

Standard Category 1

**S1066 A6**

**Lighting of London  
Underground Assets**

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## 1 Purpose

- 1.1 The purpose of this standard is to ensure that all lighting systems on London Underground (LU) infrastructure are designed, modified, installed, maintained, operated and managed at end of life in a safe and effective manner.

## 2 Scope

- 2.1 This standard applies to LU, their suppliers/contractors and third parties. This standard applies to all lighting systems on any LU infrastructure.
- 2.2 This standard should be used when designing, commissioning and verifying lighting installations on London Underground infrastructure.
- 2.3 This standard does not apply to rolling stock, lift cars, lift shafts, substations or tenancies.

Note: Lighting in substations and similar power buildings are the responsibility of Power Engineering and requirements for these buildings are provided in [S1914](#). The Power Engineer may choose to adopt some elements of [S1066](#) where deemed appropriate.

## 3 Requirements

### 3.1 General

- 3.1.1 This standard includes lighting requirements for projects following the LU Station Design Idiom and those that are not. The project Sponsor shall determine if the LU Station Design Idiom is to be followed and this shall be recorded in the Project Requirements Statement. Where the Station Design Idiom is specified, the clauses in Appendix A shall be followed in addition to the rest of this standard.
- 3.1.2 This standard must be read in conjunction with LU standard [S1374](#) 'Customer Experience in London Underground Stations', for all non-technical lighting design requirements.
- 3.1.3 LU lighting systems shall:
- Be safe
  - Enable the effective performance of all necessary tasks by both customers and staff
  - Meet the requirements of all customers, including blind, partially sighted, neurodivergent customers and those of reduced mobility in accordance with BS 8300, PAS 6463 and other inclusive design guidance where relevant.
  - Provide a welcoming visual environment
  - Be designed to minimise energy usage
  - Be optimally designed to minimise whole life cost and carbon. This could incorporate the ability to reuse, refurbish, re-manufacture and recycle individual components of the system.

- 3.1.4 Where project or maintenance works make an asset redundant or find a redundant asset, TfL Procedure [PR0475](#) (Management and Removal of Redundant Electrical and Mechanical (E&M) Assets and Systems) shall be followed.
- 3.1.4.1 Where it is proposed to leave redundant assets in situ as a result of following [PR0475](#), then a concession request with the supporting evidence listed in PR0475 shall be submitted against clause 3.1.4 of this standard.
- 3.1.5 All lighting structural and supporting elements and lighting column installations shall conform to all prevailing LU standards, in particular:
- i. [S1053](#) 'Civil Engineering – Building and Station Structures'
  - ii. [S1057](#) 'Civil Engineering – Miscellaneous Assets'
  - iii. [S1061](#) 'Civil Engineering – Bridges and Structures Assessment'
  - iv. [S1063](#) 'Cutting, grinding, drilling, fixing to and supporting from existing structures'

## 3.2 Environmental considerations

- 3.2.1 Lighting systems shall be designed to meet, and demonstrated as meeting, the requirements of The Building Regulations, Part L.
- 3.2.2 When new luminaires are installed, spill light that creates unwanted illumination of areas adjacent to LU property, sky glow and/or the illumination of building exteriors shall be minimised.
- 3.2.3 When new luminaires are installed in external locations they shall provide no upward illumination beyond the horizontal.
- 3.2.4 Lighting systems shall not spill light to, or create glare for, adjacent residential properties.
- 3.2.5 Lighting systems shall be designed to be resilient against all of the environmental conditions to which the components will be subjected, including but not limited to transient piston pressures, wind, water ingress, contaminants, chemicals, humidity, temperature, direct sunlight, radiated heat, vibration and vandalism.

Note: The impact of climate change on the duration and intensity of weather events throughout the intended and likely lifespan of the equipment should be considered when specifying equipment and its installation methodology. For example, periods of high temperature in external environments will become more frequent and longer in duration and rainfall will become heavier.

TfL's latest submission to Defra under the [Adaptation Reporting Power](#) summarises TfL's climate risks and the likely weather conditions London will experience under different emissions scenarios.

- 3.2.6 Where lighting products are removed and not life-expired, or are purchased but not required, they shall be offered to the LU Maintainer or other TfL projects for re-use.
- 3.2.7 Where lighting products cannot be reused, they shall be recycled if a suitable product recycling schemes exist.

- 3.2.8 All lighting products used in the LU environment are subject to the Waste Electrical and Electronic Equipment Regulations (WEEE).
- 3.2.9 Those removing lighting products from LU infrastructure for disposal shall ensure that the disposal is completed in accordance with the requirements of the WEEE Regulations and is covered by a suitable Waste Transfer Notice as required by Section 34 of the Environmental Protection Act.

Note: Some existing lighting system components on the network may contain Hazardous Materials (such as mercury in luminaires or Persistent Organic Pollutants (POPs) in printed circuit boards). Care should be taken to ensure these are disposed of under the correct section of the WEEE regulations.

### 3.3 Lighting Design

Note: While this section contains clauses that specifically relate to the design of lighting, the lighting designer should note that the requirements of other sections of this standard will also influence and impact a lighting design.

- 3.3.1 Lighting systems shall be fully co-ordinated with other new and existing services and station structures.
- 3.3.2 Lighting shall be designed so that the Normal Lighting illuminates the environment, with smooth transitions, so that the occupants can move around and perform all necessary tasks safely and effectively without sudden differences in lighting levels, excessively bright or dark areas or areas of strong shadows.

Note: Where frequent movement of people is anticipated between two adjacent areas that are not separated by a barrier (such as a door), it is recommended that the ratio of illuminances between the two spaces meets those listed in HSE Guide 38 (Lighting at Work).

If the ratio of illumination between two spaces exceeds the maximum ratios in HSE Guide 38, the lighting designer should only increase the illumination in the darker space if it is not possible to reduce the illumination in the higher space (e.g. the illumination levels in that space are at the minimum required by this standard).

Additionally, PAS 6463 recommends an illumination ratio of no greater than 1:3 between fixed task areas and the immediately adjacent spaces to prevent visual fatigue.

- 3.3.3 Uniformity values shall apply over the whole area of the task (defined as the Lighting Design Area), excluding a boundary zone with limits of 100mm from any wall, pillar, column or other hardware mounted in the space.
- 3.3.4 Task analysis shall be undertaken to identify the lighting task plane, which may be horizontal, vertical or both. The lighting design shall demonstrate that sufficient illumination is provided on the task plane.
- 3.3.5 Lighting systems shall be designed in a manner sympathetic to heritage requirements and shall meet the requirements of section 3.2.8 of LU standard [S1374](#).

- 3.3.6 The lighting designs for staircases or escalators shall assume a uniform task plane parallel to the incline, rather than a simulation per step.
- 3.3.7 Lighting designs shall be completed without contribution of natural or borrowed light from third parties which may affect Normal Lighting levels within the station.

Note: While lighting designs shall evidence that they can meet the illumination levels required by this standard without any light input from other sources, schemes should utilise as much daylight as possible and use controls (as per section 0 of this standard) to reduce the energy consumption of artificial lighting. This will involve collaboration with the Architect throughout the design process.

- 3.3.8 Lighting system components in public areas (including Emergency Lighting, supporting elements, cable management systems and cabling) shall be located in positions that meet the architectural intent for the area.

Note: At some locations, the architectural design for a space will include for services being visible by the public, whereas at others the intent is that all services are hidden from view. The Lighting Designer shall consult with the TfL Built Environment Engineer to confirm the strategy to be adopted.

- 3.3.9 Luminaires for externally illuminated signage shall be located so that the illumination levels on the sign under both normal and emergency conditions meet the requirements of BS EN 1838 (BS 5266-7) and BS 5499.
- 3.3.10 Luminaires shall be positioned so that they do not impact on the visibility of signage, passenger information systems or minimum headroom requirements set out in [S1371](#) Station Planning.
- 3.3.11 Luminaires shall not be installed perpendicular to the track within platforms and tunnels, as this may cause a strobing effect to train drivers as they approach.
- 3.3.12 The method used for calculating maintenance factors for use in lighting design calculations shall be declared by the designer, along with any assumptions made regarding the maintenance regime required to meet these maintenance factors.

3.3.12.1 This shall include consultation with the LU Maintainer.

Note: The SLL Code for Lighting contains guidance on determining a suitable maintenance factor.

When determining the maintenance factor, designers should take into consideration that some locations across the LU network are inherently dusty with infrequent cleaning regimes and that the figures included in the SLL Code for Lighting may need to be further adjusted.

## 3.4 Lighting Circuits

- 3.4.1 Lighting circuits shall be designed, installed and tested in accordance with LU standard [S1069](#) 'Low Voltage Electrical Installations' and BS 7671.

3.4.2 Where sub-surface locations have a single LU CEPS supply and a local DNO supply and Emergency Lighting is provided by a central battery system, the supply to the central battery system shall be sourced from the DNO supply.

Note: Sub-surface locations are identified in LU Standard [S1086](#) - Fire safety classification of stations and shafts.

3.4.3 Within public areas and not-normally accessible public evacuation routes at stations, an individual luminaire or circuit failure shall not cause a loss of more than:

- i. 25% of Normal Lighting levels or 50% of Emergency Lighting levels at sub-surface stations
- ii. 33% of Normal Lighting levels or 50% of Emergency Lighting levels at surface stations

Note: The intent is that the lighting system is still able to provide sufficient illumination for the station to operate in a Degraded Mode in the event of the failure of an individual luminaire or circuit.

The expectation is that lighting designs for most public area and not-normally accessible public evacuation routes at sub-surface locations will consist of a minimum of 3no. circuits from the LU CEPS supply (1 per phase) and 2no. circuits from the central battery LEPS.

The expectation is that public area Normal Lighting at surface stations will consist of a minimum of 3no. circuits (1 per phase).

3.4.4 Where multiple non-LEPS luminaires are required in a space to meet the required illumination levels, adjacent luminaires on these circuits shall be fed from different phases.

3.4.5 Lighting loads shall be balanced over three phases of a Three Phase & Neutral (TP&N) supply.

Note: In addition, where multiple circuits are required in non-public areas to achieve a compliant lighting design, it is expected that the lighting load within that given space will also be balanced over 3 phases.

3.4.6 Lighting for public areas shall not be supplied from the same circuit as non-public area lighting.

Note: Circuits in public and non-public areas can be controlled by the same Lighting Control System, whilst being on separate electrical circuits.

3.4.7 Lighting circuits shall achieve the specified disconnection times for their Circuit Protective Device (CPD) as tabulated in BS 7671 without the need of additional devices.

- 3.4.8 Residual Current Devices (RCDs) shall not be used on lighting circuits.
- 3.4.8.1 Where the nature of a location (e.g. within a shower cubicle) necessitates the use of RCDs on circuits to meet the requirements of BS 7671, the designer should first seek to locate the lighting equipment outside of this location.
- 3.4.8.2 Where this is not possible, the designer shall complete a location specific risk assessment for the use of RCDs that details the mitigation that will be put in place to reduce the risk to ALARP. This shall be agreed with the LU Maintenance representative at concept design stage.
- 3.4.8.3 As a minimum, the assets shall be clearly labelled on site and identified within the handover documentation.
- 3.4.9 Circuit Protective Devices (CPDs) shall not be used for routine switching of lights.
- 3.4.10 Lighting designers shall ensure that the circuit protective device selected for each lighting circuit is able to accept the cumulative in-rush current of all drivers connected to the circuit.
- 3.4.11 The only signage that shall be supplied from an OLBI system are emergency exit, way out and escape signs.
- 3.4.12 Lighting equipment shall be located outside of the 25kV 2.5m exclusion zone in stations that are in close proximity to other rail providers running 25kV AC overhead line (OHL).
- 3.4.13 Where rotary, or moving, machines are used the lighting circuitry shall be wired to utilise at least two phases to reduce stroboscopic effects.

### **3.5 Luminaire Installation**

- 3.5.1 Luminaires shall have a sufficient number of fixings to ensure that there is no single point of failure in the luminaire support system and shall take into consideration the manufacturers recommendations. The number of supports installed for an individual luminaire shall not be less than two.
- 3.5.1.1 The number, type and location of fixings/supports provided shall take into consideration the levels of vibration and air movement experienced in the LU environment (including the piston effect from trains). If these conditions are present, consideration should be given to the use of anti-vibration washers and fixings on the supports.
- 3.5.1.2 The weight of each fitting shall be distributed evenly across all supports.
- 3.5.2 Luminaire supports shall be independently fixed to the structure of the building and shall be installed in accordance with the manufacturer's instructions. This includes locations where a suspended ceiling or cladding is installed.
- 3.5.3 Only cables terminating within a luminaire shall enter a luminaire.



