Fire Safety Strategy Report
For
Project Union, HV Sub Station

Reference: S20041499

Issue No: Planning Application – Issue 01

Revision History

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Client Details

Client:	Bruce Shaw Partnership
Client Address:	Artillery House 11-19 Artillery Row London SW1P 1RT
Project:	Project Union, North Hyde Gardens, Hayes, London

Validity

This report is produced on the basis of the information and experience available at the time of preparation. It is applicable to the above-mentioned project only in accordance with the client's instructions.

Where utilised in this report, the terminology "will" or "will be", represents the recommendation / understanding of Bureau Veritas UK regarding the proposed design, construction and management of the premises.

No review of the building construction, design or installation of any system has been undertaken. This report is only valid provided the items are implemented as described and no other modifications are made other than those for which a formal opinion has been sought and given by Bureau Veritas UK.

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1 Executive Summary

1.1 Design Philosophy

Bureau Veritas has been appointed to prepare a fire safety strategy for the Project Union development which includes the construction of a new data centre, including ancillary building. This report includes only the fire strategy of the HV Sub Station. Reference should also be made to the general Fire Strategy report covering the whole Project Union site.

This fire strategy is intended to outline the design features necessary to ensure a suitable level of life safety is embedded within the buildings during normal operation of the premises.

The proposals in this document assume:

- Fire is an accidental event.
- That there will only be a single fire at any one time.
- Fire safety within the buildings will be managed correctly and take in account the requirements of this fire safety strategy.
- An adequate number of suitably trained, physically able, staff will be available when the premises are occupied to respond to, manage and assist in the evacuation of the premises in an emergency.
- Access to the premises is controlled.
- The site will be owned and under the control of Ark Data Centres.

1.2 Key Aspects of the design

The following are key aspects for the fire strategy for the Project Union Development (HV Sub Station):

- The HV substation consists of two external HV intakes of 66kV and reduces the power intake to 11.9kV to a switchgear compartment on the ground floor of the Substation control building, then through to a switch room on the first floor.

  The first floor of the substation control room consists of a switch room and control room on the first floor storey of the building.

  The building is raised due to the cable intake and it is positioned to the south of North Hyde Gardens Road next to the Visitor Reception Centre.
- The means of escape within the substation building are sufficient as the control room and switch room has independent access and there are two external stairs leading from the first floor. The compartment walls and floors shall be fire rated where any services pass through, and the external doors should be fire rated as a person may pass these as part of their escape route.
- Oil -Insulated transformer details can be found in Section 10 of this report.
- The fire strategy has been developed on the basis of the guidance of BS 9999 assuming:
  - An A3 risk profile for the HV Sub Station.
- The building height (see Section 2.4) is:
  - HV substation = 3.0m.
- The evacuation strategy for the building will be simultaneous evacuation (see section 5.1).
- The building will be protected by a minimum of a Category L2 automatic fire alarm and detection system (see section 5.3).
- The building will be provided with the following levels of structural fire resistance (see section 7):
  - HV substation = 120 mins

  The control room and switch room building will be constructed to 120 minutes fire resistance and provided with compartmentation to separate the control rooms. The Design Team has confirmed that the construction will provide a blast-proof protection in the event of an explosion from the 66kV transformer in accordance with BS EN 61936-1.
- The external envelopes of the building will meet the external fire spread requirements as specified in section 8.

2 Introduction

2.1 Purpose of the Report

The objective of this report is to present a fire safety strategy, which satisfies the functional (life safety) requirements of the Part B of the Building Regulations 2010 (as amended).

This fire strategy has been developed primarily on the basis of the guidance in British Standard (BS) 9999:2017 incorporating Corrigendum No.1; Fire safety in the design, management and use of buildings – Code of practice.

Where no specific provision is mentioned in this fire safety strategy regarding any particular aspect reference should be made to BS 9999.

2.2 Limitations of Report

This report is intended to highlight the key design issues and the proposed solutions in order to meet compliance with the Building Regulations 2010.

This document will therefore act as the basis of discussions between the design team and Approval Authorities, in order to obtain approval in principle for the design in respect to fire safety compliance.

The approving authorities have the final decision as to whether this strategy satisfies relevant legislation. No work on site should be performed on the basis of this fire strategy until it has been agreed with the relevant approval authorities.

This fire safety strategy is not intended to provide a detailed system specification and reference should be made to applicable guidance including BS 9999 and relevant British Standards in relation to detailed specifications and system design.

2.3 Sources of Information

The information within this report is based on documents and drawings (listed in the table below) provided up to the date of this report by Nicholas Webb Architects (NWA).

Note: *The figures within this report are only to illustrate the fire safety principles; for confirmation of layout or other details reference should be made to the current project drawings.*

Table 1 - List of Sources of Information

Document Title	Document Owner	Document Number	Revision
Site Plan Proposed	NWA	NWA-0471-SN-ZZ-DR-A-03-005P	02
GFL Isoclad Elevations	JSM	149980_130	A
FFL Isoclad Elevations	JSM	149980_131	B
Isoclad 3D View	JSM	149980_132	A
Union Park 66/11.9/11.9kV Substation Elevation	JSM	P1152-ARK-DWG-1001-SHT2	IFC
Union Park 66/11.9/11.9kV Substation Cable Tray Layout	JSM	P1152-ARK-DWG-1001-SHT3	IFC

2.4 Buildings/Site Description

The overall project includes the construction of a new Data Centre and associated buildings in Hayes, London.

The HV Sub Station is highlighted in yellow below.

