.

Within the emergency lighting installation the type of lamp should be carefully considered as many are unsuitable due to restrike time, time to reach full luminescent output, colour etc. For example discharge luminaires should not be used in emergency fittings due to restrike times.

Auxiliary lamps provide a limited amount of emergency lighting, generally these are designed for a maximum of 1lux provision and therefore should not be used at sub-surface locations. It is preferred that they are not used at surface locations as they are essentially an additional asset to inspect and test and an extra item which could develop a fault.

In public areas, control rooms and other permanently occupied spaces, it should not be possible to switch the emergency lighting in a manner which would render it unavailable in the event of a power failure. This does not necessarily mean that all emergency lighting should be of the maintained type.

Emergency systems that use flashing lights to attract attention are acceptable and are not considered part of the lighting system.

1.1.3 Tunnel lighting:

From pg 19 of Part 2A Infrastructure of RSPG:

- (i) Running tunnels, cross-passages and access shafts should be permanently equipped with adequate lighting. The lighting need not normally be illuminated but should be capable of being switched on remotely from adjacent stations, the railway control room, manually from within the tunnel, and automatically on the interruption of the electric traction supply.
- (ii) The electrical supply to the lighting should be arranged to prevent total loss through disruption of power supplies, electrical faults or damage. The lighting should provide adequate illumination for passenger evacuation. In the event of a total power failure, it should be possible to sustain emergency lighting at not less than 5 lux for at least the time required for evacuation and not less than 3 hours.
- (iii) The position of any cross-passage, access shaft and tunnel telephone should be indicated by permanently illuminated marker lights connected to the emergency lighting system and be provided with unique identification.

Throughout London Underground's sub-surface and deep tube network, there is a requirement for a permanent installation of tunnel lighting designed to facilitate de-training and access to work sites via running tunnels. N.B. to undertake work within tunnels, appropriate task lighting will be required.

Supplies from two independent sources are required to the tunnel lighting system, on the Jubilee Line extension stations this is achieved with the use of the independent station UPSs on each supply, however in a majority of Underground stations, both an LU (CEPS) and DNO power supply are acceptable. Supplies from station OLBIs are not to be used.

During a significant HV Network supply failure, preventing the operation of the tunnel lighting system, "anti-panic" battery lighting within trains will be energised and remain on, only once the CEPS supply is re-instated and the tunnel lighting restored will de-training occur, if deemed necessary.

The system described below is considered to meet the requirements of BS 5266 for emergency lighting in the event of a significant grid failure that disables both the CEPS and DNO power supplies.

Each "Road" and traction section shall have an independently controlled lighting system which, under normal operation, is required to be ON upon discharge of the 630v/750V DC traction supplies and OFF when the traction supplies are live. Switches for each traction section are required on each platform to override the automatic on/off controls. These switches are to be located generally on the headwall but in 4-section systems it is appropriate to position them on the nearest end wall for the remote traction section, as shown on the sketches.

Each road and/or traction section to have a minimum of 2 No. single phase lighting circuits with supplies to alternate luminaires from alternate circuits.

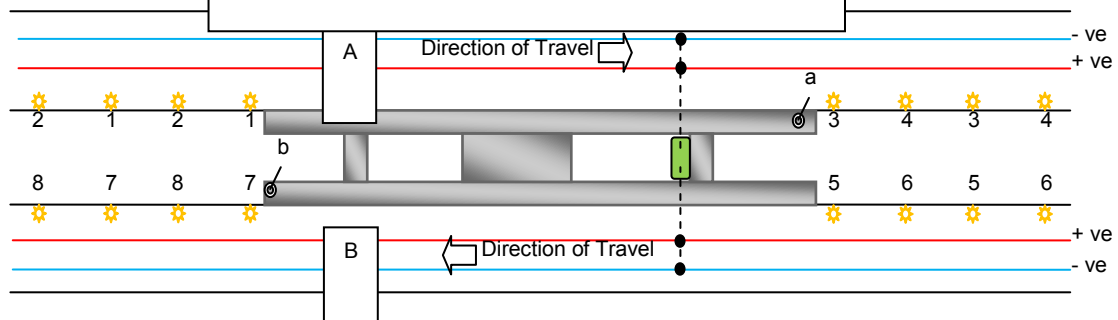
Luminaires are to be positioned wherever possible such that they illuminate through the windows of the train stock and to ensure there is illumination from a minimum of 1 luminaire on each circuit per carriage for wherever a train may come to a stop. Consideration must be given to Gauging and Clearances to ensure compliance with LU category 1 standard. 1-156.