- 3.5.4 Where circuit cabling is routed through a luminaire compartment that contains the light source, the installer shall ensure that the circuit cabling has suitable heat resistance to prevent premature failure of the cabling.

Note: This could be achieved by using a heat-resistant over-sleeving.

- 3.5.5 Lighting circuits shall be wired as radial circuits with no spurred luminaire connections. Three cables shall not be connected to a single connection point.
- 3.5.6 Luminaires shall be connected to the fixed wiring via robust, captive plug and sockets, suitable for the environment they are to be installed in. The sockets shall be installed immediately above, or immediately adjacent to the luminaires. The connection from the socket to the luminaire shall be via a double insulated flexible cable of a length not more than 1000 mm.

- 3.5.6.1 In public areas, it shall be ensured that the plug & socket and flexible cable connection to the luminaire cannot be accessed by members of the public.

Note: In external or hazardous environments that could impact the condition or safe operation of the equipment, consideration should be given to the use of conduit connections to luminaires.

- 3.5.7 All luminaires, cabling, sockets, plugs, connectors, joints, terminal, and junction boxes shall be mounted away from areas where they could obstruct access to other equipment, or be knocked or damaged by persons, pests, or other means. They shall be suitably protected from persons, pests, and any other means, which could impact the condition and safe operation of the equipment.
- 3.5.8 Dissimilar metals shall not come into direct contact in any part of a lighting installation in accordance with the requirements of clauses 3.4.18 – 3.4.19 of [S1069](#).
- 3.5.9 All components of a lighting system shall be labelled in accordance with the requirements for 'equipment' as defined in section 3.27 of [S1069](#).

### 3.6 Requirements for Maintenance

- 3.6.1 Lighting systems shall be maintained so that during normal operation:
- the measured illuminance values do not fall below those specified in the relevant standard.
  - spaces with multiple lighting circuits are not left with only one functioning circuit or supply source.
- 3.6.2 Emergency Lighting systems shall be maintained in accordance with BS 5266-1, BS EN 50172 and TfL Technical Specification [T0090](#).
- 3.6.3 Glazing that allows contributory daylight into a space shall be cleaned and maintained so that they continue to allow natural daylight into the space.

- 3.6.4 Lighting controls and associated sensors shall be maintained so that lighting systems are continuously available for operation, are working as designed and are providing the correct remote reporting data.
- 3.6.5 A technically competent person shall carry out a visual inspection to verify operational and mechanical integrity of all luminaires at intervals that reflect the environmental conditions of the location and the risk of luminaire failure. The results of the inspection shall be recorded.

Note: Consideration shall be given to an inspection frequency of 18 months, to match the previous frequency of visit for fluorescent re-lamping regimes.

- 3.6.6 On all new build stations and where feasible on existing stations, luminaires in public areas shall be designed and installed such that they are accessible for maintenance during traffic hours without the need for special access equipment nor closure of public areas.

Note: This should include consideration of the location of components of the lighting system. There is a preference for locating equipment at low level so that it can be reached without the need for high level access equipment, noting the requirement not to compromise headroom below compliant levels.

A cross-discipline coordinated approach to the overall station design is required such that the solution does not compromise the overall energy efficiency of the installation.

- 3.6.7 All lighting equipment (including luminaires, plugs & sockets, connectors, joints and junction boxes) shall have reasonable safe access that is accessible using standard access equipment that does not require specialist training to use.

3.6.7.1 Where access equipment requiring specialist training to use is required to reach lighting equipment, the maintenance regime shall be discussed and agreed with the LU Maintenance Representative at concept design stage. This shall include consideration of installing socket outlets for earth loop impedance testing at the end of each lighting circuit at low level (i.e. that can be reached without the use of any access equipment).

3.6.7.2 Where socket outlets are installed for earth loop impedance testing, they shall have a non-standard pin configuration to prevent use for other purposes or equipment and shall have a warning label located adjacent to the socket stating that it shall only be used for earth loop impedance testing.

- 3.6.8 All lighting equipment (including luminaires, plugs & sockets, connectors, joints and junction boxes) shall be easily accessible with suitably designed access hatches or routes provided where required to allow routine inspection, testing and repair activities provided.

- 3.6.9 The condition of lighting assets shall be assessed in accordance with the process described in [S1042](#) (Managing LU Asset Risk: Recording of Assets and Data for Condition Reporting) and [R0736](#) (Asset Health Indicator Methodology).

Note: Where the systems and processes are not in place to apply the full methodology described in [R0736](#), the guidance in section 11.3 (Electrical Assets - Asset Condition Reporting Category Selection Guidance) of [S1069](#) may be used determine a condition category for lighting assets.

### 3.7 Glare

- 3.7.1 Glare shall be controlled so that reflections created by the lighting do not impair the view in mirrors or any Closed Circuit Television (CCTV) equipment.

Note: Reflections from artificial and natural light sources in surface finishes shall not be permitted to interfere with signal aspects.

Means shall be provided for the control of glare caused by direct sunlight penetration. Specular materials shall not be used in locations where it is likely that reflection of direct sunlight from them could interfere with train driver vision.

- 3.7.2 Glare levels for indoor locations shall be determined, by calculation, using the International Commission on Illumination (CIE) Unified Glare Rating (UGR) tabular method as defined in BS EN 12464-1.
- 3.7.3 Glare levels for outdoor locations shall be determined, by calculation, using the International Commission on Illumination (CIE) Glare Rating (GR) method as defined in BS EN 12464-2.
- 3.7.4 Glare calculations within depots shall consider the effect of glare on train drivers while identifying points of emphasis within the depot.

Note: In this context, points of emphasis within a depot may include, but not be limited to, stopping marks, points and track walkway crossings.

- 3.7.5 Glare caused directly from luminaires shall be limited to the UGR levels specified in Table 1. Areas not listed in the table shall meet the UGR levels specified in the relevant table of BS EN 12464-1 or the GR levels specified in BS EN 12464-2.

Note: Extra care should be taken when luminaires are wall mounted at low level or at finished floor level, particularly when installed near stairs, or when uplighters are used.

Additional films or special diffusers may need to be fitted after installation of luminaires in these locations to ensure that customers and staff do not experience problematic levels of glare.

Table 1: Unified Glare Rating Maximum Levels

Location	Unified Glare Rating (UGR)
Ticket hall - circulation	28
Ticket hall - POMs	22
Ticket hall – Visitor Information	22
Concourse	28
Gate lines	22
Corridors / Passageways	28
Stairs and ramps	28
Stair Landings	28
Escalators	28
Escalator Landings	28
Platforms	28
Platform edge zone	28
Waiting rooms	22

### 3.8 Luminaire and Light Source Requirements

- 3.8.1 The use of Kit of Parts luminaires and light sources is mandatory for all new upgrade, renewals or enhancements projects.
- 3.8.1.1 In instances where none of the products listed within a category of the Kit of Parts catalogue are suitable for a specific location for technical or aesthetic reasons, alternative products shall be agreed in principle with the Head of E&M Engineering before use, with the decision formally recorded via a concession and equipment listed within the LU Product Information Register (PIR) or equivalent.
- 3.8.1.2 Where the Kit of Parts catalogue is not available or does not contain a category for a type of equipment, proposed products shall be assessed as being suitable for the application by the Electrical Discipline Engineer in consultation with the LU Maintenance Representative.
- 3.8.1.3 Where a proposed product has not been used on LU previously, the requirements of [S1011](#) (Product Selection, Assessment and Authorisation for use) shall be met and, if applicable, the equipment should be listed on the LU Product Information Register.
- 3.8.2 All luminaire and light sources proposed for use shall, as a minimum, meet the requirements of the relevant product Technical Specification published on [TfL's Management System \(TMS\)](#).
- 3.8.3 Electric lighting equipment shall have a power factor between 0.9 and 1.
- 3.8.4 All luminaires shall be able to demonstrate compliance with the relevant parts of BS EN 60598.
- 3.8.4.1 In particular, emergency luminaires shall meet the requirements of BS EN 60598-2-22 and internally illuminated emergency safety signs shall meet the requirements of BS EN 60598-2-22 and BS EN 1838.

- 3.8.5 Light sources and luminaires shall have a minimum luminous efficacy to meet the requirements of The Building Regulations Part L and The Ecodesign for Energy-Related Products and Energy Information (Lighting Products) Regulations.
- 3.8.6 Light sources shall have a minimum Colour Rendering Index (CRI) of 80.
- 3.8.7 Luminaires shall be fitted with a fixed fuse holder and fuse in accordance with BS 1362. Fuse holders may be combined with the terminal block.

Note: Also note the requirements of clause 3.20.23 for fire-survivability requirements of fuses and fuse holders when used in central battery backed emergency lighting systems.

- 3.8.8 In order to compensate for lumen depreciation over time, new luminaires shall either;
- Have control gear that is capable of automatically increasing the drive current over time, or
  - Utilise a lighting control system that adjusts the lumen output of the luminaire to meet a designated maintained illumination level, using a comparison of live measured illumination levels against calibrated readings taken during commissioning.
- 3.8.9 All new lighting for general illumination shall have a colour temperature of 4000K except:
- Where a different colour temperature is required for heritage reasons
  - Where existing lighting of a different colour temperature exists in the space and the scope of the works is only to replace a section of the lighting. In this case the new lighting shall match the colour temperature of the existing lighting.
- 3.8.10 All new luminaires shall carry the United Kingdom Conformity Assessed (UKCA) mark.

Note: The UK is currently undergoing a transition from the EU CE mark to the UKCA mark. During this transition, products carrying a CE mark are acceptable. Projects should refer to the Government rules in place at time of purchasing any new equipment.

- 3.8.11 Lighting materials at sub-surface stations shall conform to LU standard [S1085](#).
- 3.8.12 Designers shall demonstrate that dust and water ingress have been taken into account when specifying the ingress protection (IP) rating of luminaires.

Note: Degrees of protection against ingress of dust, solid objects, and moisture (IP rating) are defined in Annex J of BS EN 60598-1. Luminaires shall have been tested and certified in accordance with the requirements of section 9 of BS EN 60598-1 to evidence the assigned IP rating.

- 3.8.13 Luminaires that could be subjected to water spray from sprinkler systems shall be rated IP65.

- 3.8.14 Where the control gear is not mounted within the luminaire, it shall be mounted in a compliant enclosure with the same IP rating and finish as specified for the luminaire. The cable length between the control gear and the LED shall not exceed the maximum recommended by the manufacturer.
- 3.8.14.1 Dissipation of heat produced by the control gear shall be taken into consideration when specifying the enclosure and fixing methods. This shall include taking into account any manufacturers recommendations.
- 3.8.15 Luminaires shall have a secondary safety support, such as a safety lanyard or chain, provided for diffusers, louvres, gear trays and any lids or doors not retained by hinges so that they are prevented from falling if their primary support should fail or is released.
- 3.8.15.1 The number, type and location of fixings/supports provided shall take into consideration the levels of vibration and air movement experienced in the subsurface LU environment (including the piston effect from trains). If these conditions are present, consideration should be given to the use of anti-vibration washers and fixings on the supports.
- 3.8.16 All lighting shall comply with BS EN 55015, BS EN 61547 and LU Standard [S1222](#) for Electromagnetic Compatibility.
- 3.8.17 Luminaires shall meet the relevant requirements of BS EN IEC 61000-3-2 for harmonic production.
- 3.8.18 The lumen output required to achieve the design illumination levels at end-of-life for each luminaire shall be marked on a permanent label both on the inside of the luminaire body and on the gear tray/driver, both in a position that can be viewed without removing any components.
- 3.8.19 Luminaires for use in depot pits shall have an impact resistance of IK11 or above in accordance with BS EN 62262.

### 3.9 Modifications to Existing Installations

Note: When completing a new lighting installation or upgrading an existing system, consideration should first be given to the reuse, refurbishment or re-manufacture of existing lighting products before purchasing new products.

- 3.9.1 When modifying luminaires or replacing light sources, the requirements of section 3.8 of this standard shall also be met in addition to this section.
- 3.9.2 Where works have any impact on an existing lighting installation, either the existing lighting installation shall be modified or new lighting shall be installed to deliver a level of lighting performance compliant with all applicable standards.
- 3.9.3 Alterations to lighting systems, including works to individual luminaires, shall match the existing lighting design and architectural intent for the area. There shall be no sudden changes in illumination levels.

3.9.4 In public areas, where luminaires or equipment associated with a lighting system are replaced with equipment of different dimensions, any parts of the building fabric made visible shall be made good.

