

Category 1 Standard

1-123 Requirements for Matching Electrical Loads to Supplies when making changes to Low Voltage Infrastructure



Please read the Written Notices
attached to this standard

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1 Purpose

- 1.1 The purpose of this Standard is to define LU's minimum requirements for the matching of all LV electrical loads and equipments to LV power supplies. This Standard also captures LU's forward looking requirements for when infrastructure changes are made such that new capacity is integrated into the LU infrastructure and critical loads are matched to the available capacity.
- 1.2 This Standard clarifies the minimum requirements for low voltage equipment resilience against LV supply events and the permissible feeding arrangements to support suppliers with project delivery, whilst safeguarding LU's need to optimise operational reliability and remain compliant within statutory limits.
- 1.3 This Standard supports LU Standard 1-100 (Load Change Application Requirements for Electrical, Compressed Air and other services) and should be read in conjunction with this and other LU Standards.

2 Scope

- 2.1 This Standard applies to all LV electrical loads and equipment installed on the LU network or supporting the LU railway where LU is the Infrastructure Manager, including the feeding arrangements from the point of supply to the point of use.

Note: The scope of this standard necessarily extends beyond asset discipline boundaries as per the nature of power supplies and the sub-distribution of those supplies to the loads that may be within other asset areas.

- 2.2 This Standard applies to LU and all LU suppliers.
- 2.3 The matching of LU loads to LV supplies shall be brought into compliance with this Standard as new works are undertaken but not retrospectively.
- 2.4 This Standard does not apply to DC traction systems.
- 2.5 This Standard supports the requirements for the provision of power supplies for the purpose of lighting of underground assets in accordance with LU Standard 1-066.
- 2.6 This Standard captures some of the requirements which previously existed in the following LU Standards
 - a) 1-125 Power Supplies for Operational Purposes;
 - b) 1-100 Load Change Application Requirements for Electrical, Compressed Air and other services.



3 Requirements

3.1 Classes of Power Supply

- 3.1.1 Table 1 below gives a brief description of the primary power supplies which are available for use on the LU network. The full description of all classes of power supplies including those which may support the primary supplies are as defined in section 6.3 of this document.

Class A supplies	LVAC supplies that are derived from BSPs, switch houses, substations and transformer rooms. This supply has an inherent CEPS capability.
Class B supplies	LVAC supplies that are derived from BSPs, switch houses, substations and transformer rooms but where arrangements do not inherently have a CEPS capability.
Class C supplies	LVAC supplies that are derived directly from DNO infrastructure also known as 'street supplies'.

Table 1 - Brief Description of Primary Supplies Available on the LU Network

Note: Section 5.1 of this document provides additional supporting information regarding the role of LEPS and CEPS.

Section 6.3 of this document defines the additional Classes of power supplies which where applicable are used to support the primary Classes of power supplies described in Table 1. i.e. Classes N, U, O, G and S.

- 3.1.2 Where an LU supplier wishes to use a Class N supply the supplier shall approach LU to discuss it's suitability for use on the LU network prior to design.

3.2 Categories of Load

- 3.2.1 The Categories of load are as defined in Section 6.3 of this document.
- 3.2.2 The loads and systems that form part of each Category are as follows:
- Category 1a - Critical for the evacuation of the railway are as the following:
 - evacuation lighting in service control centres and tunnels;
 - control centre systems required to evacuate the railway;
 - British Transport Police control room loads and systems required to evacuate the railway;
 - drainage pumps for deep tube tunnelled sections;
 - fire-fighter lifts as defined in BS 81-72.
 - Category 1b - Important for the evacuation of the railway are as the following:
 - evacuation lighting in stations and depots;
 - essential task and emergency lighting in stations, control rooms, depots and British Transport Police control rooms;
 - wired and wireless communication systems;
 - emergency traction discharge and audio communication systems;
 - CCTV systems;
 - public address systems;
 - SCADA systems;