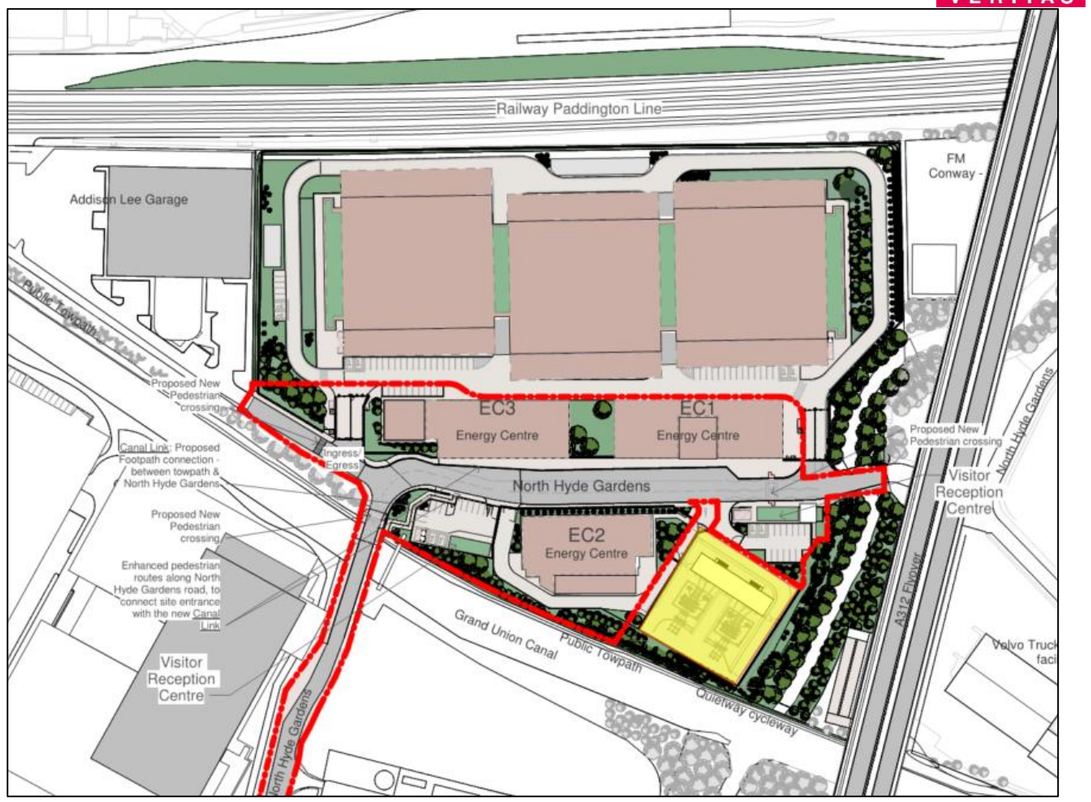

Figure 1: **– Site Plan highlighting the HV Sub Station**

This document presents the fire safety strategy only for HV Sub Station.

The site is owned by ARK Data Centres who will have overarching control.

2.4.1 High Voltage Substation and Control Building

A general layout of the substation is detailed below:

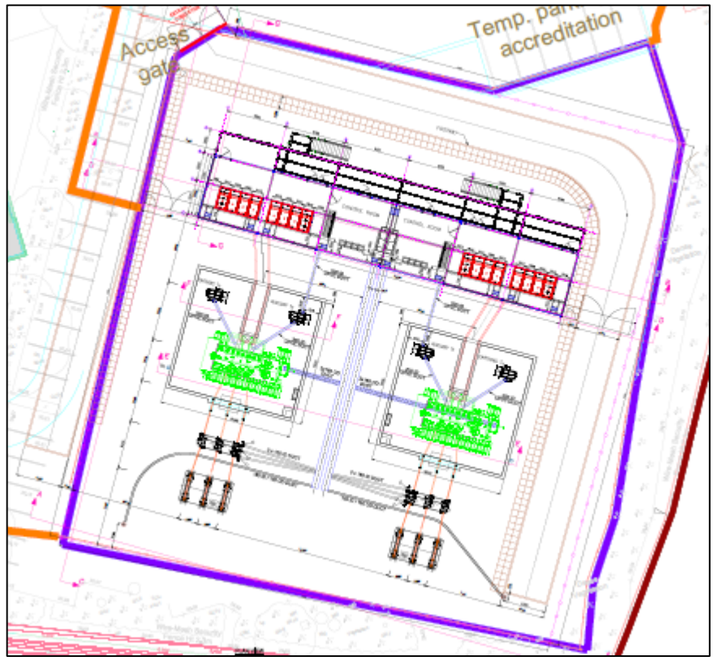

Figure 2: **High Voltage Sub Station Site Plan**

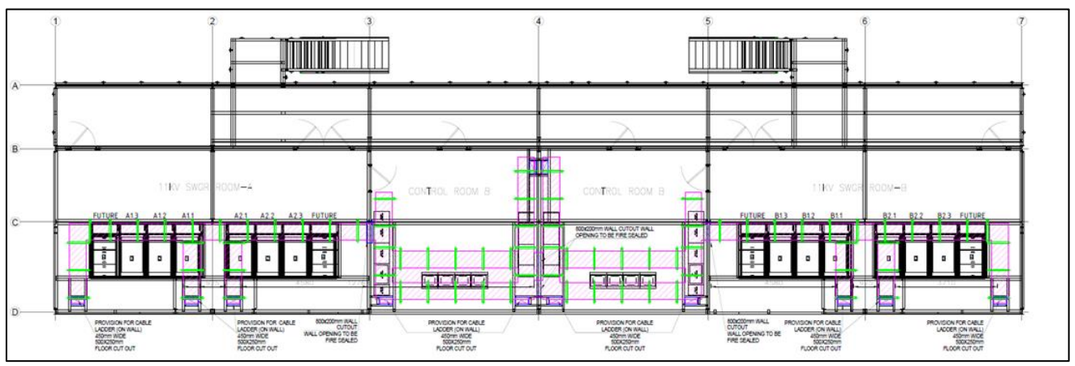

Figure 3: **Sub Station Floor Plan**

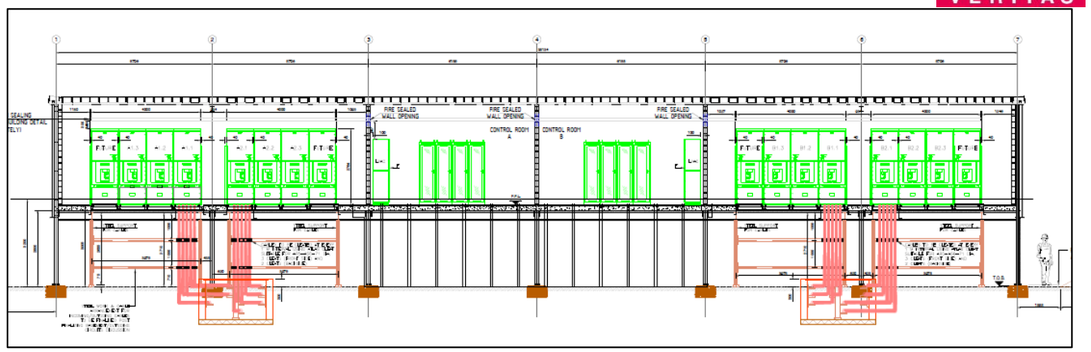

Figure 4: **Sub Station Section**

3 Statutory Requirements

The following sections provide an outline of the Regulations and Guidelines on which the Fire Safety Strategy is based.

3.1 The Building Regulations

The building work will be subject to the statutory requirements of the Building Regulations 2010. It is, therefore, necessary for the building to meet the functional requirements of Part B of Schedule 1 of these Regulations.

The functional requirements relate to the following:

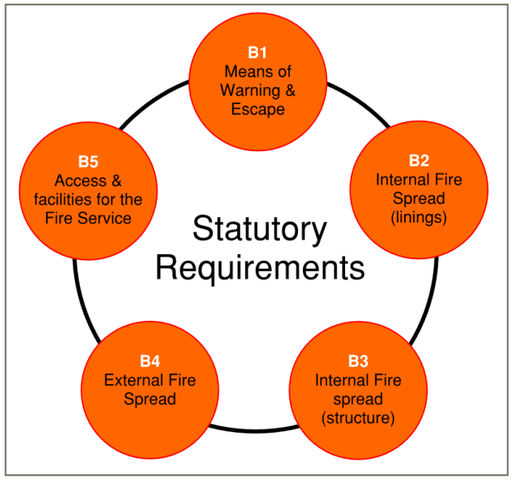

Figure 5: **- Part B of The Building Regulations**

3.2 Guidance

It should be noted that the above functional requirements are primarily concerned with life safety.

For the building, compliance with the above requirements will be achieved by the application of British Standard 9999: 2017, supplementing this with fire engineering solutions when necessary to ensure that the key fire safety objectives for the design are achieved.

Whilst the standard guidance within BS 9999: 2017 will offer some degree of property protection, the guidance does not specifically consider elements such as property protection/ insurers requirements/business continuity. As such this fire safety strategy does not include these aspects.

It is therefore recommended that the client:

- Confirm with their insurers if there are any additional measures that need to be taken into account;
- Considers undertaking an assessment of the potential direct and indirect losses that could occur as a result of a fire.

It is noted that the recommendations and guidance given in BS 9999: 2017 are based on the assumption that under normal circumstances a fire is unlikely to start in two different places in a building at the same time.

3.3 The Regulatory Reform (Fire Safety) Order 2005

Once the building/construction work is completed and the premises occupied, the Regulatory Reform Order (RRO) becomes the controlling fire safety legislation.

It is necessary under this order, among other things, for the owner/occupier of the building to carry out and maintain a fire safety assessment.

The building's management team will also be responsible under this order to ensure that the building's fire safety provisions are appropriately managed, maintained and tested over the whole life of the building.

Note: Compliance with the requirements of the Building Regulations **DOES NOT** imply compliance with the requirements of the RRO.

3.4 Regulation 38

Regulation 38 of the Building Regulations requires that the fire safety information in respect to a 'relevant building' should be passed to the 'responsible person' upon completion of the work or when the building is first occupied (whichever is earlier).

1. This regulation applies where building work:
    a. Consists of or includes the erection or extension of a relevant building; or
    b. Is carried out in connection with a relevant change of use of a building, and Part B of Schedule 1 imposes a requirement in relation to the work.
2. The person carrying out the work shall give fire safety information to the responsible person not later than the date of completion of the work, or the date of occupation of the building or extension, whichever is the earlier.
3. In this regulation:
    a. "Fire safety information" means information relating to the design and construction of the building or extension, and the services, fittings and equipment provided in or in connection with the building or extension which will assist the responsible person to operate and maintain the building or extension with reasonable safety;
    b. A "relevant building" is a building to which the Regulatory Reform (Fire Safety) Order 2005 applies, or will apply after the completion of building work;
    c. A "relevant change of use" is a material change of use where, after the change of use takes place, the Regulatory Reform (Fire Safety) Order 2005 will apply, or continue to apply, to the building; and
    d. "Responsible person" has the meaning given by article 3 of the Regulatory Reform (Fire Safety) Order 2005.