3.9.5 Where existing luminaires are being converted to accept an LED light source, the luminaire housing shall have a minimum remaining service life equivalent to the expected lifespan of the LED light source being installed.

3.9.5.1 Where it is determined that the luminaire housing does not have sufficient remaining service life, the whole luminaire should be replaced with a new product with an LED light source.

Note: Where the consequence of meeting clause 3.9.5 would result in replacement of an individual luminaire, the requirements of clause 3.9.3 take precedence.

3.9.6 Where existing luminaires are being converted to accept LED light sources, the new components shall be positioned to ensure that any heat generated is dissipated and does not build up within the luminaire.

3.9.6.1 Internal wiring shall be suitably rated for the temperatures that may be experienced within a luminaire.

Note: This may require the use of heat-resistant over-sleeving.

3.9.7 Where individual luminaires in a system are replaced, they shall be replaced with a luminaire with the same performance and distribution as the adjacent luminaires.

3.9.8 Where existing luminaires have been converted to accept LED light sources, warning labels shall be installed stating that the luminaire has been modified. This shall include the voltages available at lamp end cap or lamp-holder terminals.

Note: Suggested wording for the warning label: "WARNING - This fixture has been modified - Use only 230V LED single end fed lamps with integral drivers. DO NOT use fluorescent lamps"

3.9.9 Any new components being retrofitted into existing luminaires shall have undergone testing and be certified as complying with relevant British Standards (such as BS EN 62560 and BS EN 60598-2-22).

3.9.10 Where new components are being retrofitted into existing luminaires, confirmation shall be obtained from the manufacturer of those components that they are suitable for installation into the existing luminaire enclosures.

3.9.10.1 This shall include confirming that any Volatile Organic Compounds (VOCs) that may be present in components of the luminaire (such as in gaskets or seals) will not adversely impact, or interact with, a new light source.

3.9.11 Any modifications to existing luminaires shall ensure that the existing IP rating of the fitting is not compromised.

3.9.12 Any modifications to luminaires shall ensure that the modified luminaire complies with the requirements of the relevant parts of BS EN 60598.

### 3.10 Lighting within Tunnels

3.10.1 Running tunnels (including dedicated passenger walkways), cross-passages and access shafts shall be permanently equipped with lighting that is able to meet the illumination levels specified in Table 2.

3.10.2 Each station shall have a tunnel lighting panel that provides tunnel lighting to a point midway between stations.

3.10.3 Where works are required to existing tunnel lighting installations, the existing power supply configurations shall be maintained.

3.10.3.1 Where the tunnel lighting panel or the cabling to it is to be replaced as part of works, at least one of the supplies to the tunnel lighting panel shall be wired in enhanced fire resistant cables.

3.10.3.2 Where the existing cabling between the tunnel lighting panel and the luminaires in the tunnel requires replacing, enhanced fire resistant cables shall be installed between the tunnel lighting panel and the first luminaire on each circuit.

3.10.4 Tunnel lighting in new tunnels, or where major refurbishment works are being carried out to existing installations, shall meet the requirements of the Railways (Interoperability) Regulations 2011 and associated Safety in Railway Tunnels National Technical Specification Notice (NTSN), Rail Industry Guidance Note GIGN 7619 and BS 9992.

**Note:** The Head of E&M Engineering shall decide on what is a major refurbishment.

Further requirements for power supplies to tunnel lighting can be found in [S1069](#).

During a local DNO power failure, the CEPS system will support the tunnel lighting system. During a significant HV Network grid failure, preventing the operation of the tunnel lighting system, the train emergency battery powered lighting is designed to provide a minimum of 5 lux for a minimum of 30 minutes.

3.10.5 Each traction section of running tunnel shall have dedicated tunnel lighting circuits supplied from the tunnel lighting panel located in the adjacent station.

3.10.6 Each traction section of running tunnel shall have a minimum of 2 No. circuits with supplies to adjacent luminaires from alternate circuits.

3.10.7 Lighting within running tunnels and cross-passages shall 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.



- 3.10.8 The tunnel lighting shall be switched off automatically on energisation of the traction supply, unless it has been switched on by a manual override switch as described in clause 3.10.7.
- 3.10.9 Tunnel lighting override switches shall be located at stations and shall control the lighting to a point midway between stations.
- 3.10.9.1 For Two-Section Tunnel Lighting Panels, override switches shall be located on platform headwalls.
- 3.10.9.2 For Four-Section Tunnel Lighting Panels the override switches shall be located on either the headwall or tailwall, whichever is closest to the traction section they operate.
- 3.10.10 The tunnel light fittings shall be located at a height which is level with the rolling stock windows and orientated so that the majority of the light falls onto the window of the train carriage.

Note: The intent is not to provide functional lighting within the train carriage, but to provide a level of reassurance to customers on the train in event of a loss of traction supply.

- 3.10.11 Luminaires shall be located so that wherever a train stops in the tunnel, there are at least 2 luminaires per carriage, 1 per circuit.
- 3.10.12 Lighting within access shafts shall be provided separately to the tunnel lighting system. This shall include any lobbies at tunnel level.
- 3.10.13 The supply arrangement for lighting in cross-passages, shafts and lobbies shall ensure that the lighting is available whenever it is needed, taking into account whether it can be accessed during Traffic Hours and/or Engineering Hours or whether it forms part of an escape route from the tunnels.
- 3.10.14 The switching arrangement within access shafts, associated lobbies and cross-passages shall take into consideration whether the shaft, lobby or cross-passage is to be used for evacuation of the railway or only for maintenance access. If automatic controls are used they shall be:
- Fail safe so that the lighting defaults to full output on failure of the automated device
  - Suitable for the environment they are installed in – e.g. sensors whose ability to detect persons could be degraded by the build-up of dust shall not be used
  - Configured so that they can also be manually switched on
- 3.10.15 At cross-overs, lighting is to be permanently on.

3.10.16 Points of interest shall be indicated by permanently illuminated marker lights. These shall be connected to a BS 5266 compliant Emergency Lighting system.

Note: Points of interest within a tunnel are shafts and cross passages designated as a safe area or egress route. This also includes equipment for use in an emergency, such as tunnel telephones and tunnel lighting push-buttons.

3.10.17 All marker lights used in tunnels shall be;

- a) of a colour that is clearly distinguishable from any signal aspects and follows a co-ordinated strategy for the line.
- b) located in positions that do not obstruct the visibility of any signal aspects
- c) of a luminous intensity that does not;
  - i. Reduce the visibility of any signal aspects
  - ii. Present an unacceptable level of glare to drivers

Note: It is suggested that marker lights that identify shafts and cross passages designated as an egress route are blue in colour and all other marker lights are white.

### 3.11 Depot Lighting

3.11.1 The level of illumination within depot sheds shall be selected in accordance with the requirements of BS EN 12464-1 based on the tasks that will be carried out within that space.

3.11.1.1 This will require co-ordination with the end users and any Requirements Specifications for the depot sheds to ensure that there is a methodology in place to provide suitable lighting for all maintenance tasks that will occur in the depot sheds.

Note: This could be provided by (but not limited to) fixed lighting, sockets for the connection of temporary lighting or the provision of charging points for battery powered task lighting.

3.11.2 Illumination levels in depot sheds shall be calculated & measured when trains are stabled.

3.11.2.1 It shall be ensured that sufficient illumination is provided on all designated walkways between trains to enable persons to identify any potential hazards.

### 3.12 Escalator Lighting

#### 3.12.1 Plant Areas and Inclines

3.12.1.1 Fixed lighting shall be provided for all escalator plant areas, e.g. UMC, LMC, access walkways/stairways including the general plant area up to the interface with the incline and lobby areas.

3.12.1.2 Luminaires for fixed lighting shall have a minimum IP rating of IP54.

- 3.12.1.3 Fixed lighting and cable management systems shall not be installed directly over equipment or onto/across removable access hatches.
- 3.12.1.4 Fixed lighting on the incline and any walkways/stairways shall be installed such that it can be maintained whilst standing directly on the walkways/stairways.
- 3.12.1.5 Maintenance task lighting is not required within any Escalator Plant Area (UMC, LMC etc.) or Incline; refer notes 1 & 4 below.
- 3.12.1.6 The incline, areas beneath the Truss or between the Truss and the tunnel side walls, do not require lighting, unless they are a dedicated access walkway/stairway or have equipment requiring maintenance located in the space (such as fire equipment) and shall then require fixed lighting as defined above.
- 3.12.1.7 Any area considered/defined by TfL Safety Health, Environment (SHE) or Human Factors teams as a confined space does not require fixed lighting.
- 3.12.1.8 Machinery spaces shall be provided with permanently installed lighting in accordance with the requirements of BS EN 115-1.
- 3.12.1.9 Upper and lower landing Maintenance Spaces (when designated within the truss) shall be illuminated using 1 No. bulkhead luminaire, switched locally from within the space. The luminaire shall not be isolated when the Escalator itself is electrically isolated. Illumination levels shall meet the requirements of BS EN 115-1.
- 3.12.1.10 Escalator inclines must incorporate a single switching arrangement to enable lighting in these areas to be easily turned on and off.

Note:

1. Whilst fixed task lighting purely for maintenance purposes is not required within the plant rooms, a good plant room lighting design will provide sufficient lighting for access and also provide sufficient lighting for most maintenance activities to be undertaken, by ensuring lighting is appropriately positioned, e.g. in front of control panels and local to equipment etc.
2. Maintenance Space is the floor pit type enclosure at the top and bottom Landings of some HD Metro Escalators. This house the motors and gear, from within which maintenance is undertaken.
3. Lighting of the 'Working Area', as identified within BS EN 115, covers the illumination of the position from where you are undertaking a task and shall be delivered by fixed lighting.
4. Maintenance Task Lighting covers the illumination of the task itself and may be delivered by lighting that is either fixed, portable or a combination of both
5. Fixed lighting is permanently installed luminaires and infrastructure with no facility for it to be readily moved.

### 3.12.2 Escalator Public Area Lighting

- 3.12.2.1 The primary lighting for the public area of escalators shall be provided by light fittings located such that they are readily accessible for maintenance without the need for access equipment for working at height.

3.12.2.2 Designs shall ensure sufficient ambient lighting is delivered at high level as well as on the escalator steps.

**Note:** The ability to provide compliant illumination to 1 or 2 bank escalators via luminaires wall mounted directly above the poster panels is proven. Supplementary lighting systems may however be required where more than 2 escalators are installed in a bank.

Where new escalators are being installed, lighting fixed within the escalator skirting or other suitable location(s) may be considered as a possible option if required.

3.12.2.3 Where lighting is provided within the escalator skirt, it shall;

- a) Be supplied from circuits separate to the escalator controller.
- b) Include emergency fittings supplied from the station LEPS system to meet the lux level requirements of this standard. The wiring system shall comply with the requirements of BS 5266.
- c) Include a lockable point of isolation between the supplying distribution board and the lighting drivers. This shall be the demarcation point of the ownership boundary between the Low Voltage (LV) electrical maintainer and the escalator maintainer.
- d) From the point of isolation identified in c) above, the mechanical protection and IP rating of the cabling and lighting drivers shall be suitable for the environment, and meet the mechanical protection requirements identified in BS 7671 (with care taken to ensure that heat is dissipated so that it doesn't affect the reliability or lifespan of the drivers).
- e) Ensure that all public facing components are at Extra Low Voltage.
- f) Ensure that all components are accessible for maintenance without the need to remove any other sections of the escalator.

3.12.2.4 Luminaires shall not be installed above escalators unless it has been demonstrated to the TfL Electrical Discipline Engineer that there is no other viable alternative.

3.12.2.4.1 In these cases, it shall be ensured that the lighting can be maintained from access equipment with off-set legs, approved for use on LU escalators, that can be placed on the escalator steps.

3.12.2.4.2 Where access equipment is required for maintenance of the lighting system, the project installing the lighting shall also provide the access equipment and a storage location within the station (if requested by the LU Maintainer). The Access and Maintenance Strategy shall describe how it is to be used, including reference to the requirements of LU Procedure [PR1352](#) (Maintenance scaffolding on escalators and moving walks) as well as any maintenance requirements for the access equipment itself. This shall be agreed with the LU Maintainer at Concept Design Stage.

**Note:** This covers the full length of an escalator incline, including where an escalator barrel enters a larger 'box' structure (such as a ticket hall).

