

Category 2 Standard

S2100 Fire Engineering – Fire Safety Design and Strategy



**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 how London Underground (LU) applies fire safety engineering principles, develops fire strategies and ensures compliance with fire safety legislation – specifically;-

London Underground (LU) Category 1 Standard 1-080, “The Application of Fire Safety Engineering Principles to London Underground Premises”.

The Regulatory Reform (Fire Safety) Order 2005

The Fire Precautions (Sub-surface Railway Stations) (England) Regulations 2009

- 1.2 This document consolidates best practice guidance to promote compliant design and construction.

2 Scope

- 2.1 This Standard applies to all works undertaken by London Underground (LU), their contractors and third parties on stations and associated accommodation.
- 2.2 Where projects are unable to fully meet, applicable standards and/or legislation the issues shall be described in the Fire Strategy. The solutions shall be reviewed and agreed at a Qualitative Design review (QDR) in accordance with BS7974.

3 Requirements

3.1 Fire Safety Strategy Considerations

- 3.1.1 Various factors should be considered in the development of a Fire Strategy for a premises, these include (but are not limited to);
- a) The location of the premises
 - b) Impact to and from adjacent premises
 - c) The architectural layout
 - d) Building structure
 - e) Building system provisions
 - f) Building use
 - g) Levels of occupancy
 - h) Mobility of occupants
 - i) Building management and operational procedures
 - j) Access and facilities for fire-fighters.
- 3.1.2 Fire protection systems shall be incorporated into LU premises in compliance with statutory requirements and with any further conditions imposed by other parties (such as Insurers, the Fire Authority and the Office of Rail Regulation (ORR)).
- 3.1.3 Constructional fire safety features and materials used will comply with the intent of the Building Regulations Approved Document B; BS 9999 or any more onerous requirements specified in a Cat 1 standard.
- 3.1.4 Where there is the opportunity to improve the fire safety of the station this should be identified for discussion with the relevant regulator(s).

- 3.1.5 Where works are being carried out consecutively or concurrently by a number of Projects, it may be necessary for a 'holistic' view to be taken of the impact of all the projects combined when deciding what is reasonably practicable as regards fire precautions. The Project Managers are responsible for co coordinating with each other, assistance can be provided by the Project Fire Engineer or the Fire Safety Unit. Where this situation is identified, it is important that the overall scope of works is agreed with the Regulator(s) prior to any of the individual works commencing, and that the duties of co-operation and co-ordination laid out in Regulation 22 of the 2005 Fire Safety Order are complied with by the various parties involved before, during and after the works have taken place.
- 3.1.6 The implementation of the requirements of a Fire Strategy may well require significant changes to the proposed premises.
- 3.1.7 Where the works are planned to retain existing non compliances, with relevant fire codes and standards, either during construction or once complete, a Fire Engineering approach may be used, as set out in BS 7974 – “The application of fire safety engineering principles to the design of buildings”. A Fire Engineering approach is used to demonstrate an equivalent level of safety to that of a code compliant approach.
- 3.1.8 It may be acceptable to use BS 9999 to design the fire precautions in premises. This includes the use of risk profiling to modify fire safety requirements (though for stations this should only be used for areas to which the public do not have access). If risk profiling is to be used, it is very important to agree the appropriate risk category with the regulator(s) before significant design work is embarked upon.
- 3.1.9 Specific Fire Strategy documents will be required to cover any special risks, large projects, projects that significantly affect fire risk or projects that affect the current state of compliance with fire standards. Examples would include works affecting step-free access to the station; congestion relief projects or major station reconfigurations.
- 3.1.10 The production of a Fire Strategy Report will not normally be required for premises (including stations) that are only undergoing minor works or decorations, including modernisations or enhancements unless those works materially alter:
- a) The layout of the premises
 - b) Its means of escape
 - c) Its use
 - d) Its occupancy (e.g. by the introduction of step-free access to all or part of a premises)
- 3.1.11 In the case where non-compliances are not being addressed by the proposed works they shall be reviewed against the risk to the premises in accordance with 1-521: Safety Decision Making. Any resulting mitigations or recommendations for improvement will be described in the Fire Strategy or impact assessment.
- 3.1.12 Consideration should be given to the whole life cost for the intended works.