A suggested <u>but not exhaustive list</u> is given below:

- This fire strategy report.
- Management information proposed as part of this fire strategy report.
- Active (Fire Alarm Systems, emergency signage and lighting, fire curtains, dry risers etc.) and Passive (compartmentation, fire doors, cavity barriers etc.) Fire Protection System details with relevant maintenance schedules and operational details.
- O&M Manuals for building systems, including commissioning information and certification.
- Any information related to facilitating the evacuation of disabled occupants where applicable.

3.5 Construction, Design and Management Regulations

Projects undertaken within the UK are subject to the requirements of the Construction, Design and Management Regulations (CDM).

This report defines the strategy for meeting the functional and performance requirements for fire safety in the finished building. Where any conclusions or recommendations have been arrived at, which specify particular materials, products or forms of construction, these will have been assessed in accordance with CDM Regulation 9 (Duties for Designers). In the event that these involve significant residual risks or health and safety critical assumptions, this information will be made available, to the Principal Designer. Where the architect or other consultants use the standards put forward in this report to specify works, they are understood to be competent in alerting the Client, Principal Designer, Contractor and Building Occupiers of CDM issues.

4 Risk Profile

BS 9999 is a risk-based document and requires a risk profile to be established in order to determine the appropriate means of escape and design features for the building. The risk profile is a key measure of the potential for fire risk to people. This reflects the occupancy characteristics and the fire growth rate for the building and is derived as shown in the following subsections.

4.1 Occupancy Characteristic

An occupancy characteristic **A** has been applied to the HV Sub Station on the basis that all occupants should be awake and familiar with the premises.

4.2 Fire Growth Rate

BS 9999 defines the Fire Growth Rate as the rate at which a fire in a building is estimated to grow. This depends on the fire load distribution and type of combustible materials that can be found in the building.

Generally, the fire load distribution and materials found within these buildings are associated with a Fast (3) fire growth**.**

Notwithstanding the above classification, it is noted that certain ancillary spaces within the building, which are classified as special fire hazard areas (such as Transformer and High Voltage Switch Rooms), could have an ultrafast fire growth rate (4) due to the increased fire risk.

In consideration that the HV Transformers are outdoor, and the enclosed Control Building will be provided with a significant level of compartmentation, it is provided to reduce the fire growth rate by one level in these areas, subject to approval authorities' review and sign off. Therefore, the above fire growth rates are modified to:

- Fast (3) fire growth - Transformer and High Voltage Switch Rooms. Generator decks and the control building for the High Voltage substation have also been considered part of this group. The High Voltage substation is external approximately 10 m away from the Substation building. The HV Substation is external and does not impact the means of escape for persons in the substation building.

4.3 Risk Profile

Risk profiles are given as a combination of occupancy characteristics and fire growth rate. Therefore, the following risk profile will be allocated to the building:

- HV Sub Station – **A3**

4.4 Benefits from Additional Fire Protection Measures

The buildings must have appropriate management systems in place and will incorporate minimum fire protection measures (both active and passive) outlined within BS 9999 to allow occupants to escape from the building in the event of a fire.

In some instances, it is permissible to increase travel distances, and to reduce exit widths and stair widths by providing additional fire safety measures over the minimum that the baseline guidance is based on.

This is subject to the maximum variations outlined within Clause 18 of BS 9999 and subject to the additional measures providing a clear benefit. The table below outlines the additional fire protection measures proposed within the project building(s).

Table 2 - Benefits from Additional Fire Protection Measures

Location	Minimum requirement	Additional Measure	Benefit applied
Areas with an A3 Risk Profile	Category L2 automatic fire detection and alarm	None	No additional increase in these areas.

5 Means of Detection, Warning & Escape

5.1 Evacuation Strategy

The proposed evacuation strategy for the building is based on a single-stage simultaneous evacuation approach in the fire effected building. This means that on activation of a fire alarm (by a single device) all occupants of the building where the activation occurs start their evacuation. **Note: Each building of the site will evacuate on their own (independently from other buildings).**

5.2 Expected Number of Occupants

Due to the nature/use of the different premises, the numbers of people within each of the buildings will be extremely low.

The occupancy in the HV Substation control building will be less than 60 people.

***Note 1**: The design team should confirm that the occupancy given above meet with the requirements of how the building will be used.*

5.3 Active Fire Protection Systems

5.3.1 Fire Detection & Alarm Systems

The minimum fire detection and alarm system required in accordance with BS 9999 for a building with an A3 Risk Profile is a Category L2 system. This will be provided to the HV Sub Station in accordance with BS 5839-1:2017.

The fire detection and alarm systems are to be designed and installed in accordance with BS 5839-1. Category L2 automatic fire detection systems typically provide protection throughout the building; in the following areas (however, for full information see BS 5839-1):

- All escape routes;
- All rooms that open onto escape routes;
- Spaces classified as special fire hazard;
- Access rooms off inner rooms.

Optical smoke detectors should be provided throughout the building with the exception of rooms that may contain naked flames (kitchen), or within which smoke or steam (plant rooms, kitchen) may be expected. In these cases, standard heat detectors may be used as an alternative to the smoke detectors.

Note. Heat detectors are not suitable for use within escape routes or circulation routes and optical type smoke detectors should always be provided throughout these areas.

In addition to audible alarms, visual alarms devices (VADs) should be provided to any areas where it is anticipated that persons with impaired hearing may be located in relative isolation or in areas where ambient noise levels are relatively high such as plant rooms and terrace areas. The VADs must comply with BS EN 54 - 23: 2010.