### 3.13 Platform Lighting

- 3.13.1 The Normal Lighting system on station platforms shall enable train operators to view the Platform Edge Lighting Zone in any mirrors provided for this purpose.
- 3.13.2 Lighting systems serving covered platforms on sections of railway at or above ground shall not create adaptation problems for train drivers entering or leaving the area.

Note: In these situations, lighting designers should also take into account the impact of daylight on drivers' visibility, and ensure a smooth transition between areas of natural and artificial lighting.

- 3.13.3 All luminaires used in platform installations (whether for general illumination or any other purpose) shall be;
- a) Of a colour that is clearly distinguishable from any signal aspects
  - b) Located in positions that do not obstruct the visibility of any signal aspects
  - c) Of a luminous intensity that does not;
    - i. Reduce the visibility of any signal aspects
    - ii. Present an unacceptable level of glare to drivers
- 3.13.4 Status or indicator lamps (such as those found on self-contained Emergency Lighting) shall be positioned such that they are not visible by drivers.
- 3.13.5 Platform lighting shall be located so that it can be accessed without the need to install access equipment on the track.
- 3.13.6 For areas assessed as requiring under-platform gap lighting in accordance with clause 3.5.10 of [S1131](#) (Premises – Station Platforms) it shall:
- a) Illuminate any hatched markings on the track ledge or track bed between the platform edge and the nearest running rail (where present at train door opening locations)
  - b) Not cause glare to drivers entering the platform
  - c) Not cause glare to customers on platforms or that are moving between a platform and a train
  - d) Be a white light with a colour temperature of 4000K
  - e) Be positioned so that the luminaires, cabling and CMS do not encroach on the under-platform refuge as defined in [S1131](#) and [S1156](#) (Gauging and Clearances)

### 3.14 Lighting Columns

- 3.14.1 High Mast and collapsible (folding) column lighting shall be designed such that both the columns and fittings can be maintained without the need to close any sections of the Railway.

Note: This includes stations, depots, lineside buildings and any walking routes or Escape Routes associated with them.

Clause 3.14.1 does not preclude the use of local barriers to protect works taking place on a column, as long as the safe movement of people around the worksite is still possible.

- 3.14.2 Photocells and drivers for High Mast lighting shall be installed at low level so that they can be maintained without the need for specialist access equipment.

Note: Reaching luminaires, drivers and photocells using access equipment stored within the depot or station is permitted by this clause if it can be used without the need to shut sections of the depot or station.

- 3.14.3 Collapsible (folding) columns shall be:

- a) Positioned parallel to running tracks and roadways, or at an angle that is sufficient to clear any permanent structures or obstructions, but not impinge the track gauge when lowered or enter the exclusion zone for Overhead Line Equipment (OHLE).
- b) Designed to prevent damage to any other equipment (CCTV cameras, PA loudspeakers, signs) mounted on the column.

- 3.14.4 Where columns are used to support signs or communication equipment, structural load assessments shall be conducted as required by LU Civils Cat 1 Standards. Supports for signs fixed to columns shall be designed to meet the static and dynamic loading requirements.

- 3.14.5 Fixed columns shall be used only where physical restrictions prevent a folding column from being lowered.

- 3.14.6 Folding lighting columns shall be of the pivot type.

3.14.6.1 The axis of the pivot shall be between a height of 0.5 and 1.3 metres from the ground level.

- 3.14.7 Lighting columns shall be fixed to the ground via a root or flange mounting.

- 3.14.8 The design of lighting foundations and fixings shall be co-ordinated with the Civils Designer to ensure that there is suitable provision for cables entering the column.

Note: This shall include consideration of the cable bending radius and installation methodology.

- 3.14.9 Concrete columns shall not be permissible except where replacing equipment on heritage installations, or adding additional columns to stations which merit such replication.
- 3.14.10 Lighting columns shall not be supplied with ladder rests.
- 3.14.11 Lighting columns shall be provided with local double-pole isolators located within a suitably IP rated compartment below the pivot point of the column.
- 3.14.11.1 Where more than one circuit enters a lighting column, it shall be possible to isolate each incoming circuit independently.
- 3.14.12 Columns shall have good Visual Contrast against the floor and background in which they are seen.
- 3.14.13 Columns should be marked with a visually contrasting band to meet the requirements of clause 3.2.7 of [S1131](#). An additional, visually contrasting lower band should also be used to mark them as a hazard.
- 3.14.14 Lighting columns shall not be used as masts for catenary wiring.

### 3.15 Lighting of Construction Sites

- 3.15.1 Illumination levels on construction sites shall be determined by risk assessment based on the tasks being carried out. This shall be subject to the same design assurance requirements as a permanent installation, as described in this document.

<p>Note: Guidance and suggested illumination levels for different types of construction activities can be found in HSE Guide 38 (Lighting at Work), the HSE website and in BS EN 12464-2.</p>
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- 3.15.2 Emergency Lighting shall be provided on construction sites in accordance with BS 5266 and shall come on automatically in the event of a failure to the primary supply.
- 3.15.3 Lighting on construction sites shall be supplied at 110V (55V-0-55V). RCDs shall not be used on these circuits.
- 3.15.4 The lighting shall be designed such that the failure of any single luminaire or circuit does not leave a space in darkness.

### 3.16 Lighting Controls

Note: Lighting control may be achieved by the use of local switching (whether manual or automatic), or by a centrally managed software based Lighting Control System.

- 3.16.1 All electric lighting installations shall be provided with controls which:
- a) enable the premises to meet the requirements of Building Regulations, Part L
  - b) are readily accessible by the operators and other staff who need to use them
  - c) cannot be interfered with by unauthorised persons (including members of the public)
  - d) enable the switching ON and OFF of lighting without operation of the circuit protective device
  - e) minimise energy usage by employing automatic daylight-linking
  - f) minimise energy usage by employing presence detection equipment in non-public areas with the exception of machine rooms, plant rooms and equipment rooms
  - g) enable all light fittings (including emergency) to be switched off when the room is unoccupied without introducing additional safety risks
  - h) minimise maintenance intervention
  - i) provide adjustment of the lighting levels for personal comfort in offices or similar types of location (i.e. control rooms)
  - j) are labelled clearly to indicate which lighting circuit they operate
- 3.16.2 Manual controls for lighting shall meet the requirements of BS 8300 in respect of height, operation (i.e. shall not require the use of both hands simultaneously and be operable with a closed fist) and Visual Contrast between the switch and the background it is mounted on.
- 3.16.3 Where rotary machines are used, motion sensors shall not be used to control the lighting circuits.
- 3.16.4 Where a central battery system is used, the lighting controls must be configured to ensure that 'normal' AND 'emergency' lighting are controlled to come on simultaneously: it must not be possible for non-Emergency Lighting circuits to be switched on without their associated Emergency Lighting also being switched on, or vice versa.
- 3.16.5 Where light output from luminaires can be adjusted, it shall not cause any buzzing or humming noises to be generated by components of the lighting system.
- 3.16.6 Where automatic controls are used to control multiple luminaires, a manual override facility shall be provided.

Note: For example, a manual switch to bypass photocell or contactor arrangements that control multiple luminaires and/or areas.



### 3.17 Lighting Control Systems

- 3.17.1 When determining whether to use local lighting controls or a Lighting Control System, a whole life cost/benefit analysis in accordance with section 3.23 of this Standard shall be completed. Additionally, this shall also consider the use of the space and any existing controls that are installed in the location.
- 3.17.2 Where Lighting Control Systems are used, they shall comply with the requirements of this section in addition to the requirements of section 3.16.

**Note:** Lighting Control Systems may be of either a cabled or wireless type.

- 3.17.3 Lighting Control Systems shall not be a closed protocol system that can only be installed in one manufacturers' luminaires.
- 3.17.4 Lighting Control Systems shall not be bespoke systems created specifically for LU. Modification of settings in systems to meet LU specifications and requirements is acceptable.
- 3.17.5 The Lighting Control System shall provide a flexible network, such that additional modules (luminaires and control devices) can be added to the system without compromising the overall performance of the lighting system.
- 3.17.6 Lighting Control Systems shall identify and report when any luminaire driver and/or light source in the system is approaching end of life and when it has reached end of life.
- 3.17.7 Where a Lighting Control System incorporates presence detection, the system shall ramp up the light output of the fittings over a period of time on detection of a person in a space as described in PAS 6463.
- 3.17.8 Lighting Control Systems shall provide automatic Emergency Lighting testing and reporting for all self-contained emergency luminaires at a location.
- 3.17.8.1 The Emergency Lighting test shall, as a minimum, include the following features:
- a) Continuous real-time monitoring of emergency luminaires
  - b) Automated test regimes for periodic function and discharge testing
  - c) Historic record of all test results
- 3.17.9 In locations where a Lighting Control System and a central battery system are installed, it shall be possible to switch all lighting into any state or position required for testing of the central battery system via the software without manual intervention or physical switching on site.
- 3.17.10 Lighting Control Systems shall be complete with the functionality to clone drivers.
- 3.17.11 Lighting Control Systems shall be automatic in their normal operation.
- 3.17.12 Lighting Control Systems shall include modes to enable maintenance activities.

3.17.13 Lighting Control Systems shall be fail-safe when in fault condition.

Note: This shall ensure that a loss of function of part or all of the Lighting Control System does not result in a loss of illumination in a space. This may require luminaires within a space to be split across multiple lighting control modules.

3.17.14 All control switches should be clearly labelled in order that staff and maintainers can easily understand the intended function.

3.17.15 Lighting Control Systems shall have the following methods of control (in order of priority):

- a) Priority 1 (highest) - Fire panel "Luminaires to full brightness" override
- b) Priority 2 - Emergency Lighting / UPS test mode
- c) Priority 3 - Station Operations Room (SOR) lighting override panel
- d) Priority 4 - Local switches and sensors
- e) Priority 5 – If applicable, operation from the SMS

3.17.16 Lighting Control Systems shall be capable of connecting to a network to enable viewing of data from an off-site location. The remote connection shall:

- a) Allow monitoring of the performance of the system in real-time.
- b) Provide automated reporting and notification of faults, including the ability to interrogate the fault event.
- c) Allow access to, and the download of, historic fault data and test results.
- d) Not allow the lighting to be controlled, operated or switched from an off-site location, except by agreement with the Head of E&M Engineering.

Note: The exception to 3.17.16d) is tunnel lighting systems, as they may require a remote switching function from a control centre to meet the requirements of the Safety in Rail Tunnels NTSN.

3.17.17 Where a Lighting Control System is connected to a network for remote access (via a TfL network or via the internet), the system shall comply with the requirements of TfL's Cyber Security Standards, including:

- a) [S1770](#) – Operational Technology Cyber Security – Governance
- b) [S1771](#) – Operational Technology Cyber Security – Projects and Upgrades
- c) [S1772](#) – Operational Technology Cyber Security – Operations and Maintenance

3.17.18 Lighting Control Systems shall be able to interface with common open-source communication protocols used by other building management systems (e.g. BACnet).

- 3.17.19 Any wiring used as part of the Lighting Control System installation shall be selected and installed to mitigate the impact of Electromagnetic Interference (EMI) on the system's performance.

Note: Additional requirements for cabling for Lighting Control Systems are contained in section 3.18 of [S1069](#) and Engineering Bulletin [ENG025](#) (DALI Lighting Control Cables).

### 3.18 Illumination Levels

Note: The Workplace (Health, Safety and Welfare) Regulations 1992 requires that every workplace should have suitable and sufficient lighting.

Within LU premises this means that lighting shall be provided:

- Where a task of work (i.e. not just walking) is regularly undertaken within a space
- Within areas providing access to a place where tasks are performed

Where existing illumination is provided in a space, the levels may need to be increased to meet this obligation, for any new or altered tasks to be carried out within that space.

- 3.18.1 Table 2 contains illumination and Uniformity levels required to be achieved for LU specific locations.
- 3.18.2 Where there is no LU specific requirement specified in this document, then European or British Standard requirements shall be followed with Chartered Institution of Building Services Engineers (CIBSE) guidance and Department for Transport (DfT) Code of Practice to be used for further support.
- 3.18.3 No lighting is required if an area is defined by a TfL SHE representative as a confined space.
- 3.18.4 Where no lighting is present in a space, warning labels shall be installed at all entry points to highlight this and to state that anyone entering the space should have portable battery powered lighting with them.
- 3.18.5 The illuminance levels in Table 2 are Maintained Average Illuminance Levels measured in the horizontal plane at floor level unless otherwise stated.

Note: It is expected that the designed Maintained Illuminance Level shall not exceed +20% of the levels stated in the table to prevent over-lighting and unnecessary energy consumption.

Where the selected maintenance factor results in initial lighting levels at switch-on that exceed this, it is expected that controls will be used to reduce the initial illuminance level.