The Tunnel Lighting system at a station shall control the lighting to a point midway between stations.

Fire resistant cables shall be installed between:-

- the tunnel lighting board/panel and the first point on each circuit
- one of the supply source intakes and the tunnel lighting board/panel or one of the supply UPSs and the tunnel lighting board/panel

Typical 2-Section Tunnel Lighting Principle



Key

 Tunnel Luminaire & circuit number

 Headwall Override Switch c/w Traction Section Identifier

 +ve conductor rail

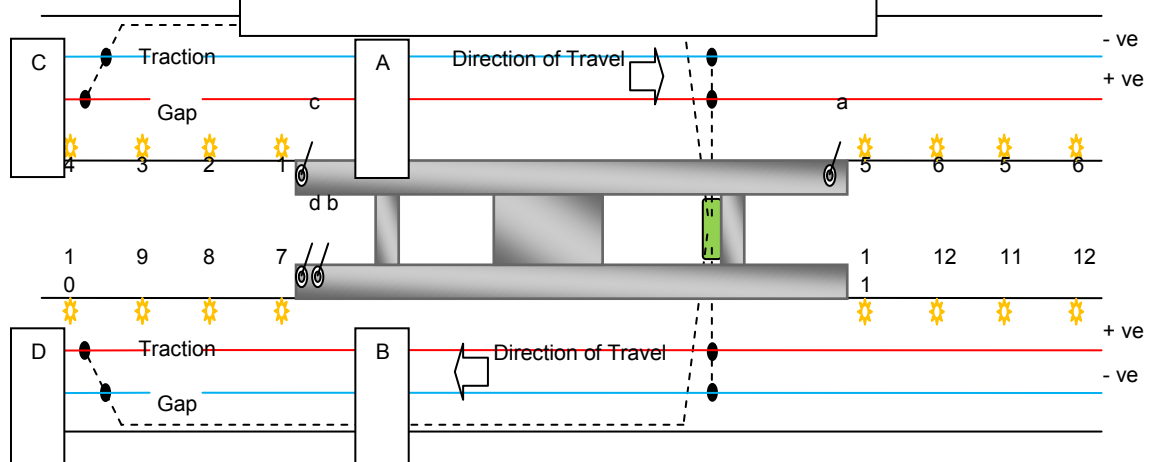
 -ve conductor rail

 Traction Section Identifier

 Traction Section connection

 Switchroom

Typical 4-Section Tunnel Lighting Principle



Typical 2-Section Tunnel Lighting System

Luminaire circuits 1, 2, 3 and 4 are all linked to the energisation of Traction Section 'A' and the state of headwall override switch 'a'. Similarly, luminaire circuits 5, 6, 7 and 8 are all linked to the energisation of Traction Section 'B' and the state of headwall override switch 'b'.

Typical 4-Section Tunnel Lighting System

Luminaire circuits 1, 2, 5 and 6 are all linked to the energisation of Traction Section 'A' and the state of headwall override switch 'a'. Luminaire circuits 3 and 4 are linked to the energisation of Traction Section 'C' and the state of headwall override switch 'c'.

At sidings and cross-overs, lighting is to be permanently on, irrespective of the status of override switches and traction current.

Individual sections of tunnel lighting need not be balanced over three phases. This is because the normal practice is that adjacent luminaires are fed from separate circuits, resulting in an even number of circuits per section.

With regard to meeting the requirements of BS 5266 in tunnels, the emergency lighting on the train enables clause 3.2.12 of LU category 1 standard 1-066 to be met. Since LU has dispensation to restore supplies after a given time from an emergency source in the event of grid failure, the train emergency lighting is relied upon until such time as the emergency supplies are available.

1.1.4 Task and Ambient Lighting:

LU prefers that lighting is designed to be task-specific, although it is recognised that with a range of tasks taking place in difficult environments, a compromise is often required. It is for this reason that the LU category 1 standard 1-066 sets out area illuminance values for particular locations. Within this requirement, designs should use a variation in illumination to assist way finding and orientation and to highlight particular areas and passenger operated equipment.