Manual call points should be provided and comply with BS 5839-1 or Type A of BS EN 54-11. Manual call points should be located on escape routes at all final means of escape exits to free air. Where it is determined that the call points will be prone to malicious operation, the use of a transparent hinged covers can be considered.

The fire alarm system should have interfaces and links as necessary to operate equipment / devices and a number of examples are indicated below. Refer to BS5839-1:2017 for full information.

- Electromagnetic hold-open devices on fire doors – released to closed position;
- Security systems on exit doors - released as required;
- Gas supply valves (kitchens, plant areas) – isolate;
- Lifts – travel to ground floor (or to first floor if the alarm is activated on ground floor in vicinity of the lift), open doors and go out of service. Each firefighting lift should operate as per other lifts until activation of a firefighters lift switch;
- Heating, ventilation and air conditioning systems – shut down to restrict spread of smoke and hot gases.

5.3.2 Emergency Escape Lighting & Signage

Suitable lighting should be provided to enable the safe movement of persons along escape routes to a place of relative or ultimate safety. Emergency escape lighting, when needed, should be provided to the following areas and in accordance with BS 5266 Part 1: 2016 and BS EN 1838-7 2013.

Table 3 - Emergency Lighting

Building Characteristic	Areas Requiring Emergency Lighting
A	Underground or Windowless accommodation
	Stairways in a central core or serving storey(s) more than 18 m above ground level
	Internal Corridors more than 30m long
	Open plan areas more than 60m^2
Any Risk Profile	All sanitary accommodation with a floor area over 8m^2
	Windowless sanitary accommodation with a floor area not more than 8m^2
	Electricity ad generator rooms
	Switch room/ battery room for emergency lighting system
	Emergency control room

Escape and other fire safety signage should also be provided in accordance with BS ISO 3864 Part 1: 2011 and BS 5499 Part 4: 2013.

5.3.3 Secondary Power Supply

All essential electrical cables supplying power to fire safety equipment should be fully robust and their routes should be cautiously chosen to limit the potential for damage. Secondary power supplies are required to all equipment essential for functioning during a fire, including the fire detection and alarm systems and the emergency lighting system.

The secondary power supply should comply with BS 8519: 2010.

Where possible all insulation and casing on cables should be of the zero halogens low smoke (0HLS) type to minimise the risk from toxic and corrosive fumes and smoke.

Where dual power supplies are recommended by the relevant British Standard or industry guide to any life safety system, the primary power source should generally be taken from the public electricity supply, with secondary power being supplied from an alternative utility supply from another substation, a generator, an uninterruptable power supply (UPS) or batteries.

The output of each power supply should be sufficient to satisfy the maximum demands of the system.

The electrical distribution system should conform to BS 7671, the relevant parts of BS EN 60947, and BS 7346-8.

Systems that will require a secondary power supply include:

- Emergency lighting.
- Automatic fire detection and alarm systems.

5.4 Horizontal Evacuation

5.4.1 Minimum Number of Escape Routes

The minimum number of escape routes and exits from any room, tier or storey should be not less than the minimum recommended in Table 4 based on the intended number of occupants.

Table 4 - Absolute Minimum Number of Exits/ Routes

Maximum Number of Persons	Minimum Number of Exits/ Routes
60 Note 1	1
600 Note 2	2
More than 600 Note 2	3

***Note 1**. A single escape route should be provided only where a room, tier or storey has an occupant capacity of 60 or fewer people and the travel distance limit for travel in one direction only (as set in section 5.4.2 of this report) is not exceeded.*

***Note 2:** Where the occupancy exceeds 60, the exits should open in the direction of escape.*

5.4.2 Travel Distances

The travel distances should not exceed the maximum values given in Table 11 of BS 9999 for the appropriate Risk Profile. These are:

- Risk Profile A3 – 18m and 45m for single and two way travel respectively.

However, where additional fire protection measures are provided the travel distance may be increased subject to maximum acceptable variations indicated in Table 15 of BS9999. The table below presents the maximum travel distances in each of the areas taking in to account allowable variations.

Table 5 - Maximum Travel Distances

Building / Area	Risk Profile	Ceiling Height Benefit	AFD Benefit	Travel Distance Type Note 1	One Way Travel Distance Note 2	Two Way Travel Distance Note 2
High Voltage Substation Control Building	A3	3-4m 5%	No	Actual	18.9m	47.25m

***Note 1:** Actual travel distance takes into account layouts of rooms etc. When developing layouts the actual travel distance should not be exceeded.*

***Note 2:** Travel distances have included the % increases from the additional fire protection measures and take into account the maximum acceptable variations indicated in Clause 18.4 of BS 9999.*

Travel distances within the proposed building are in accordance with the above.

5.4.3 Exit Doors

Doors on escape routes (both within and from the building) should be easily identified and readily openable by all people. In particular, they should either not be fitted with lock, latch or bolt fastenings, or be fitted only with simple fastenings that can be readily operated from the side approached by people making an escape. The operation of these fastenings should be readily apparent, without the use of a key and without having to manipulate more than one mechanism.

Where a door on an escape route has to be secured against entry when the building or part of the building is occupied, it should only be fitted with a lock or fastening which is readily operated, without a key, from the side approached by people making their escape. Similarly, where a secure door is operated by a code, combination, swipe or proximity card, biometric data or similar means, it should also be capable of being overridden from the side approached by people making their escape.

Electrically powered locks should return to the unlocked position under any of the following conditions:

a) on operation of the fire alarm (see BS 7273-4);

b) on loss of power or system error;

c) on activation of a manual door release unit (type A) conforming to BS EN 54-11:2001+A1 positioned at the door on the side approached by people making their escape. Where the door provides escape in either direction a unit should be installed on both sides of the door.