**Table 2: Normal Lighting Illuminance levels**

Location	Illuminance (Lux)	Uniformity	Note
<b>Stations</b>			
Gatelines	200	0.8	<p>Instead of a maintained average horizontal illumination value, this is the minimum value for illumination that any individual measurement point within the space shall not fall below at any time.</p> <p>Illumination level required at oyster card reader level. The lux level measured at floor level must still meet the requirement for the Ticket Hall.</p>
Ticket Hall / Concourse	200	0.6	
Passageways / Corridors	150	0.6	
Escalators & Travelators	150	0.5	<p>Instead of a maintained average horizontal illumination value, this is the minimum value for illumination that any individual measurement point within the space shall not fall below at any time.</p> <p>Uniformity figures are to be measured at 2 equally spaced points on each leading edge tread along the pitch line.</p>
Stairs / Internal Ramps	150	0.5	<p>Instead of a maintained average horizontal illumination value, this is the minimum value for illumination that any individual measurement point within the space shall not fall below at any time.</p>
Escalator & Travelator Landings	150	0.8	<p>Instead of a maintained average horizontal illumination value, this is the minimum value for illumination that any individual measurement point within the space shall not fall below at any time.</p> <p>The Escalator Landing is the area between the end of the escalator floor plate and the transition point where the steps move from horizontal to an incline.</p> <p>The Travelator Landing is the area between the end of the travelator floor plate and a distance 0.5m onto the moving walkway.</p>
Stair Landings	150	0.8	<p>Instead of a maintained average horizontal illumination value, this is the minimum value for illumination that any individual measurement point within the space shall not fall below at any time.</p> <p>Stair Landing area is defined as 0.5m from the top/bottom of the flight of steps, including at intermediate Landings.</p>

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Location	Illuminance (Lux)	Uniformity	Note
Surface Platform – Open	50	0.4	This shall include the Platform Edge Lighting Zone
Surface Platform – Canopy	100	0.4	This shall include the Platform Edge Lighting Zone
Platform Edge Lighting Zone (Sub-Surface Platform Only)	150	0.5	<p>Instead of a maintained average horizontal illumination value, this is the minimum value for illumination that any individual measurement point within the space shall not fall below at any time.</p> <p>Where Platform Edge Doors are used, the values stated apply only to the sections of platform where the doors are located. The illumination level is only applicable when the doors are open.</p>
Sub-Surface Platform	100	0.5	The Platform Edge Lighting Zone is not to be included in calculating platform illumination levels and Uniformity.
Waiting Areas	150	0.4	
Station Exterior Walking Route	20	0.4	Instead of a maintained average horizontal illumination value, this is the minimum value for illumination that any individual measurement point within the space shall not fall below at any time.
Station Entrance	20	0.4	This is the area under the station entrance canopy. The Designer shall take into consideration the illumination levels in adjacent third party assets to prevent significant transitions in lux levels.
Secure Suite, Booking Office and Other Control Rooms – Floor Level	150	0.4	
Secure Suite, Booking Office and Other Control Rooms – Desk Level	500	0.6	<p>Human factors assessment should be undertaken to determine any additional task lighting requirements.</p> <p>Lighting in the booking office shall be 100 lux measured in the vertical plane at the counter to enable effective lip-reading.</p> <p>Dimming shall be provided in accordance with clause 3.16.1i).</p>

Location	Illuminance (Lux)	Uniformity	Note
Plant Rooms	200	0.5	<p>Includes Communications Equipment Rooms (CERs), substations, switchrooms, switch cupboards, pump rooms, fan rooms, Offline Battery Inverter (OLBI) Rooms, Hub, Lift Electrical Equipment Room (LEER), Sprinkler Valve Chamber (SVC) rooms and transformer rooms.</p> <p>Illumination is provided for general wayfinding and visual inspection only. Portable or temporary lighting may be required to provide increased illumination for some maintenance tasks.</p> <p>Whilst fixed task lighting purely for maintenance purposes is not required, a good lighting design will provide sufficient lighting for access and also provide sufficient lighting for most maintenance activities to be undertaken, by ensuring lighting is appropriately positioned, e.g. in front of control panels and local to equipment etc.</p>
Storerooms (including Bin Stores)	100	0.4	
Mess Room	150	0.5	
Cleaner's Stores	150	0.4	
Escalator Machine Rooms	200	0.4	Further information is held within LU Lift and escalator category 1 standard <a href="#">S1097</a> .
Escalator Inclines	150	0.4	Further information is held within LU Lift and escalator category 1 standard <a href="#">S1097</a> .
Platform Inverts	10	0.4	No lighting required if defined by TfL SHE representative as a confined space.
Overbridges	100	0.4	
Public Facing Machines (e.g. ATM's & POMs) & Permanently Fixed LU Public Information Poster Locations	200	0.5	Vertical illuminance on the front face of the machine at the controls/human input area.

Location	Illuminance (Lux)	Uniformity	Note
Passenger Help Points	100	0.8	<p>Instead of a maintained average horizontal illumination value, this is the minimum value for illumination that any individual measurement point within the space shall not fall below at any time.</p> <p>Vertical illuminance on the front face of the machine at the controls/human input area.</p>
<b>Tunnels</b>			
Running Tunnels	10	0.5	Illumination level at running rail level across the width of the tunnel.
Crossover/Junction & Intervention Points	10	0.5	Instead of a maintained average horizontal illumination value, this is the minimum value for illumination that any individual measurement point within the space shall not fall below at any time.
Sidings – unoccupied	5	0.5	Lighting is to be permanently on at the ‘unoccupied’ levels.
Sidings – occupied	10	0.5	<p>Lighting is to be controlled so that when a train or a person enters the sidings area, the lighting level shall be automatically increased to provide the ‘occupied’ levels.</p> <p>Motion detectors shall be fail safe, so that if the sensor fails the illumination levels are automatically increased to provide the ‘occupied’ levels.</p>
Ventilation & Cable Shafts	10	0.4	Illumination required where cat ladders and Landings are installed. Shafts & tunnels used for forced ventilation, which do not have any other rooms or equipment within, do not require permanent lighting. Where shafts or tunnels provide access to other areas, lighting shall be provided.
Pedestrian Walkways	10	0.5	
<b>Depots</b>			
Stabling Area and Track	10	0.1	Figured stated with no trains present. Lighting design for this area should take into consideration providing sufficient illumination at points of emphasis within the track environment, such as points or crossings.
Covered Stabling Areas and Sheds – Walkways	150	0.4	

Location	Illuminance (Lux)	Uniformity	Note
Uncovered Exterior Designated Walking Routes (Including Driver Access Points cross-track walkways)	10	0.1	<p>Instead of a maintained average horizontal illumination value, this is the minimum value for illumination that any individual measurement point within the space shall not fall below at any time.</p> <p>Lighting provision for Driver Access Points should ensure that sufficient illumination is provided to enable a Driver to carry out any task required in that space (such as operating push buttons or train control panels). The use of internally illuminated buttons or control panels could also be considered.</p>
Exterior Footpaths and Overbridges (excluding Designated Walking Routes)	10	0.1	
Covered Exterior Designated Walking Routes	20	0.1	
Swimming Pool Roads Underneath Train	150	0.5	<p>Illuminance measured in horizontal plane at both rail height and floor height in centre of pit when train is present.</p> <p>See clause 3.8.19 for luminaire IK requirements.</p>
Swimming Pool Roads Walkways	200	0.5	See clause 3.8.19 for luminaire IK requirements.
Standard Inspection Pit	125	0.5	<p>Illuminance measured in horizontal plane at both rail height and floor height in centre of pit when train is present.</p> <p>See clause 3.8.19 for luminaire IK requirements.</p>
Loading Bay	150	0.5	
Stores: General & Flammable	150	0.5	Equipment (including luminaires and switches) in flammable stores shall comply with the requirements of clause 3.1.14 in <a href="#">S1069</a> .
Stores: Open Compound	20	0.1	



Location	Illuminance (Lux)	Uniformity	Note
Plant & Equipment Rooms	200	0.5	<p>Includes Communications Equipment Rooms (CERs), substations, switchrooms, switch cupboards, pump rooms, fan rooms, Offline Battery Inverter (OLBI) Rooms, Hub, Lift Electrical Equipment Room (LEER), Sprinkler Valve Chamber (SVC) rooms and transformer rooms.</p> <p>Illumination is provided for general wayfinding and visual inspection only. Portable or temporary lighting may be required to provide increased illumination for some maintenance tasks.</p> <p>Whilst fixed task lighting purely for maintenance purposes is not required, a good lighting design will provide sufficient lighting for access and also provide sufficient lighting for most maintenance activities to be undertaken, by ensuring lighting is appropriately positioned, e.g. in front of control panels and local to equipment etc.</p>
Office	350	0.4	Human factors assessment should be undertaken to determine any additional task lighting requirements.
Staff Accommodation	150	0.5	
Trip Cock Test	30	0.4	
Motor Vehicle Roads	10	0.5	
Motor Vehicle Road Tunnels & Subways	50	0.5	

Lighting for areas covered by other standards	
SERs/IMRs	See S1197
Lift Car Interior	See S1093 & S1095
Lift Pits and Shafts	See S1093 & S1095
Lift Motor Rooms	See S1093 & S1095

### 3.19 Verification

3.19.1 Illuminance meters used for verification of lighting installations shall be shown to be suitable for the type of light source installed at a location. This includes providing a copy of the meter datasheet showing the spectral sensitivity graph of the meter when requested by the Electrical Discipline Engineer for review in advance of taking measurements.



3.19.2 Lux level measurements shall be taken in accordance with TfL Procedure [PR0476](#). The submitted results shall include details of the manufacturer, type/model and serial number of the illuminance meter used for the measurements. A copy of an in-date calibration certificate for the illuminance meter shall be submitted with the results.

### 3.20 Emergency Lighting

3.20.1 Where Normal Lighting is installed in a space, Emergency Lighting shall be provided to meet the requirements of BS 5266, BS EN 1838 and BS EN 50172, unless specified otherwise within this standard.

3.20.2 Emergency Lighting at sub-surface stations shall provide a maintained horizontal illuminance of at least 15 lux average (5 lux minimum) across the whole floor area.

3.20.3 Escape Route lighting at surface stations shall provide a minimum maintained horizontal illuminance on the Escape Route of 2 lux measured at the walkway surface.

3.20.4 On platforms at surface stations, an Escape Route shall be provided along the full length of the platform and provided with illumination to meet the levels of clause 3.20.3. In addition, the whole length and width of the platform shall be provided with illumination of 1 lux in emergency conditions.

3.20.5 Emergency lighting calculations may exclude a boundary zone with limits of 100mm from any wall, pillar, column, or other hardware mounted in the space.

3.20.5.1 The boundary zone identified in clause 3.20.5 does not apply to the platform edge.

3.20.6 Escalator Landing zones shall be considered as high risk task areas as defined in BS 5266.

3.20.7 Where LEPS at LU stations is provided by either self-contained battery luminaires or a UPS, the batteries shall be able to provide a minimum autonomy of 180 minutes (3 hours).

Note: Additional requirements for power supplies to Emergency Lighting can be found in [S1069](#), [S1076](#) and [S1948](#).

3.20.8 Emergency Lighting in signalling rooms shall be provided to meet the requirements in signalling standard [S1197](#).

3.20.9 Rooms for the control, monitoring or supervision of station and other operational areas and trains during a loss of power or evacuation shall have a minimum of 2no. lighting circuits and either:

- a) 50% of the luminaires supplied from circuits backed by the central battery system, or
- b) All of the luminaires in these rooms shall be self-contained battery luminaires, where no central battery system exists at the location.

- 3.20.10 The degree of security and redundancy offered by any given power supply arrangement shall be such that the level of supply loss risk is as low as reasonably practicable.
- 3.20.11 Emergency Lighting in non-public outdoor areas is not required unless it is designated as an Escape Route from a building to a place of safety, or unless stated as required elsewhere in this standard.

**Note:** The site Fire Strategy or latest fire risk assessment should be consulted to determine what is defined as an Escape Route and any potential place of safety beyond a building's exit.

Some external locations (such as depot track areas) may require local procedures (such as the carrying of torches or battery lighting when using the space) to be in place to enable persons to reach a place of relative safety in the event of a loss of Normal Lighting.

- 3.20.12 LEPS Emergency Lighting shall be provided either by:
- a) self-contained luminaires (with self-testing regime or remote centrally controlled monitoring/reporting facility)
  - b) OLBI or
  - c) central battery system (i.e. UPS).