Where fine detailed tasks may take place, i.e. in a depot, task lighting should be provided to ensure adequate lighting of the correct plane.

In the case of ticket offices, station and other control rooms, a human factors assessment should be carried out in order to ensure that the area to be lit has an appropriate level of ambient lighting. Task lighting should then be made available to supplement the ambient lighting to permit operators to carry out specific tasks. The rooms should not be provided with excess ambient lighting solely for the performance of tasks requiring the highest level of lighting as this may cause discomfort to other staff in the room. In the case of station control rooms, high levels of lighting may prevent staff from seeing out due to reflections from the glazing.

Staff should be given controls for the general lighting of these areas that is accessible and straightforward to operate so they may adjust the level of lighting to suit their preference. Lighting equipment should be capable of being dimmed, and dimming controls should be simple to use. Where stations are provided with a centralised building management or lighting control system, consideration should be given to the provision of supplementary local control systems in station ticket offices and control rooms.

Designs should avoid dark ceiling cavities, the upper parts of station walls and the ceiling or tunnel crown itself. This is because although upward light makes no direct contribution to working plane illuminance, by raising the brightness at high level the overall impression created will be of a lighter space. At some sub-surface stations this may not be practical due to the quality of platform finishes, but the lighting design should take account of the problem and provide enhanced lighting if this is required and the desired effect can be achieved without an undue energy penalty. Very harsh shadows should be avoided as these hinder visual adaptation and create significant difficulties for many visually impaired people. When calculating lighting levels, it is possible to avoid extreme shadowing by verifying that the illuminance in adjacent areas is not too diverse. In order to make a reasonable assessment of diversity, it is recommended that the lighting calculation grid applied in software design packages uses a spacing of not greater than 0.5m x 0.5m

Use of natural light should be made wherever possible, particularly in surface locations and automatic daylight-linked switching of lighting is encouraged in public areas where it is appropriate and viable. Daylight-linked controls should incorporate some redundancy (for example more than one photo-

electric cell) and turn the lighting on at an appropriate ambient level to cater for overcast skies as well as the hours of darkness. Lighting designs should avoid light spill and nuisance to neighbouring properties or areas. There is also a deal of borrowed light from third parties which may affect normal lighting levels within the station but should not be taken as a contribution to station illuminance at the design stage. There are generally more difficulties in achieving acceptable uniformity levels and designs should take this into account and mitigate accordingly.

With modern lighting equipment, the unintentional creation of stroboscopic effects from is rare. However should discharge lighting employ classical wound (magnetic) control gear, stroboscopic effects may occur and this is best avoided by ensuring that adjacent lighting is fed over three phases. It is particularly important that stroboscopic effects are avoided on escalators and passenger conveyers.

1.1.5 Lighting for People with Impairments

Station lighting should assist in the creation of an inclusive environment. What this means is quite simple – if the conditions are helpful to those users with visual or mobility problems, everybody else will find the station easier to use too.

There are many forms of visual impairment and as many as 40% of LUL passengers could be affected by some eyesight problem varying from spectacle wearing to being registered blind. The lighting requirements for each type of visual disorder may be different, but there are some common issues which if considered at the design stage can help in all but the most severe cases. Bear in mind that many registered blind people do have a small amount of residual vision, and the lighting should aim to maximise the use of this. The following points are intended to be a very basic guide.

- Make sure that all areas where people have to move around are well lit – avoid dark shadows and unlit corners;
- Although it is important to light platforms, ticket halls, stairs, escalators and passageways well, the lighting should not be too uniform. A degree of visual contrast will aid orientation and provide visual cues;
- Provide increased levels of lighting at points of hazard – stairway and escalator landings, changes of level and direction, help points and the like;
- Take care that lighting does not create a false platform edge. The white line will in most cases be a clear point of demarcation, do not compromise this;
- Colour can be very effective in assisting navigation – this may be applied to surfaces or be from the light sources themselves. Make sure that if coloured surfaces are used, the lighting renders the colours well enough for them to be effective;
- Where different levels of light are used to create contrast and highlight specific areas, make sure that brightness transitions are gradual, not harsh;
- Take care with very bright light sources – natural and artificial. Direct and reflected glare presents serious problems to all visually impaired users;
- The way the light falls on surfaces can have a dramatic impact on how it appears for those with eyesight problems. Lighting of hazards should have a directional element rather than being purely diffuse, to give some modelling to reveal relief and detail. This is especially important at steps and on stairs – the risers and treads should be easy to distinguish or they will not be recognised as a change in level;
- Try to think about how the mobility impaired view their environment. In particular wheelchair users will have a very different view of lighting hardware and signage than people who walk around the system;
- When positioning luminaries, make sure that they do not make signs and passenger information systems more difficult to read – too much vertical illuminance will reduce visibility;
- Numerical values (“lux levels”) are less important than achieving an installation which looks good and adds to a feeling of security – use judgement to assess a lighting installation before resorting to a photometer.