It might also be appropriate to accept on some final exit doors locks for security that are used only when the building is empty. In these cases the emphasis for the safe use of these locks should be placed on management procedures.

The door leaf of any exit door should be hung to open in the direction of escape, where the number of persons that might be expected to use the door at the time of a fire is more than 60.

Note: In general, due to the low numbers of occupants in each area doors should not need to open in the direction of escape. **However due to the level of risk in the HV Sub Station, doors to the outside should open in the direction of escape (clause 15.6.3 of BS 9999)**

Vision panels should be provided where doors on escape routes subdivide corridors, where any doors are hung to swing both ways, or where it is required as one of the conditions for providing an inner room arrangement.

Wicket doors and gates are acceptable in consideration that they are not used along escape routes from high risk areas, and noting that:

1) they are not intended to be used by members of the public;

2) not more than 10 persons are expected to use them in an emergency;

3) they provide an opening at least 500 mm wide, with the top of the opening not less than 1.5 m above the floor level and the bottom of the opening not more than 250 mm above the floor level;

Fail-safe turnstiles, revolving doors and automatic doors in accordance with BS EN 16005 and BS 7036-0, are acceptable along escape routes provided that either:

- they are arranged to fail safely in the open position or be easily openable in an emergency; or
- Outward opening hinged doors, of an appropriate width and fastening, are provided immediately adjacent to such doors or turnstiles.

5.4.4 Exit Door Widths

The minimum widths of all exit doors is proportional to the number of persons using the exits. However, this is subject to an absolute minimum width of 800mm.

***Note:** Other parts of the Approved Documents such as Part M may require larger exit widths.*

***Note:** Where a storey or final exit relates to an area where unassisted wheelchair access is necessary, the minimum clear width is 850mm in accordance with Clause 16.6.1 from BS 9999.*

Due to the low numbers of occupants in each of the areas/buildings all doors **(with the exception of doors on routes leading from the escape stairs to outside, which should be at least as wide as the stair they serve)** should only meet the above minimum widths.

For the purposes of this report, the width of a doorway is the clear width of the opening between the door leaf and frame (or projecting building hardware or the width between two opening door leaves in the case of double doors) assuming that the door leaf is free to open 90 degrees or more. Where double doors are provided the width of one of the leaves should be not less than 800 mm.

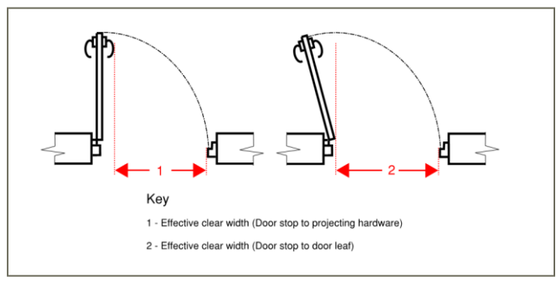

Figure 6 – Clear Exit Width

5.5 Vertical Escape

The minimum widths of stairs is proportional to the number of persons using the stair. However, this is subject to an absolute minimum width of 1000mm for stairs used for downward travel.

Note: *Handrails and strings on escape stairs which do not protrude more than 100mm into the clear width can be ignored.*

Note: *Other parts of the Approved Documents such as Part M may require larger stair widths*

5.5.1 High Voltage Substation Building

The High Voltage substation building is provided with two external stairs serving the control rooms. The stairs are not required to be firefighting stairs but should have a minimum width of 1000mm.

5.5.2 External Escape Stair Requirements

External stairs should meet the following requirements:

1. All doors giving access to the external stair should be fire-resisting and self-closing, except that a fire-resisting door is not needed at the head of any stair leading downwards where there is only one exit from the building onto the top landing.
2. Any part of the external walls within 1800mm of (and 9m vertically below), the flights and landings of an external escape stair should be of fire-resisting construction, except that the 1800mm dimension may be reduced to 1100mm above the top level of the stair if it is not a stair up from a basement to ground level (see Figure 16 of BS 9999).
3. Any part of the building (including any doors) within 1800 mm of the escape route from the stair to a place of relative or ultimate safety should be provided with protection by fire-resisting construction [see also 16.3.12d) of BS 9999].
4. Glazing in areas of fire-resisting construction [see 3. above] should also be fire-resisting to meet the criteria for both integrity and insulation, and should be fixed shut.
5. Where a stair is more than 6m in vertical extent it should be protected from the effects of adverse weather conditions.

   NOTE: A full enclosure is not necessary. The extent of enclosure needed depends on the location of the stair and the degree of protection given to the stair by the building itself. Trace heating is acceptable but needs to be maintained throughout the life of the building and be treated to the same standard as emergency escape lighting and provided with thermostatic control to operate in cold weather.

   NOTE: Where an external stair has been highlighted as being used for firefighting additional levels of fire protection are required in accordance with Table 8 of this report.

5.6 Escape for People with Mobility Impairments

If the proposal is meant to be an accessible building, refuges for disabled persons should be provided in within protected areas and located so that they do not impede the escape route of other occupants.

The minimum size of the refuge is 900mm x 1400mm and designed in accordance with Clause 45 from BS 9999.

The refuge is to be fitted with an Emergency Voice Communication (EVC) system. The EVC system should comply with BS 5839 Part 9:2003 and consist of Type B outstations which communicate with a master station located in accordance with Clause 12.6 of BS5839 Part 9.