**Note:** In sub-surface stations, LEPS provision should typically be 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.

- 3.20.13 When choosing between a central battery system and self-contained luminaires, a whole-life assessment shall be completed in accordance with section 3.23 of this standard.

3.20.13.1 The assessment shall include replacement of system batteries during the lifespan of the system. The frequency of battery replacement used in this assessment shall take into consideration the impact of the environmental conditions present at the location, noting that external locations will be subject to higher temperatures and therefore quicker degradation of the batteries.

- 3.20.14 Where self-contained battery luminaires are proposed, the LU Maintenance Representation shall be consulted at concept design stage and their agreement obtained on product selection.

- 3.20.15 Self-contained battery luminaires shall be part of a self-testing and self-reporting system.

3.20.15.1 The self-testing shall complete all tests required by BS 5266 and LU Specification [T0090](#).

3.20.15.2 The self-reporting functionality shall be available to access both locally on-site and remotely and shall report on the luminaire and battery status as well as the test results.

Note: The exception to clause 3.20.15 is where individual luminaires are being replaced due to failure or small-scale additions are being made to a site with an existing testing regime. This shall be agreed with the LU Maintenance Representative at concept stage.

3.20.16 In sub-surface locations, spaces shall not be served by a single luminaire if it is only supplied either from the Central Emergency Power Supply (CEPS) or an OLBI, as it will not function as an emergency luminaire when the normal supply fails.

3.20.17 Emergency luminaires using discharge lamps shall not be supplied from an OLBI due to the possibility of stroboscopic effects and re-strike times and the possibility that the luminaire may not re-strike at all.

3.20.18 When adding additional LED drivers to Emergency Lighting circuits supported by central battery systems, the lighting designer shall ensure that the central battery system is able to support the total in-rush current associated with all LED drivers connected to it.

3.20.19 Commissioning of Emergency Lighting circuits and systems shall include providing test evidence demonstrating that central battery system inverters can support the load in the event of a supply failure. This testing shall include isolating the incoming power supply (or supplies) so that the central battery system does not go into an automatic bypass mode if the inverters cannot meet the demands of the load.

Note: Where a UPS uses the neutral of the upstream supply for its neutral reference, care should be taken when completing this testing that this neutral reference is not isolated.

3.20.20 Where emergency signage is installed that requires external illumination, Emergency Lighting shall be installed to meet the requirements of BS 5266, BS EN 1838 and BS 5499.

3.20.21 Emergency systems shall not use flashing lights.

3.20.22 Emergency Lighting circuits on systems using a central battery system shall not have joints. Where permitted by concession, cable joints shall meet the requirements of BS 5266-1.

3.20.23 In Emergency Lighting installations using a central battery system, it shall be ensured that the Emergency Lighting fixed wiring installation (inclusive of final connections from the fixed wiring to individual luminaires) adequately resists the effects of fire and mechanical damage, and retains circuit integrity as required by BS 5266-1 section 8.2.

3.20.23.1 The design decisions taken to produce a solution complying with clause 3.20.23 in each area at a location shall be documented, demonstrating the actions to be taken to reduce risks to ALARP. This shall include, but not be limited to, consideration of the;

- a) loss of a single circuit derived from a central battery source.
- b) impact of a singular fire event on a luminaire and its associated circuit.

**Note:** Where an Emergency Lighting circuit supplies multiple luminaires, primary consideration should be given to the installation of a minimum of 2 central power supply system derived Emergency Lighting circuits within each area requiring Emergency Lighting. The emergency luminaires connected to those circuits must be interwoven throughout the space to ensure the impact of a singular fire event cannot impact both circuits simultaneously. Therefore adjacent Emergency Lighting luminaires should be connected to different circuits. This will ensure that Emergency Lighting is still available in the event of a failure of another Emergency Lighting circuit and for when maintenance activities are being undertaken.

By documenting the risks and mitigations associated with this solution, there is confidence that such a final design solution can be evidenced as ALARP.

Where such an installation cannot be shown to be either ALARP or more cost beneficial, then either; luminaires shall include a porcelain terminal block and an in-line fire resistant fuse holder, or a secondary fire-resistant enclosure with integral cable terminals and fuses in-line with the luminaire cable take-off shall be used locally, but independent to, each emergency luminaire.

Where the luminaire is to contain the porcelain terminal block and the in-line fire resistant fuse holder arrangement, this shall be provided by the luminaire manufacturer so that the luminaire can be certified as meeting the requirements of the relevant parts of BS EN 60598 in accordance with clause 3.8.4 of this standard.

Where a secondary fire-resistant enclosure with integral cable terminals and in-line fuses, is provided, access to the enclosure shall be provided as required by clauses 3.6.7 and 3.6.8 of this standard.

### 3.21 Emergency Lighting Records

3.21.1 Emergency Lighting Log books shall be kept for all locations in accordance with the requirements of [T0090](#) Emergency Lighting Systems Testing and Records.

3.21.2 The Emergency Lighting Log Book shall be updated at each amendment, or addition, to the Emergency Lighting installation by the delivery team responsible for the works.

3.21.3 When emergency lighting assets are impacted by project works, the Project Manager and site's Emergency Lighting Responsible Person shall agree how the Emergency Lighting system will be maintained, tested, evidenced and documented during the works.

The Emergency Lighting Log Book shall be;

- a) Updated to reflect any change in responsibility
- b) Kept up to date throughout the constructions works, including any associated documents (such as lighting layout drawings)
- c) Updated to reflect the asset and maintenance status at handover

### **3.22 Reliability, Availability, Maintainability and Safety (RAMS)**

3.22.1 The availability and reliability requirements of systems shall be derived through the development of a quantified risk assessment (Quantified Risk Assessment (QRA)). A risk assessment shall be conducted prior to the systems requirements phase and may be conducted at subsequent phases if deemed appropriate (in particular, installation phase, if this poses additional risk).

3.22.2 The QRA must consider as a minimum, impact on:

- a) Service affecting failures as categorized in the LU fault reporting system
- b) Maintenance interventions as captured in the LU fault reporting system and by the fault reporting centre
- c) Operational interventions as recorded by the service controller in the failures & defects sheet

3.22.3 The QRA must recognise the application of the system with respect to factors not limited to:

- a) Specified business / line / asset reliability targets
- b) Availability of alternative or backup systems
- c) Expected duty of the systems
- d) Environmental conditions
- e) The asset maintenance regime
- f) Impact on other lines

3.22.4 The Reliability, Availability, and Maintainability (RAM) failure categories in Table C3 of BS EN 50126-1 may be used to categorize identified risks.

3.22.5 Degraded mode for a lighting system is specified to be operation with up to 25% of the luminaires failed in one area (emergency luminaires excluded).

3.22.6 It shall be possible under Degraded Mode Lighting conditions for stations to remain open for normal operations.

3.22.7 The design, selection and installation of lighting system components shall be capable of providing a maintainable service life that meets or exceeds the

Reference Service Life (RSL) set for each component in CIBSE Guide M Appendix 12.A1 (Indicative Economic Life Expectancy).

- 3.22.8 Compliance with the requirements of this standard shall be demonstrated to LU by each party contracted to LU. Additionally LU may audit compliance as part of its surveillance regime.

### 3.23 Whole Life Cost/Benefit Analysis

- 3.23.1 It shall be shown that asset selection for lighting assets has taken into account whole life cost (in accordance with clause 3.23.2) and any likely future changes with procurement.
- 3.23.2 A whole life cost/benefit analysis for the purpose of this standard shall be based upon the following (where applicable);
- a) Capital Expenditure
  - b) Operation and maintenance
  - c) Specialist interventions (such as manufacturer call-out)
  - d) Software upgrades
  - e) Mid-life upgrades and/or component replacement (including any additional commissioning or other interventions required due to this)
  - f) Obsolescence
  - g) Annual load/energy profiles
  - h) Energy cost per kWh
  - i) Whole life carbon
  - j) End of life (such as costs associated with disposal, recycling etc.)

**Note:** The maintainable service life of the system shall be selected as described in clause 3.22.7.

Due to the changing nature of energy costs, costs shall align with those provided by the TfL SHE team at the time of undertaking a whole life cost analysis, to ensure an accurate forecast is taken. If in doubt, consult the accredited TfL Electrical Engineer.

- 3.23.3 Any whole life cost/benefit analysis shall include an assessment of whole life carbon. Carbon modelling assumptions shall be common to cost modelling assumptions. Operational energy assessments of electrical systems and embodied carbon assessments of electrical products shall follow the methodology outlined in CIBSE Technical Memorandums TM54 and TM65 respectively.

3.23.3.1 Where the assessment is part of a larger project or building assessment, the outcome of the operational and embodied carbon assessments shall feed into a whole life carbon assessment following the requirements outlined in BS EN 15978 (Buildings) and BS EN 17472 (Infrastructure), and the methodology outlined in [RICS Whole Life Carbon Assessment for the Built Environment](#). Carbon data sources shall be selected following the methodology outlined in [RICS Whole Life Carbon Assessment for the Built Environment](#).

## 4 Responsibilities

- 4.1 The Head of E&M Engineering is responsible for the development of the requirements in this standard.
- 4.2 Any change to the operational railway, either an infrastructure or an operational change that has a consequential impact on the environmental conditions specified in this standard, the Project Engineer / Project Manager / Operator / Maintainer shall be responsible for demonstrating compliance with the requirements in this standard.
- 4.3 Any change to the operational railway, either infrastructure or operational change that has a consequential impact on the performance of an existing lighting system, the Project Engineer / Project Manager / Operator / Maintainer shall be responsible for demonstrating compliance with the requirements in this standard.

## 5 Person accountable for this document

Name	Job title
Ryan Gresty	Interim Head of E&M Engineering

## 6 Definitions

- 6.1 In this standard the definitions given by BS EN 12665 shall be applied. In addition with reference to Emergency Lighting, the definitions given in BS 5266-1 shall be applied.

Term	Definition	Source
Average Illuminance	The mean of all measured values for that area.	Jargon Buster
Central Emergency Power Supply	A supply generated by a source independent of other supplies, which is distributed to LU equipment using the Normal Supply electrical network at reduced capacity. Provides the basic needs for the evacuation of the railway.	Jargon Buster
Degraded Mode Lighting	A level of lighting below Normal Lighting conditions but above Emergency Lighting levels. This could be due to a number of fittings being extinguished by a component failure, phase failure or a single supply failure.	Jargon Buster



Designated Walking Route	A route that has been identified for your safety, and might include made-up paths. You must use and keep to those walking routes (if they are available) when: walking to or from your place of work or carrying out your duties, or going to or from a booking-on point	Jargon Buster
Emergency Lighting	<p>Illumination sufficient for the termination of a potentially dangerous process and/or the safe evacuation of a building.</p> <p>Delivered by Maintained Luminaires which are supported by a battery system (LEPS) for when its' incoming mains supply fails.</p>	Jargon Buster
Escape Route	A route designated for escape to a place of safety in the event of an emergency.	Jargon Buster
Escalator Landing	The area between the end of the escalator floor plate and the transition point where the steps move from horizontal to an incline.	Jargon Buster
Four-Section Tunnel Lighting Panel	A tunnel lighting distribution panel that supplies power to tunnel lighting spread across 4 separate traction sections.	Jargon Buster
Hazardous Materials	Refers to Hazardous Materials which form part of assets (including but not limited to civil assets, built environment, E&M systems and vehicles)	Jargon Buster
High Mast	A tall, specialised lighting column (from 10m to 40m) that comprises a single steel mast capable of supporting a variety of lighting provisions at high level	Jargon Buster
Lighting Control System	A software system that controls lighting levels across multiple circuits/areas at a location (typically by receiving information from sensors or that are set by the user in software and then sending control signals to the luminaire driver).	Jargon Buster
Lighting Design Area	The total area within a given space over which the lighting design applies, excluding a boundary zone extending 100mm wide from any wall, pillar, column or other hardware mounted in the space.	Jargon Buster
Local Emergency Power Supply (LEPS)	A supply derived from a source local to the point of utilisation which feeds equipment provided to guarantee the safety of passengers and staff. LEPS will usually be	Jargon Buster

	provided by batteries. Provides the basic needs for the evacuation of station areas.	
Maintained Average Illuminance	The average value below which illuminance will not fall prior to scheduled maintenance taking place.	Jargon Buster
Normal Lighting	The lighting provided for the performance of tasks under the usual operational conditions of the LU system, which is intended for use the whole period of time the location is occupied.	Jargon Buster
Open Area Lighting	That part of emergency escape lighting provided to avoid panic and provide illumination allowing people to reach a place where an Escape Route can be identified	Jargon Buster
Platform Edge Lighting Zone	A horizontal area extending 300mm either side of the physical edge of a station platform and running the full length of it, at platform surface level.	Jargon Buster
Travelator Landing	The area between the end of the travelator floor plate and a distance 0.5m onto the moving walkway.	Jargon Buster
Two-Section Tunnel Lighting Panel	A tunnel lighting distribution panel that supplies power to tunnel lighting spread across 2 distinct traction sections.	Jargon Buster
Uniformity	The ratio of minimum illuminance to the Average Illuminance over a range of measurement points.	Jargon Buster
Visual Contrast	Perception of a difference visually between one surface or element of a building and another by reference to their light reflectance values (LRV).	Jargon Buster