Well positioned and clearly labelled lighting controls are essential to the success of all lighting schemes and LU encourages the use of controls which minimise energy usage as well as optimising operational performance. In no case should any new installation rely upon MCBs for routine switching of lights – proper switches should always be installed, using contactors where appropriate. Where daylight linked controls are used or presence detection is provided, it is preferred that these are automatic in their normal operation to limit the extent to which users can defeat the benefits. It may be necessary to provide over-ride features for automatic controls to enable maintenance and other activities to take place and to cater for certain failure modes. Where this is done, consideration of the human factors associated with such issues should be taken into account.

1.1.6 Lighting Construction

Relating to 3.2.17 – Lighting in areas exceeding 50 square metres should be supplied evenly over the phases such that in the event of a phase failure an area of the room does not go dark, only the overall luminance value drops. This permits continued use of the space if required.

Lighting columns require adequate foundation. The column manufacturer's guidance foundation depth should be followed, as a minimum. LU civil engineering standards may require more substantial foundations than are usual in highway lighting applications.

In order to allow construction flexibility flanged columns are preferred to avoid the need for the electrical and civil contractors to be on site simultaneously.

It is expected that task lighting will be required in most depot and shed areas and sufficient sockets should be incorporated into designs to facilitate the use of this.

There is usually high mast lighting, particularly for external walkways and siding/stabling areas. Glare can be an issue on walkways dependent on where fittings are located as well as in inspection and swimming pool pits. Designers need to understand how areas are to be used and where people's eye line is likely to be to provide sufficient lighting to the correct areas (i.e floor and at the bogie level of a train within a pit) without negatively impacting people's vision. High mast lighting should be designed such that columns and fittings can be maintained without the need to close sections of the depot. What this means is that folding columns should be positioned such that they can be lowered without fouling tracks.

1.2 Lighting Control

In order to minimise the energy consumption of LU operational areas and premises, the use of natural light should be maximised by way of lighting control systems.

Lighting control is an inherent part of any lighting design or installation and may consist of: time-based control, daylight-linked control, occupancy-linked control, localised switching or microprocessor controlled. Lighting controls automatic or otherwise need careful consideration and application to ensure the best solution for each location and may consist of a combination of technologies. All lighting control systems should have the ability for override, be easily operated and be fail-safe when in fault condition.

Presence detectors should not be used in public spaces. Where presence detectors are installed in non-public areas, overrides should be provided to cater for maintenance, failures, and staff wishing to have the lighting on in times of low activity. System designs incorporating appropriate dual PIR control are acceptable. Presence detection is not to be used in equipment rooms, plant rooms and switchrooms, in order to comply with the electricity at work act, and it is also not recommended for designated escape routes.

Sub-surface stations may not have the ability to be fully controllable for energy saving during traffic hours, however opportunities should be examined to give the ability for reducing lighting levels in engineering hours.

Control switches for normal operation should be located in a different area to the override or emergency controls, although all should be easily accessible to authorised operators and staff. To prevent unauthorised operation, it is anticipated that control switches will be placed in non-public locations such as a control room, supervisor's room or switch room.

It is imperative that operators and staff are able to understand and fully utilise all of the elements of manual control available. This can be achieved through clear operation manuals, straightforward user interactions, and, where appropriate and in exceptional circumstances, staff training. It should be noted that in many stations (particularly surface stations further out on the network) relief staff who are unfamiliar with the station may be expected to switch lighting on and off, therefore it should be clear to an operator unfamiliar with the station where to find the over ride switches and when and how to operate them.

It is imperative that maintainers have the appropriate information by way of documentation, manuals and commissioning data to enable maintenance support to be undertaken. Further advice and information on maintenance issues can be sought from LU Asset Performance Directorate (APD) or via the Project Management Framework (PMF2).