3.2 Assumptions

- 3.2.1 The fire plans, emergency plans and risk assessments etc. outline the current strategy for the premises and therefore the premises are currently operable with appropriate risk mitigations in place. Any concerns found should be highlighted through the Fire Strategy or impact assessment.
- 3.2.2 COO Asset Performance ensures that the existing fire safety assets are maintained in good condition and operate to the required performance in accordance with the relevant LU, British or European standards
- 3.2.3 COO Asset Performance maintain records of all assets and their condition and plan their replacement to ensure they continue to meet all relevant standards.
- 3.2.4 Approved Document B is not retrospective except in the case of material alterations, changes of use or where works are carried out to meet the requirements of legislation/regulations for life safety purposes.

3.3 Preparation of a Fire Strategy

- 3.3.1 The Fire Strategy shall be prepared as part of the design process for all new buildings, stations, and railway facilities.
- 3.3.2 The Guidance Document G0100 captures a number of solutions used in the past, good practice and concepts that have been recognised by the regulator in the past. It can be used as a guide to the development of a fire strategy if required.
- 3.3.3 For work on existing premises a Fire Risk Management Assessment shall be completed. This will assess the impact of the works on any existing fire risk assessment and highlights the requirement for a full Fire Strategy if necessary. A template for this Assessment is provided in Guidance Document G0100 Providing for Fire Safety and Pathway. If a Fire Strategy is produced this document is not required.
- 3.3.4 Where a Fire Strategy is not produced, this document outlines LU's fire safety requirements during the design and construction phases of a project to ensure:
 - a) that Fire Safety Risk has been reduced so far as is reasonably practicable in the circumstances of the case,
 - b) that life safety measures meet legal requirements,
 - c) asset protection measures are adequate for the risk,
 - d) whole life cost and ease of maintenance are considered,
 - e) that the works do not fit within the scope of those requiring a Fire Strategy.
- 3.3.5 The Fire Strategy should address:
 - a) the means of escape from the premises (in case of fire) for able bodied and persons with restricted mobility;
 - b) the means of giving warning in case of fire (fire detection and alarm systems: public address / voice alarm systems (PA/VA));
 - c) automatic fire suppression or extinguishing systems, which may be provided either for safety reasons or for asset-protection purposes;

- d) the provision of fire-resisting construction, to provide fire and smoke separation or containment (often known as 'compartmentation') or to provide structural fire resistance;
- e) control over the reaction-to-fire performance of the materials used in construction and fit-out (including flame spread, combustibility, smoke and toxic fumes);
- f) the provision of manual fire suppression / extinguishing systems (both fixed and portable) for use by the occupants of the premises;
- g) the provision of emergency lighting and illuminated escape signage (including Emergency Do Not Enter signage)
- h) access and facilities for fire-fighters, including protected fire-fighting access, fire brigade communications and fire-fighting water supplies;
- i) fire safety signage
- j) smoke management and/or smoke venting.

3.3.6 A Fire Strategy template is provided in Guidance Document G0100 Providing for Fire Safety and Pathway (See Attachment 7.1).

3.3.7 The preparation of a Fire Strategy (or impact assessment in the case of minor alterations) shall be prepared by a competent Fire Engineer and will be checked and approved by an LU accredited Fire Engineer. On acceptance of this Fire Strategy, this will form the scope of works with respect to fire safety.

3.3.8 When producing these documents site specific documents must be considered (e.g. specific fire strategies for stations, risk assessments, fire compliance plans, emergency preparedness plans etc.) and all relevant Category 1 and 2 standards

3.3.9 There may be historic/existing Fire Strategies for the premises & it may sometimes be useful to refer to them to inform the drafting of a new strategy. If the contents of these historic documents are to be used, the standards and assumptions therein shall be checked to ensure they are still current and valid. The conclusions must be reviewed to ensure they remain compliant with current good industry practice (including this standard).

3.4 Generic Fire Safety Requirements

3.4.1 Fire Resistant Construction (compartmentation / separation)

3.4.1.1 Fire resistant construction should be designed to:

- a) contain a fire incident to defined areas and restrict spread
- b) protect defined means of escape routes
- c) ensure safe evacuation
- d) provide separation or segregation of public areas from non-public areas
- e) separate area of defined fire hazard or operationally critical areas
- f) minimise smoke production and/or control smoke movement;
- g) provide a reasonable degree of protection to fire-fighters whilst performing their duties of fire-fighting and rescue and;

- h) protect 'critical' assets (i.e. assets whose loss may have a major impact upon the reliability or availability of the train service).

3.4.1.2 'Compartmentation' refers to a fire rated elements of construction (including all elements of walls, floor and ceiling) segregating areas of risk.