- VIII) evacuation lifts as defined in BS 9999;
 - IX) lifts identified in LU standard 1-105, Appendix 3A;
 - X) drainage pumps (excluding deep tube tunnelled sections);
 - XI) active fire protection systems;
 - XII) ventilation systems required for evacuation purposes (including fans to maintain infrastructure);
 - XIII) evacuation signage;
 - XIV) OPO and platform to train monitoring systems.
- c) Category 2a - Critical for the operation of the railway is.
- I) All signalling systems and signal equipment room loads.
- d) Category 2b - Important for the operation of the railway are as the following:
- I) heating or ventilation equipment required to maintain infrastructure during operational use;
 - II) point heaters;
 - II) staff accommodation.
- e) Category 3 - Non-essential for the evacuation or the operation of the railway are as the following:
- I) domestic supplies (including PCs, kitchen appliances, socket outlets);
 - II) socket outlets for cleaning equipment;
 - III) domestic heating and ventilation equipment;
 - IV) advertising signage;
 - V) third party tenants (including shops and retail);
 - VI) vending machines;
 - VII) all other lifts not defined as Category 1a, 1b or 2b;
 - IX) escalators except those defined in clause 3.3.2.

3.2.3 Where the Category of a load has not been specified in clause 3.2.2 of this document, an assessment shall be undertaken by the supplier and provided to LU for approval identifying which of the Categories the load falls under as defined in this Standard.

Note: Dialogue with LU in the asset area applicable is encouraged at the earliest stage when identifying the Category of load.



3.3 Requirements for Matching Categories of Load to Classes of Supply

3.3.1 Table 2 identifies how the Category of loads shall be matched to the primary Classes of supply. Additional Classes of supply may also be required to support the use of these primary supplies.

Categories of load	Primary Classes of Power Supply		
	Class A	Class B	Class C
Category 1a – Critical for the evacuation of the railway	Yes, irrespective of what supplies already exist at the site for which the load is to be located.	No	Yes
Category 1b – important for the evacuation of the railway	Yes, where a Class A supply already exists at the site for which the load is to be located.	No	Yes
Category 2a – Critical for the operation of the railway	No	Yes, irrespective of what supplies already exist at the site for which the load is to be located.	Yes
Category 2b – important for the operation of the railway	No	Yes, where a Class B supply (which can be derived from a Class A supply) already exists at the site for which the load is to be located.	Yes
Category 3 – Non-essential for the evacuation or the operation of the railway	No	No	Yes

Table 2 - Matching of Categories of Load to Primary Classes of Supply

Note: Table 2 identifies what supplies shall be made available for the categories of load. Where it is identified that more than one supply shall be made available, both supplies shall be used. i.e. not either supply.

3.3.2 Escalators identified in LU Standard 1-105, Appendix 3A or at interchange sub-surface railway stations which are required for evacuation shall use a Class A supply. Escalators at interchange sub-surface railway stations which are not required for evacuation shall use a Class B supply.

Note: The evacuation strategy will typically identify the required passenger flow rate to enable safe evacuate a station. To achieve the necessary passenger flow rate, it



may be required that one or more of the station escalators are operational. These escalators shall be supplied by a Class A supply to enable safe evacuation during a network wide power failure during which CEPS will be used.

- 3.3.3 All systems fed at LV shall be designed to include resilience to supply events as detailed in the requirements detailed in Attachment 7.1 of this document, prior to purchasing of the equipment.
- 3.3.4 Where Class U or O supplies are required, the requirements specified in LU Standard 1-069 and Attachment 7.2 of this document shall be complied with.
- 3.3.5 Class G supplies are permitted for use when installed only as fixed equipment at strategic control centres. Class G supplies are not permitted for use elsewhere on the network. Attachment 7.3 provides further details for use at control centres. The only exception to this is the use of temporary generation to restore supplies in unplanned or emergency conditions.

3.3.6 Power Supply Configuration Requirements

- 3.3.6.1 Further power supply feeding arrangements for the requirements of critical control centres and systems shall be designed in accordance with the requirements specified in Attachment 7.3 of this document.
- 3.3.6.2 Where two primary Classes of supply are required, each shall be designed to be capable of meeting the full rating for the Categories of load they are required to support at all times so far as is practicable.

Note: For example it is not permissible for a primary class of supply to be unavailable for a given load centre because it has been switched over to feed a second load centre due to capacity constraints. A planned maintenance outage would be considered as a reasonably practicable condition.