All control switches should be clearly labelled in order that staff and maintainers can easily understand the intended function without resorting to 'trial and error' methods of switching.

All control system equipment should be sited in the most optimal location in terms of both operation and accessibility. This will enable effective maintenance support of the system through accessibility without compromising operational effectiveness and efficiency.

Emergency lighting that incorporates automatic self-testing should be connected via a management system to a central control panel to monitor, initiate and record mandatory testing. The timing of the self test must be carefully considered and set at a time least likely to cause worry or alarm to staff or passengers, yet ensure that the station remains compliant to the BS 5266 requirements. Other emergency lighting should utilise manual emergency lighting switches for testing.

Further information on LU control systems can be found in LU category 1 standard 1-071 Building Management and Control Systems.

1.3 Lifts and Escalators

Lighting in lift machine rooms and within lift cars can be found in the LU and BS standards covering these assets. 1-093 (lifts including fire fighting and evacuation lifts).

1.4 Design and Installation Considerations

London Underground relies on electric light for many of its operations. Where daylight is available. It is acceptable for illuminance values to be met by natural light during daylight hours. As most LU emergency lighting is on when the general lighting is also on, the contribution of emergency lighting may also be taken into account when calculating general lighting illuminance.

LU does not adopt a single maintenance factor to be used in lighting design calculations. It is expected that for each design, maintenance factors will be calculated appropriate to each type of luminaire to be used, in accordance with the method laid down in the SLL (CIBSE) Code for Lighting.

In ventilation and other shafts where a permanent ladder and lighting system is installed, lighting measurements should be taken at the cat ladder rungs and at landing levels, though the lighting design, whilst aiming to avoid superfluous fittings to achieve the required levels at these locations should provide the surrounding areas with a general background level of light. Such areas can be give rise to a feeling of insecurity and lighting should be used to overcome this. Local task lighting should be provided where appropriate by those planning work

Individual light fittings should have their own internal fuse to protect the ballast unit and in order to minimise the risk of multiple lamps being tripped due to a fault. The fuse should be of a low breaking capacity to discriminate with the ballast manufacturers' internal fuse and have a time delay in order to accommodate for high inrush currents for a brief duration.

It is highly recommended that luminaires which have been converted by control gear removal to accept a different variety of lamp such as LED shall possess a suitable warning label fitted which warns of its new configuration and the danger of mains voltages being present at the lamp-holders.

The following factors should be taken into account when selecting or specifying light sources:

- i) The operating voltage range of the lamps;

- ii) The light output range of the lamp type(s);
- iii) Any thermal issues with regard to lamp performance;
- iv) The colour rendering properties of the lamp;
- v) Run-up and re-strike times (in the case of HID lamps);
- vi) Risk of explosive failure mode, such that use may only be in enclosed fittings;
- vii) UV and IR exposure risks;
- viii) Lamp burning positions and any effect alternative positions may have on lamp life;
- ix) Lamp cap type and compatibility issues;
- x) Availability of lamps for spares, and rationalisation of lamp types at a given site;
- xi) The colour temperature (appearance) range of the lamp type, this should be consistent at a given site;
- xii) Compatibility with controls, such as dimming;
- xiii) The suitability of the lamp for the optics of the luminaires in which they will be used;
- xiv) Lamp life and the maintenance regime required to optimise this.

When retro-fitting different lamps into equipment designed for a specific lamp type, the following should be taken into account:

- i) Whether the replacement lamp will match or exceed the performance of the lamp being replaced. Performance criteria include light output, thermal considerations, rated life, colour properties, maintainability and suitability for the supply voltages likely to be encountered in the LU environment;
- ii) The whole-life cost of the replacement lamp(s), taking into account operation and maintenance, relative to the lamp(s) which they will replace;
- iii) The suitability of the replacement lamp(s) for the optics of the luminaires in which they will be used. The control of glare is of particular concern;
- iv) Any potential health or human factors issues associated with the replacement lamp;
- v) The compatibility of the replacement lamp(s) with any dimming and control systems in use.

1.5 Architectural Integration

The quantity of light, its location and the manner in which it is used should be integrated with amenities to ensure glare is minimised. This specifically includes, but is not limited to the holistic integration of lighting with ticket office windows, signage and customer operated equipment.