## 7 Abbreviations

Abbreviation	Definition
ATM	Automated Teller Machine
BMS	Building Management System
BS	British Standard
BS EN	British Standard European Norm

CIBSE	Chartered Institution of Building Services Engineers
CCTV	Closed Circuit Television
CE	Conformité Européenne
CEPS	Central Emergency Power Supply
CER	Communications Equipment Room
CIE	Commission Internationale de l'Elairage
CPD	Circuit Protective Device
CRI	Colour Rendering Index
DfT	Department for Transport
DNO	Distribution Network Operator
E&M	Electrical and Mechanical
EMI	Electromagnetic Interference
FAT	Factory Acceptance Test
GR	Glare Rating
HD	Heavy Duty
IMR	Interlocking Machine Room
IP	Ingress Protection
LED	Light Emitting Diode
LEER	Lift Electrical Equipment Room
LEPS	Local Emergency Power Supply
LU	London Underground
LMC	Lower Machine Chamber
LV	Low Voltage
NTSN	National Technical Specification Notice
OHLE	Over Head Line Equipment
OLBI	Off Line Battery Inverter

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PIR	Product Information Register
POM	Passenger Operated Machine
POP	Persistent Organic Pollutants
QRA	Quantified Risk Assessment
RAM	Reliability, Availability, Maintainability
RCD	Residual Current Device
SER	Signalling Equipment Room
SHE	Safety Health Environment
SMS	Station Management System
SOR	Station Operations Room
SVC	Sprinkler Valve Chamber
TP&N	Three Phase & Neutral
UKCA	United Kingdom Conformity Assessment
UMC	Upper Machine Chamber
UPS	Uninterruptible Power Supply
UGR	Unified Glare Rating
VOCs	Volatile Organic Compounds
WEEE	Waste Electrical and Electronic Equipment Directive

## 8 References

### 9.1 Statutory documents

Document no.	Title or URL
<b>European Legislation</b>	
2014/30/EU	Electromagnetic Compatibility (EMC) Directive
2014/35/EU	Low Voltage Directive
2006/42/EC	Machinery Directive (MD)
2012/19/EC	Waste Electrical and Electronic Equipment (WEEE) Directive

<b>British Legislation</b>
Electricity at Work Regulations 1989
Electricity Supply Regulations 1988
The Regulatory Reform (Fire Safety) Order 2005
The Regulatory Reform (Fire Safety) Subordinate Provisions Order 2006
The Fire Precautions (Sub-surface Railway Stations) Regulations 2009
Control of Substances Hazardous to Health Regulations 2002 (COSHH)
Health and Safety at Work Act 1974
Health and Safety (Manual Handling Operations) Regulations 1992
Management of Health and Safety Regulations 1999
Offices, Shops and Railway Premises Act 1963
Public Health Act 1961
Construction (Design & Management) Regulations 2015
Planning (Consequential Provisions) Act 1990
Planning (Listed Buildings and conservation Areas) Act 1990
Planning and Compensation Act 1991
National Planning Policy Framework (NPPF).
Right of Lights Act, 1959
The Building Act 1984
The Building Regulations-All Approved Documents
The Party Wall etc Act 1996
The Town and Country Planning Act 1990
Sustainable and Secure Buildings Act 2004
Workplace (Health, Safety and Welfare) Regulations 1992
Building (Inner London) Regulations 1987
Environment Act 2021

Requirements of the Environment Agency (EA)
Control of Asbestos Regulations 2012
Environmental Protection Act 1990
The Environmental Permitting (England and Wales) (Amendment) (EU Exit) Regulations 2019
Environmental protection (Duty of care) regulations 2003
Air Quality Regulations 2000
The Waste (England and Wales) Regulations 2011
Highways Act 1980
New Roads and Street Works Act 1991
Transport and Works Act 1992
Equality Act 2010
UK EMC Regulations 2016
Provision and Use of Work Equipment Regulations 1998
Railways and Other Guided Transport Systems (Safety) Regulations 2006 (ROGS)
The Railways and Other Guided Transport Systems (Safety) (Amendment) Regulations 2015
Ancient Monument and Archaeological Areas Act 1979

## 9.2 British standards and Guidance

Document no.	Title or URL
BS 5266 -1	Emergency Lighting. Code of practice for the Emergency Lighting of premises other than cinemas and certain other specified premises used for entertainment.
BS EN 50172	Emergency escape lighting systems
BS EN 12464	Light and Lighting – Lighting of Work Places
BS EN 50126	Railway applications — The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS)
BS EN 60598	Luminaires. General requirements and tests

BS EN 55015	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment
BS EN 61547	Equipment for general lighting purposes. EMC immunity requirements
BS EN 1838	Lighting applications. Emergency Lighting
BS 1362	Specification for general purpose fuse links for domestic and similar purposes
BS 7671	Requirements for Electrical Installation. IET Wiring Regulations
BS EN 115	Safety of escalators and moving walks
BS 8300	Design of an accessible and inclusive built environment
BS EN 12665	Light and lighting - Basic terms and criteria for specifying lighting requirements
PAS 6463	Design for the mind – Neurodiversity and the built environment – Guide

### 9.3 LU company documents

Document no.	Title
S1053	Civil Engineering – Building and Station Structures
S1057	Civil Engineering - Miscellaneous Assets
S1061	Civil Engineering – Bridges and Structures Assessment
S1063	Cutting, grinding, drilling, fixing to and supporting from existing structures
S1069	Low Voltage Electrical Distribution Systems
S1085	Fire safety performance of materials
S1086	Fire safety classification of stations and shafts
S1097	Escalators and Moving Walkways
S1093	PMVT Lifts (including Fire-fighter and Evacuation Lifts)
S1095	SMVT Lifts (including Fire fighters and evacuation lifts)
S1131	Premises – Station Platforms
S1197	Signalling and Signal Control – Design and Implementation

S1222	Electromagnetic Compatibility
S1371	Station Planning
S1374	Customer Experience in London Underground Stations
S1770	Operational Technology Cyber Security - Governance
S1771	Operational Technology Cyber Security - Projects and Upgrades
S1772	Operational Technology Cyber Security - Operations and Maintenance
PR1352	Maintenance scaffolding on escalators and moving walks
T0090	Emergency Lighting Systems Testing and Records

## 10 Document history

Issue no.	Date	Changes	Author
A1	October 2007	Standard 0-01105-002 re-formatted and re-numbered to 1-066	
A2	February 2008	Changes agreed at the Director Led Review Meetings - TLL Standards Review - E & M Incorporated Written Notices LU-WN-00659 and LU-WN-00699	
A3	May 2011	Updated for DRACCT 00112 to incorporate some category 2 standards requirements and review of standard in workshops with stakeholders and in consultation with other discipline areas	R. Joachim
A4	June 2015	Change of Technical Content Manager. Standard updated with the requirements from the Lighting Category Management Strategy and the station design idiom strategy.	S. Duffy
A5	August 2018	Standard reviewed and updated on change of appointment of Principal Engineer and in accordance with change No. 05399.	A. Owoeye
A6	December 2023	Standard re-structured, references updated and clarifications incorporated into text. Updates reflect current lighting technology, amendments to British Standards and Building Regulations, LU maintenance strategy and the mayor's transport strategy.  In accordance with Change No. CR-18470.	J. Albon

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## 11 Attachments

### 11.1 Deliverables

#### 11.1.1 General

11.1.1.1 The Designer shall satisfy the design, installation and handover requirements through the production of Assured products. The following sections present the minimum deliverables that should be produced by the Designer with respect to the electrical design and installation at each of the Pathway stages and provide the typical levels of detail required. These documents shall be reviewed and accepted by the accredited TfL Electrical Discipline Engineer.

Note: These sections do not contain an exhaustive list and the Designer may be required to add further design products to enable the completion, assurance, or verification of the full project design requirements - including Pathway and CDM deliverables and LU Assurance Standard [S1538](#) requirements.

This list aligns with the RIBA stages and the details set out in BSIRIA Guide BG6. The submission of these documents does not relieve the Designer from the need to comply with contractual obligations, LU's Standards and other British & European Standards.

At Handover, each project shall populate the 'Asset Information Requirements' (AIR) spreadsheet and therefore the retention of Assured documentation in the appropriate format is essential at all stages of a project.

For some projects it may be acceptable to combine some of these deliverables into fewer documents with the agreement of the TfL Discipline Engineer.

11.1.1.2 The project shall liaise with the LU Asset Maintenance Representative at the feasibility stage of the project to agree which documents require review by the LU Asset Maintenance Representative.

#### 11.1.2 Pathway Stage 2 – Option Selection

11.1.2.1 During this phase of the project, the Electrical Designer shall provide all information required to complete the Pre-Construction Information and Options Development Report Pathway deliverables. This is likely to include;

- a) Survey scopes (both intrusive and non-intrusive)
- b) Survey reports (including dilapidation and non-compliance information)
- c) Assumptions requiring clarification in design
- d) Anticipated concession requests

### 11.1.3 Pathway Stages 3-5 – Design & Delivery

Item	Concept Phase (Stage 3)	Detail Design (Stage 4)	Pre-Construction Design (Stage 5)
<p><b>Drawings</b>  (Temporary and permanent installations)</p>	<p>Outline drawings showing indicative locations/layout arrangements of luminaires, spread of emergency fittings, direction of luminaires.</p> <p>The drawings will not indicate the precise position of lighting equipment, but it should nevertheless be feasible to install the services within the general routes indicated. It should be possible to produce coordinated working drawings or installation drawings without major rerouting of the services or relocation of the services.</p> <p>Drawings may be sketches rather than CAD format.</p>	<p>Drawings showing the locations of lighting equipment and service routes. Plan layouts should be to a scale of at least 1:100.</p> <p>Coordinated drawings showing the inter-relationship of two or more engineering services and their relation to the structure, associated specialists and building fabric. Drawing features should be as follows:</p> <ul style="list-style-type: none"> <li>• Plan layouts should be to a scale of at least 1:50 and be accompanied by cross-sections to a scale of at least 1:20 for all congested areas.</li> <li>• The drawing should make allowance for installation, commissioning, maintenance, and replacement working space and methodologies.</li> <li>• The drawings should be spatially coordinated and there should be no physical clashes between the system components when installed. Critical dimensions, datum levels and invert levels should be provided.</li> <li>• The drawing should indicate positions of main crossing points and supports where they have significance to the structural design or spatial constraints.</li> </ul> <p>The references used in schematics shall be co-ordinated with the detailed design drawings.</p>	<p>Drawings based on detailed design drawings with the primary purpose of defining that information needed by the workers on site to install the works.</p> <p>The main features of installation drawings should be as per detail design stage drawings, plus:</p> <ul style="list-style-type: none"> <li>• Allowances should be made for inclusion of all supports and fixings necessary to install the works.</li> <li>• The drawing should make allowances for installation details provided from manufacturers' drawings. This includes any alternatives to the designer's original specified option that have been chosen.</li> <li>• Space should be shown for associated support systems, installation methodologies and access for maintenance and replacement.</li> <li>• Builders' work details carry forward and confirm or refine the structurally significant items from the builders' work information, and also introduce new items that are not structurally significant.</li> </ul>
<p><b>Stage Work</b> (Including any specialist supplier designs)</p>	<p>A description of any separately identifiable stages that will be required as part of the works. This may include sketches of the separate phases.</p>	<p>Detail Stage work drawings.</p> <p>Level of detail as per the 'drawings' for this stage.</p>	<p>Confirmed stage work drawings</p> <p>Level of detail as per the 'drawings' for this stage.</p>



Item	Concept Phase (Stage 3)	Detail Design (Stage 4)	Pre-Construction Design (Stage 5)
<b>Specification</b>	Outline details of how the lighting design will meet the TRS, Cat 1 standards and British Standard requirements. This should include details of the proposed luminaires (type, light source, construction materials, not necessarily specific products or manufacturers) and mounting arrangement.	Detail Electrical Specification providing all information required to procure, install, and commission the lighting system.  It shall include a description of: <ul style="list-style-type: none"> <li>• All materials, parts, components, products,</li> <li>• Installation methodology,</li> <li>• Interfaces with other disciplines,</li> <li>• Earthing and bonding,</li> <li>• Labelling,</li> <li>• Finishes,</li> <li>• Commissioning</li> </ul>	As detail design stage with any changes captured and highlighted for agreement from the relevant TfL Discipline Engineer.
<b>Lighting Control Strategy</b>	Outline details of how the lighting will be controlled. To include: <ul style="list-style-type: none"> <li>• Whether a full Lighting Control System is proposed or only local controls</li> <li>• What type of sensors/switches will be utilised in each area and if absence or presence detection will be used</li> <li>• Reporting features</li> </ul>	<ul style="list-style-type: none"> <li>• Detailed information on the proposed system to be used including confirmation of type of system (e.g. wireless/wired, DALI/KNX etc).</li> <li>• Confirmation of locations for any local head-ends, details of remote access arrangements</li> <li>• Proposals for maintainer training on operating and maintaining the system</li> </ul>	As detail design stage and with full wiring schematics for the system to be provided
<b>Emergency Lighting Strategy</b>	The whole life cost analysis to determine whether to use a central battery system or self-contained luminaires as per sections 3.20 and 3.23 of this standard. If central battery system is chosen, this document should describe how the design solution will meet the requirements of clause 3.20.23 of this standard.	As concept stage with any changes captured and highlighted for agreement from the relevant TfL Discipline Engineer.	As detail design stage with any changes captured and highlighted for agreement from the relevant TfL Discipline Engineer.