- 3.3.6.3 Where two Classes of primary supply are provided, an auto-changeover system shall be installed to rapidly and automatically change over from a failed supply to a healthy supply. Auto-changeover systems for control centres, signalling equipment rooms, and communication equipment rooms shall comply with the requirements specified in Attachment 7.4 of this document.
- 3.3.6.4 The reliability of all auto-changeover systems is understood to be critical to the overall integrity of the power supply systems in supporting the loads. The device shall have a MTBF of no less than 6 years and MTTR of no more than 24 hours.
- 3.3.6.5 The power supply and sub-distribution arrangements to support Category 1a or 2a loads (and 1b or 2b loads where a Class A supply is available), shall be designed to include parallel redundancy to minimise the risk of single point failures as far as is reasonably practicable.

Note: Where changeover systems are provided, the arrangements up to the changeover system are inherently parallel redundant. Care should be taken to minimise the risk of single point failures from the outputs of such systems by using high integrity devices and by minimising the extent of the sub-distribution system from the output of the changeover system. Where changeover systems are used close to the head of the sub-distribution system this is not possible and in these cases it is expected that the changeover systems and their sub-distribution should be duplicated to minimise the risk of single point failures.

- 3.3.6.6 Only Category 1a or 1b loads are permitted for connection to a Class A supply.



3.3.6.7 All LU suppliers shall ensure that the following loads, and only the following loads, are connected to a Class O supply:

- a) evacuation lighting in sub-surface railway stations;
- b) essential task lighting and emergency lighting as required for safe access/ egress in line and British Transport Police control rooms and stations;
- c) emergency lighting, ventilation, and communications equipment in each lift car;
- d) essential lighting in machine rooms to facilitate hand-winding;
- e) evacuation signage.

3.3.6.8 All LU suppliers shall ensure that the following loads are connected to a Class U supply:

- a) wired and wireless communication systems;
- b) emergency traction discharge and audio communication systems;
- c) CCTV systems;
- d) public address systems;
- e) SCADA systems;
- f) all signalling systems and signal equipment room loads;
- g) OPO and platform to train monitoring systems.

3.3.6.9 Where only a Class C supply is to be used for Category 1b loads, a Class U or S supply shall be used where applicable to enable the safe evacuation of the railway.

3.3.6.10 All Class O or U supplies for the purpose of supporting Category 1a or 1b loads shall be rated to provide a supply for no less than 60 minutes to its connected loads or longer where required in other LU Standards or British Standards. All Class U supplies for the purpose of supporting Category 2a or 2b loads shall be rated for no less than 15 minutes to its connected loads or longer where required in other LU Standards.

Note: Section 5.3 provides for guidance illustrations for the provision of power supplies to Category 1b, 2a, 2b and 3 loads.

3.4 Requirements to cater for load growth and other changes to the system

3.4.1 Where load growth on the LVAC systems feeding stations and depots will cause the system not to comply with the technical limitations for voltage, current ratings or protection discrimination, the network shall be reinforced.

3.4.2 The means of reinforcement for clause 3.4.1 for Class A and B systems shall be restricted to the permissible configurations in this standard. Attachment 7.5 identifies power supply configurations acceptable on the inter-station LVAC distribution systems and sub-distribution system to a load centres main switchboard.

3.4.3 The permissible configurations for clause 3.4.2 are as follows:

- a) dual feed a station incoming switchboard (Class A) directly from a substation or transformer room if the distance is less than 500m;
- b) where a station main switchboard is fed from two substations or transformer rooms and not via another station main switchboard, reinforce the LVAC mains but not exceeding $2 \times 300 \text{ mm}^2$ per circuit;
- c) provide additional transformer room or substation capacity.

3.4.4 Where the incoming main LVAC switchboard providing Class A supplies into a station or depot is being upgraded, or replaced, the incoming circuits to that switchboard shall be protected using circuit breakers.