To assist with architectural integration design considerations please refer to LU premises standard 1-135.

1.6 Maintenance, Inspection and Testing

LU seeks to maintain a good customer environment, and multiple failed luminaires generate an impression of neglect, as well as creating a negative impact on security. For matters relating to maintenance, inspection and testing refer to Part 2 of this Electrical Guidance document.

Access for maintenance in sub-surface locations is very restricted and therefore designs should be optimised for ease and speed of maintenance. It should be borne in mind that due to the confines of tunnels, physical space is limited including head height and storage facilities.

Due to the levels of vibration and air movement experienced in the LU environment (including the piston effect from trains) luminaires and diffusers should be provided with a secondary means of fixing such as a safety lanyard or chain so that should one method fail, the fitting or diffuser will not fall to the floor.

Accommodation areas with suspended ceilings should have their luminaires independently supported from the ceiling such that should the ceiling be removed (or indeed fall) the lighting installation will remain in situ. This arrangement also facilitates the maintenance of the installation.

In order to further facilitate maintenance in these areas, fittings should be installed such that ceiling panels do not need to be removed in order to facilitate basic maintenance – such as changing the lamp.

For ease of maintenance collapsible columns are preferred. Where these are utilised, consideration should be given to the need to mount other equipment (CCTV cameras, PA loudspeakers, signs) on the column.

1.7 Energy and Environmental Considerations

1.7.1 General Energy and Environmental considerations

Reference to table 1 of the Guidance Notes for the Reduction of Light Pollution issued by the Institution of Lighting Engineers is recommended when designing lighting to avoid spill light and light trespass.

The selection of light sources and lighting equipment should take account of their impact on the environment in respect of their production, operation and disposal.

All lighting products used in the LU environment are subject to Waste Electrical and Electronic Equipment Directive (WEEE) compliance, and LU suppliers should ensure that disposal of lamps and luminaires is carried out in a many which satisfies WEEE requirements. Recycling is preferred where suitable product schemes exist.

Local lamp processing for disposal (for example fluorescent lamp crushers) is not encouraged, and all lamp disposal must meet all statutory requirements with regard to pollutants. Where a local disposal facility (for example a sealed skip) is provided by an outside party, the location of this should address containment of spills and prevention of ground water contamination by use of bunds or tanks.

Energy usage is to be minimised by the use of good design, efficient light sources and the application of appropriate controls. The Building Regulations Part L2 applies to LU infrastructure and these shall be applied when designing LU lighting schemes. Although a Simplified Building Energy Model does not yet exist for a station design, it is expected that best endeavours will be made to optimise lighting energy performance. The use of the BREEAM assessment process for all new build is recommended.

Local metering, which is capable of recording trends, should be fitted at the most appropriate distribution board to capture lighting energy consumption. Where lighting is added to existing distribution boards which feed small power loads, it may be acceptable to meter the incoming feed to the distribution board if metering the new outgoing circuits alone would not be cost effective. In such cases advice should be sought from the project engineer.

1.7.2 Sub-surface Environment

The sub-surface environment is, as the name suggests underground, though this can mean cut and cover as well as deep tube tunnels. Materials used in equipment must be compliant with 1-085 to ensure that the heat load is minimised and toxic fumes are not generated in the event of a fire.

Assets are affected by the piston effect (air pressure pulses) from trains, water ingress (containing contaminants), high dust levels (the dust is made up of human skin particles, clothing fibres, silicates from train brake composites and track ballast, and steel particles). There is a high humidity level underground compared with the surface, although generally temperatures are relatively stable (though can in certain locations be extremely high) There are other factors which impact assets in a way that would not be experienced on the surface.

1.7.3 Surface Environment

This area is clearly above ground and is therefore subject to fluctuations of temperature and is exposed to the elements. There are over and under bridges, external passageways which lead generally to surface station areas being more prone to vandalism than would be expected sub-surface.

Many surface stations have platform canopies and pest control measures such as pigeon netting and spikes which will need to be taken into account when designing an installation.

There are direct interfaces with third parties such as Network Rail more commonly at surface stations than sub-surface. A significant number of surface stations have previously been owned by other rail operators whose infrastructure may not be to the usual LU standards.

Earthing arrangements can be complex and rail-specific, particularly where stations are in close proximity to other rail providers running 25kV AC over head line (OHL). Earthing arrangements at