3.4.1.3 Fire-resisting walls should be continued as imperforate up to the structural soffit (as opposed to the use of fire resistant ceilings). Fire-resisting ceilings are difficult to specify, design and construct correctly and maximising the use of walls to provide fire resistance tends to reduce the extent of hidden voids above ceilings.

3.4.1.4 Fire separation refers to fire rated construction provided to protect the means of escape from fire and smoke.

3.4.1.5 Details of the required fire resistant construction are shown on Compliance/Fire Plans which are maintained by the London Underground Fire Compliance Team.

3.4.1.6 Refer to Cat 2 standard S2102 Fire Compartmentation for detailed requirements for fire and smoke resisting doors, protection to structural steel, surface linings and construction materials, fire stopping and penetrations and cavity barriers.

3.4.2 Evacuation – Means of Escape

3.4.2.1 The provision and maintenance of safe escape routes is paramount to the evacuation strategy. The work must ensure the protection of the existing routes and as far as reasonably practicable improve the current situation. This will depend on the extent and location of the work. It will be reviewed during Design Reviews and ultimately tested when the Fire Strategy is presented at the QDR. The exit and travel times should be calculated in accordance with S1371 based on a worst case situation passenger numbers wise.

3.4.2.2 Two scenarios for stations are considered:

- a) Train on Fire in Station
In this case the evacuation load (platform and train loads) shall be cleared from the immediate area (the platform) within four minutes, and shall reach a fire-protected route or exit the station within six minutes. All routes are deemed available. The use and availability of escalators is detailed in S1371.
- b) Fire within Station Structure
In this case the affected passenger load shall reach a fire protected route or exit the station within six minutes when the most capacious route is unavailable.

3.4.2.3 For b) the Cat 1 standard requires the scenario to consider a fire affecting the most capacious escape route from the station, thereby making that route unavailable. Where the station only has one route from station areas or from the station to the exit, this may not be achievable and the calculation should be performed using this route and noting the non-compliance. Depending on the extent of the changes being introduced it may be appropriate to consider whether it is reasonably practicable to improve or provide protection to this escape provision.

- 3.4.2.4 The means of escape from back of house areas should be reviewed and where necessary, discussed within the Fire Strategy, with reference to compliance with the Building Regulations and associated standards.
- 3.4.2.5 Depots and other offices shall be assessed to ensure compliance with the Building Regulations and assessed within the Fire Strategy and the Depot Fire Risk Assessment.
- 3.4.2.6 Where existing surface stations do not have a second means of escape, in the event of a train fire, evacuation is achieved by the passengers walking past the affected carriage before it is untenable to do so. The trains are designed to have very low fire loads and in the open area environment this is the most likely scenario. New stations would have secondary means of escape.
- 3.4.2.7 Where a fire in the existing surface station structure prevents passengers from leaving the station, and there is no alternative route available, then the platform area most remote from the station structure could be regarded as a place of relative safety. This design approach is only acceptable for existing surface stations where the planned scope of works does not include any alterations to the means of escape from the station. Where it does then it must be considered whether it is reasonably practicable to remove or improve any existing non-compliances.
- 3.4.2.8 It needs to be shown that the available space would allow passengers to assemble at a safe distance from the affected part of the train e.g. by thermal radiation calculations. This safe distance is based on the safe refuge concept. In calculating the area required, the Cat 1 standards indicate a platform occupation density of 0.8m^2 per person. In an emergency situation it would be reasonable to use the floor space factors in table 1 of the Building Regulations (Approved Document B) which allows for 0.7m^2 per person for concourses and queuing areas.
- 3.4.2.9 This area excludes the platform edge, 0.5m from the platform edge where all trains stop and 0.7m from the platform edge where fast trains do not stop. This would be a temporary place of relative safety in the event of a fire in the platform structure until:
- a) the incident was dealt with and the escape route made safe, or
 - b) evacuation of passengers via trains is arranged.
- 3.4.2.10 The Fire Strategy may need to address other issues such as lighting, shelter, communications, human behaviour etc. associated with this place of relative safety
- 3.4.2.11 Where existing sub-surface stations do not have a second means of escape, in the case of station fires, passengers would remain at platform level until the fire is extinguished or be evacuated by train. If the station is considered unsafe in this scenario this should be identified in the Fire Strategy.
- 3.4.2.12 On stations with PRM lifts it may be possible to provide places of relative safety which enable the lifts to be used for evacuation when assisted by station staff. This is often done by use of fire and smoke doors. The Fire Strategy needs to address where the lift grounds and location of staff override panels based not