Note: *Fire alarm sounders should not be positioned close to the EVC communication points.*

The final exits should have level thresholds so that they do not present an obstacle to wheelchair users and other people with mobility impairments. Where a final exit is accessed without the need to first traverse steps then a level threshold and, where necessary a ramp should be provided.

6 Access & Facilities for Firefighting

6.1.1 High Voltage Substation

Fire Service access is available to over 50% of the perimeter and vehicle access will be within 45m of all areas of the control building and substation.

6.2 Fire Service Access

The fire service vehicle access requirements are outlined within the table below.

Table 6 - Fire Service Vehicle Access Routes

Appliance	Min. Width of Road between Kerbs	Min. Gateway Width	Min. Clearance Height	Min. Carrying Capacity	Min. Turning Circle	
					Kerb to Kerb	Wall to Wall
Pump	3.7m	3.1m	3.7m	12.5 tonnes	16.8m	19.2m

Note: *Fire appliances are not standardised. A check should be carried out to confirm local fire and rescue specifications.*

There are a number of security gates around the site. It should be ensured that these gates are readily openable by fire brigade.

6.3 Fire Hydrants

It is understood that the site will have a private main with fire hydrants installed around the site. Hydrants should be provided in positions near to building entry points and fire appliance parking positions as follows:

- Hydrants should be provided within 90 m of an entry point to the building and not more than 90 m apart.

Private hydrants should be design and installed in accordance with BS 9990 and should ideally form part of a ring main system.

6.4 Power Supplies

Power supplies should be in accordance with Clause 37.2.3.3 from BS 9999.

7 Designing the Building Structure

7.1 Wall and Ceiling Linings

The interior wall and ceiling surfaces in a building may have a significant influence on how fast a fire may develop. Building Regulations requires that internal linings shall adequately resist the spread of flame over their surfaces and, if ignited, have either, a heat release rate or a rate of fire growth, which is reasonable in the circumstances.

It is particularly important that in circulation spaces, where the rapid spread of fire is most likely to prevent occupants from escaping, the surface linings are restricted, by making provision for them to have low rates of heat release and surface spread of flame.

The surface finishes should satisfy the following classifications shown in, when tested under either the National Classifications (in accordance with BS 476 part 7:1997) or under the European Classifications (in accordance with BS EN 13501-1:2002).

Table 7 - Wall and Ceiling Lining Requirements

Location	National Class	European Class Note 1
Small room of area not exceeding 30m^2	3	D-s3, d2
Other rooms	1	C-s3, d2
Circulation spaces Note 2	0	B-s3, d2

Note 1 *When a classification includes 's3, d2' this means that there is no limit on the production of smoke or flaming droplets/particles.*

Note 2: *Large open plan areas that are open to the open connections have been considered as a room and therefore not regarded as circulation space even though there are circulation routes in them.*

The surface linings of the walls and ceilings should generally conform to the classification recommended above for the appropriate location. However, parts of walls in rooms may be of a lower class but not lower than Class 3 (or European Class D-s3, d2) provided that the floor area of those parts in any one room does not exceed one half of the floor area of the room, subject to a maximum of 60m^2 in non-residential accommodation.

7.2 Fire Resistance Requirements

The HV Substation control building is a ground floor and first floor building with an A3 risk profile. The structural fire resistance for the building should be a minimum of 60 minutes in accordance to table 23 of BS 9999.

However due to the location of the High Voltage intake transformer of 66kV, the structural fire resistance has been increased to 120 minutes in accordance to BS EN 61936-1.

The fire resistance performance requirements are noted within the table below.

Table 8 - Minimum Fire Resistance Requirements

Part of the Building	Minimum provisions when tested to the relevant parts of BS 476 or relevant European standard (minutes)			Method of Exposure
	Load-bearing capacity	Integrity	Insulation	
Structural Frame, Beam or Column	120	N/A	N/A	Exposed Faces
Load-Bearing Wall	120	N/A	N/A	Each Side Separately
Floors	120	120	120	From Underside
Compartment Walls	120	120	120	Each Side Separately
Compartment Floors	120	120	120	From Underside
➢ Any roof that forms the function of a floor	120	120	120	
External Fire Spread				
➢ Any part less than 1000mm from a point in the relevant boundary	120	120	120	Each Side Separately
➢ Any part more than 1000mm from the relevant boundary	120	120	15	From Inside the Building
➢ Any part adjacent to an external escape route or stair	30	30	N/A	From Inside the Building
Fire Resisting Construction	See section 7.4 of this report			Each Side Separately
➢ Ancillary Accommodation				
Cavity Barriers	N/A	30	15	Each Side Separately

7.2.1 External Protection to Protected Stairways

Where the escape stair projects beyond, or is recessed from, or is in an internal angle of not more than 135^o to the adjoining external wall of the building. That part of the external wall that is adjacent to the stair within 1800mm should have a minimum of 30 minutes fire resistance. For more information see Figure 15 from BS 9999.

7.2.2 External Protection to Escape Routes

Where an external escape route is beside an external wall of the building, that part of the external wall within 1800mm of the escape route should be of 30 minutes fire resisting construction, up to a height of 1100mm above ground level.

7.2.3 Protection to External Stairways

As highlighted earlier in section 5, external stairs should meet the following requirements:

1. All doors giving access to the external stair should be fire-resisting and self-closing, except that a fire-resisting door is not needed at the head of any stair leading downwards where there is only one exit from the building onto the top landing.
2. Any part of the external walls within 1800mm of (and 9m vertically below), the flights and landings of an external escape stair should be of fire-resisting construction, except that the 1800mm dimension may be reduced to 1 100mm above the top level of the stair if it is not a stair up from a basement to ground level (see Figure 16 of BS 9999).
3. Any part of the building (including any doors) within 1800 mm of the escape route from the stair to a place of relative or ultimate safety should be provided with protection by fire-resisting construction [see also 16.3.12d) of BS 9999].