- 3.4.5 Where new or major station modernisations provide new transformer rooms to support the increased loads, arrangements shall be made to support the adjacent electrical systems to that station where LVAC mains originally fed the station with Class A supplies. In these circumstances, the original incoming main LVAC switchboard into a station (Class A) shall be connected to the LU transformer room.
- 3.4.6 Where new or major station modernisations provide new transformer rooms to support the increased loads, arrangements shall be made to establish a new individual Class A supply switchboard and a new individual Class B supply switchboard in the station as shown in Attachment 7.5, Figure 5. The arrangements shall have dual redundancy to minimise single point failures. The dual redundant feeding arrangements shall be replicated to all of the main load centres in the station.
- 3.4.7 To ensure rapid restoration of supplies for Class B loads following a CEPS or similar event, where Class B switchboards are provided as per clause 3.4.6, all future Class B loads shall be connected to this supply via appropriate sub-distribution systems.
- 3.4.8 For new developments, Strategy and Commercial in consultation with Power Engineering shall make available sufficient space, suitably located to facilitate synergy between load centres and to minimise the likelihood of future transformer room infrastructure requirements at that location.
- 3.4.9 Where new transformer rooms and low voltage switchrooms are provided, the equipment ratings shall take account of future predicted loading on the network within a 5 year timeframe, plus 25% in accordance with annual loading plans and capacity plans as advised by LU. Facilities shall be provided in the transformer room design to enable multiple connections to future load centres at the site. Attachment 7.5, Figure 5 shows a typical arrangement.
- 3.4.10 Where new or upgraded power distribution systems are to be supplied, the arrangements shall incorporate spare outlets to permit an increase in the number of outgoing circuits by 25%.

3.5 Evidence of compliance

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.

4 Responsibilities

The Head of Power Engineering is responsible for the technical content of this standard. Any concessions in relation to this standard shall be directed to the Head of Power Engineering who has overall accountability for compliance with this standard. The Head of Power Engineering may request support from the other technical authorities when reviewing concessions or queries arising from the application of this standard.

LU and LU Suppliers shall be responsible for compliance with the requirements of this standard.

Heads of Profession are the LU technical authorities for each asset group, and shall be responsible for auditing technical compliance with this standard in accordance with the engineering asset grouping of LU Standard 1-041 and with respect to the assurance of assets to which they are accountable for. They shall provide support to



the Head of Power Engineering, if requested, with regard to any technical issues arising from concession requests or other queries to this standard.

5 Supporting information

5.1 Background Information

- 5.1.1 The LU system has generating facilities capable of supplying the essential loads for the safe evacuation of the railway. This facility is defined as CEPS and is provided by means of connection to a Class A supply.
- 5.1.2 CEPS takes approximately 15 minutes to run up and start supplying the Category 1a or 1b loads.
- 5.1.3 As CEPS is of limited capacity it cannot be used to support traction supplies. CEPS is only used to support loads which are required for the safe evacuation of the railway or to maintain the infrastructure to do so.
- 5.1.4 When a Class O, U, or S supply is supplying a Category 1a or 1b load, they are all forms of LEPS. The actual class of supply to be used for the purpose of LEPS depends upon the nature of the Category 1a or 1b load. For example a local fire detection panel may have both a Class A and C primary form of LVAC supply but in a major event or outage such as a grid failure the panel has installed a small battery which will support the system locally while the Class A & C primary supplies are unavailable. The CEPS system will become available in a short period of time (about 15 minutes) and take over from the battery supply.
- 5.1.5 Class O supplies comprise of offline battery systems. The main function of these supplies is to support emergency lighting until a CEPS supply can be established. To enable this function, Class O supplies do not start supplying the load until both the Class A and C supplies available at the site are simultaneously lost. This function is achieved by means of a Class A supply connected to the offline battery system but the class A supply acts as an inhibit function and does not support the load.
- 5.1.6 Section 6.1.5 makes reference to other LU Engineering Standards which should be read in conjunction with the requirements of this standard when determining what electrical supply arrangements are required for different electrical loads.

5.2 Physical details

- 5.2.1 The boundary between the Powerlink and the Infracore System, and the boundary between the DNO System and the Infracore System are known as Delivery Points.
- 5.2.2 Figures 1 and 2 show the LV delivery points available on the LU network for guidance.