Item	Concept Phase (Stage 3)	Detail Design (Stage 4)	Pre-Construction Design (Stage 5)
<p><b>Calculations</b>  (Temporary and permanent installations)</p> <p>Project Specific Requirements may require other calculation types to be completed.  Other calculation types should be to an equivalent level of detail as described here.</p>	<p>Initial proposals for lighting calculations including the dimensions and descriptions of each space requiring illumination along with the intended illuminance that will be provided in each space for both normal and emergency conditions.</p> <p>Estimated annual energy consumption figures for lighting installation to be produced.</p>	<p>Detailed Normal and Emergency Lighting calculations for each space including maintenance factors and surface reflectance values used, luminaires located at correct height and Uniformity values achieved.</p> <p>This shall be provided for both temporary lighting and permanent lighting.</p> <p>Annual energy consumption figures for lighting installation to be produced, including any assumptions on run-times due to use of controls/sensors.</p>	<p>As detail design stage but with all luminaires in final confirmed installation locations and heights. This shall be provided for both temporary lighting and permanent lighting.</p> <p>Any alterations to detail design stage captured and highlighted for agreement from the relevant TfL Discipline Engineer.</p>
<p><b>Training plan for new assets</b></p>	<p>A list shall be provided of all assets/equipment that will require a training plan to be produced.</p>	<p>A detailed training plan shall be provided for those assets identified at concept stage. This shall include information of who will provide training, what format it will be provided in, how long it will last for, the number of sessions to be provided, the documentation/manuals that will be given for future reference and details of ongoing support that will be provided once the training has been completed and the assets are in operation.</p>	<p>Any alterations to the training plan produced at detail design stage shall be described with documented agreement from the TfL Discipline Engineer and LU Maintenance Representative.</p>
<p><b>Factory acceptance tests (FAT) / Site acceptance tests (SAT)</b></p>	<p>Identification of assets anticipated as requiring FAT / SAT</p>	<p>Confirmation of which assets will require FAT / SAT and details of what the tests will include.</p> <p>It shall be documented who from TfL will be in attendance to witness those tests and what notice shall be given ahead of the testing taking place.</p>	<p>Signed factory acceptance test certificates shall be provided for assets identified as requiring them at concept stage. These shall be signed as witnessed by those identified as needing to attend at concept stage. Confirmation shall be provided that no changes have been made to SAT plans since Detail Design stage.</p>



Item	Concept Phase (Stage 3)	Detail Design (Stage 4)	Pre-Construction Design (Stage 5)
<p><b>Equipment schedules</b></p>	<p>Outline description of the equipment proposed for use on the project.</p>	<p>Equipment schedules to include manufacturer, product names and part/catalogue numbers.</p>	<p>Confirmation that the detail design equipment schedules have not changed.            Any variations to the detail design stage shall be highlighted along with justification for the change and documented agreement from the relevant TfL Discipline Engineer.</p>
<p><b>Access and Maintenance Strategy</b></p>	<p>Information on when and how the lighting system components can be accessed for maintenance (i.e. Traffic or Engineering Hours) and relevant parts of the system can be isolated to allow for full or component replacement.            Initial proposals of any equipment required to access the entire proposed lighting system (including drivers, sensors, CMS, connection boxes as well as luminaires).             Details of where the equipment will be stored, how it shall be maintained and where spares and components can be sourced from.             Proposals for how the equipment will be dealt with at end of life (including both how it will be removed as well as how it will be recycled/disposed of).</p>	<p>Final details of any equipment required to access the entire proposed lighting system (including drivers, sensors, CMS, connection boxes as well as luminaires) and details of any changes to the proposals agreed at concept stage with confirmation of agreement with the relevant TfL Discipline Engineer.             Confirmation of plans for how the equipment will be dealt with/removed at end of life.</p>	<p>As detail design stage with any changes captured and highlighted for agreement from the relevant TfL Discipline Engineer.</p>



Item	Concept Phase (Stage 3)	Detail Design (Stage 4)	Pre-Construction Design (Stage 5)
<b>Redundant Asset List</b>	Details of any assets planned to be made redundant by the works that the project proposes to leave in situ.	<p>Confirmation of any assets that are planned to be left in situ and what actions will be taken to ensure they are safe and clearly labelled in accordance with the requirements of this standard.</p> <p>All assets detailed in the list shall be accompanied by approved concessions against this standard.</p>	<p>Confirmation that the list provided at detail design stage has not changed.</p> <p>Any variations to the detail design stage shall be highlighted along with justification for the change and documented agreement from the relevant TfL Discipline Engineer.</p>
<b>Label Schedule</b>			A complete schedule of all labels that will be installed. The schedule shall include details of label material, colour schemes and text size.

### 11.1.4 Completion/ Handover

- 11.1.4.1 On completion of the works on site, the electrical contractor shall provide all electrical information and documentation required to complete the 'Asset Information Requirements' (AIR) form (PD0272). This shall include the provision of electrical specific information required to populate multi-discipline or project-wide documentation.



## 11.2 Station Design Idiom Technical Lighting Requirements

### 11.2.1 General

Note: This section contains all of the station design idiom technical lighting requirements for public area ticket hall, concourse, platforms, escalators, stairs and associated passenger routes.

11.2.1.1 The station design idiom technical lighting requirements shall be applicable when stated by the project requirements documents or when instructed by the project Sponsor. Where this is the case, the requirements in this Appendix shall apply in addition to those in the rest of this standard.

11.2.1.2 There shall be four layers of light provided as follows:

- a) Ambient Lighting
- b) Accent Lighting
- c) Feature Lighting
- d) Orientation / Signage / Way Finding Lighting

11.2.1.3 The layers of light shall be blended together to create contrast.

Note: Contrast ratio is defined as the illuminance ratio of the target area with its immediate background. For example the ratio of an illuminated information panel to the wall it is mounted on.

11.2.1.4 A lighting designer shall be employed to develop a design which complies with the station design idiom design principles as defined in S1374 'Customer Experience in London Underground Stations'.

11.2.1.5 The ambient lighting layer shall be provided to all public areas of the station.

11.2.1.6 The lighting designer shall specify what areas of the station shall be illuminated with accent lighting.

11.2.1.7 The lighting designer shall specify what feature lighting shall be provided and where it shall be located.

11.2.1.8 The LU Signage Team shall specify to the Lighting Designer what signage / way finding lighting shall be provided and where it shall be located.

### 11.2.2 Ambient lighting layer

11.2.2.1 The ambient lighting layer is defined as the basic 'background' that provides functional illumination across the space.

11.2.2.2 The ambient lighting layer calculation surface shall be horizontal.

### 11.2.3 Accent lighting

11.2.3.1 The accent lighting layer shall increase the illuminance above that of the ambient lighting layer.

- 11.2.3.2 The accent lighting layer shall illuminate key areas such as POMs or gatelines so that they are highlighted.
- 11.2.3.3 Where specified, the accent lighting layer shall illuminate vertical surfaces (i.e. walls, columns).
- 11.2.3.4 Wall mounted station information panels shall be illuminated with accent lighting to a minimum objective display illuminance ratio of 3:1. Where this cannot be achieved, an illuminance of 300 lux shall apply.
- 11.2.3.5 Station information floor zones shall be illuminated with accent lighting to a minimum objective display illuminance ratio of 3:1. Where this cannot be achieved, an illuminance of 300 lux shall apply.
- 11.2.4 **Feature lighting**
- 11.2.4.1 Where specified, feature lighting layer shall be provided.
- 11.2.4.2 Feature lighting includes the provision of either / or:
- a) feature chandeliers;
  - b) concealed coloured luminaires.
- 11.2.4.3 Where specified, architectural features shall be illuminated with feature lighting to a minimum objective display illuminance ratio of 10:1.
- 11.2.4.4 Where specified, soffits shall be illuminated with feature lighting to a minimum objective display illuminance ratio of 10:1.
- 11.2.5 **Orientation / signage / way finding lighting**
- 11.2.5.1 Where specified, in conjunction with LU Signage Team, LU Fire and LU Premises, signage / way finding lighting shall be provided.
- 11.2.5.2 Signage / way finding lighting includes the provision of either / or:
- a) Illuminated signage
  - b) luminaires located at tunnel entrances
  - c) luminaires located at nodal points.
- 11.2.5.3 Wall mounted maps shall be illuminated with orientation lighting to a minimum objective display illuminance ratio of 2:1. Where this cannot be achieved, an illuminance of 200 lux shall apply.
- 11.2.5.4 Signage shall be illuminated with orientation lighting to a minimum objective display illuminance ratio of 2:1. Where this cannot be achieved, an illuminance of 200 lux shall apply.
- 11.2.5.5 Key station junctions shall be illuminated with orientation lighting to a minimum objective display illuminance ratio of 2:1. Where this cannot be achieved, an illuminance of 200 lux shall apply.



- 11.2.5.6 Thresholds of tunnels shall be illuminated with orientation lighting to a minimum objective display illuminance ratio 2:1. Where this cannot be achieved, an illuminance of 200 lux shall apply.
- 11.2.5.7 Thresholds of walkways shall be illuminated with orientation lighting to a minimum objective display illuminance ratio of 2:1. Where this cannot be achieved, an illuminance of 200 lux shall apply.

**11.2.6 Station Design Idiom Illuminance Levels**

- 11.2.6.1 Where LU standards differ from statutory, European or British standard requirements the illuminance values for specific tasks and locations are laid down in Table A.1.
- 11.2.6.2 The illuminance levels in Table A.1 are maintained average levels measured in the horizontal plane at floor level unless otherwise stated.
- 11.2.6.3 Where locations are not listed in Table A.1, the illuminance levels for these locations are specified in Table 4.

**Table A.1:** Station design idiom Normal Lighting Illuminance levels

Location	Illuminance (Lux)	Uniformity
Ticket hall - circulation	100	0.5
Ticket hall - POMs	100	0.7
Ticket hall –Information Zone	300	0.7
Concourse	100	0.3
Gate lines	300	0.8
Corridors / Passageways	100	0.5
Stairs and ramps	150	0.5
Stair Landings	200	0.5
Escalators	150	0.5
Escalator Landings	200	0.5
Platforms	100	0.5
Platform edge zone	300	0.5

**11.2.7 Station Design Idiom Lighting Controls**

- 11.2.7.1 Lighting Control Systems shall be provided. Lighting Control Systems installed as part of station design idiom installation shall meet all the requirements of section 0 of this document as well as the requirements of this section.



- 11.2.7.2 Lighting Control Systems shall be capable of being connected into the Station Building Management System (BMS).
- 11.2.7.3 Lighting Control Systems shall be capable of providing dynamic lighting including either:
- a) feature (colour change) or,
  - b) circadian linking (tonal change) or;
  - c) automated or scene set dimming.
- 11.2.7.4 A Lighting Control Panel with Override and Scene setting functionality shall be provided in the SOR