4. Glazing in areas of fire-resisting construction [see 3. above] should also be fire-resisting to meet the criteria for both integrity and insulation, and should be fixed shut.

5. Where a stair is more than 6m in vertical extent it should be protected from the effects of adverse weather conditions.

   NOTE: A full enclosure is not necessary. The extent of enclosure needed depends on the location of the stair and the degree of protection given to the stair by the building itself. Trace heating is acceptable but needs to be maintained throughout the life of the building and be treated to the same standard as emergency escape lighting and provided with thermostatic control to operate in cold weather.

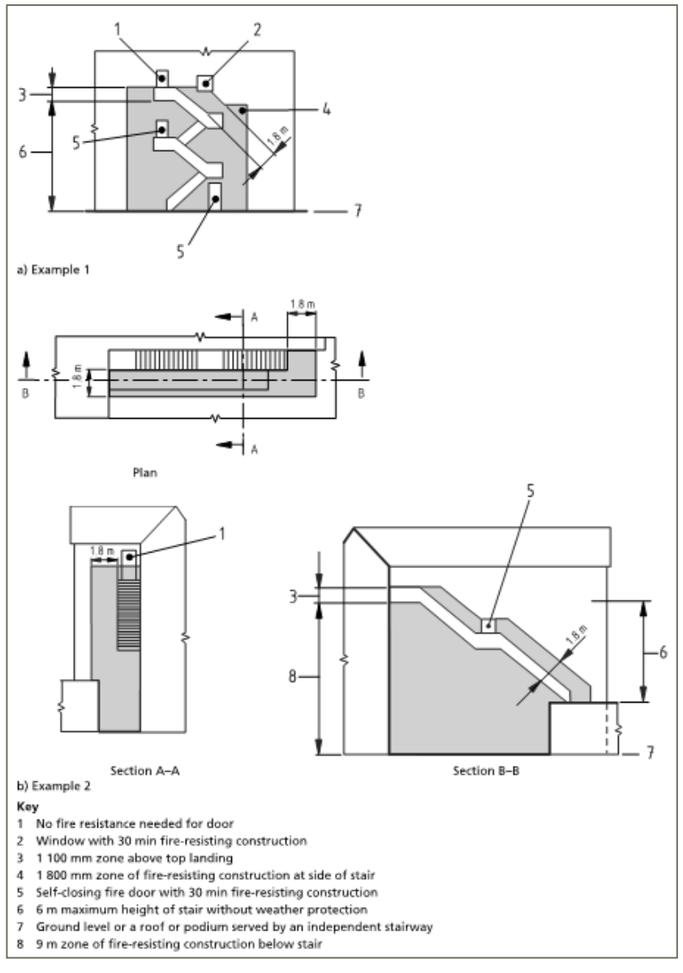

Figure 1 –Fire Resistance to External Stairs

NOTE: Where an external stair has been highlighted as being used for firefighting additional levels of fire protection are required. Please refer to fire strategy drawings.

7.3 Compartmentation

The height of the first floor is less than 18 m therefore the maximum compartment size should not exceed 14,000m^2. This is reflected in the proposal.

However, the Substation is provided with 120 fire resistance as a consequence of the location to the 66kV transformers.

7.4 Ancillary Accommodation

Areas of ancillary accommodation should be separated from the remainder of the building by appropriately fire rated construction.

Table 9 - Ancillary Accommodation

Ancillary Accommodation	Minimum Fire Resistance
Storage areas greater than 1m^2 in area but not greater than 450m^2 (other than refuse areas).	Robust construction having a minimum standard of fire resistance of 30 minutes
Repair and maintenance workshops where flammable or highly flammable liquids are not used or stored	
Kitchens (separately or in conjunction with an associated staff restaurant or canteen)	
Transformer, switchgear and battery rooms for low-voltage or extra low voltage equipment	
Engineering services installation rooms	
Dressing or changing rooms	
Storage areas greater than 450m^2	Robust solid non-combustible construction having a minimum fire resistance of 60 minutes
Service installation rooms	
Places classified has high fire risk areas	
Repair and maintenance workshops where flammable or highly flammable liquids are used or stored	
Covered loading bays and storage areas other those previously mentioned	Robust solid non-combustible construction having a minimum standard of fire resistance equivalent to that required for the elements of construction of the building and in case less than 60 minutes
Refuse storage areas	
Boiler rooms	
Fuel storage areas	
Transformer and switchgear rooms for equipment above low voltage	
Rooms housing fixed internal combustion engines	
Any electrical substation or enclosure containing any distribution board, generator, powered smoke control plant, pressurization plant, communication equipment, and any other equipment associated with life safety and fire protection systems	**Robust solid non-combustible construction having a minimum standard of fire resistance of not less than 120 minutes**

Note 1: *Kitchens that are for reheating purposes i.e. microwaves etc. are not considered kitchens under ancillary accommodation and do not need to be enclosed within fire resistance.*

7.5 Fire Doors

Fire doors should be provided in all fire rated enclosures in accordance with BS 476: Part 22: 1987 and specified with cold smoke seals (only where smoke seals are required [S or Sa]) in accordance with the recommendations of BS 476 Section 31.1. The fire resistance requirements for the doors are shown in the table below:

Table 10 - Fire Doors

Position of Door	Tested to BS 476-22	Tested to BS EN 1634-1
Riser Cupboard not opening into a protected space	Half the period of fire resistance of the wall it is fitted in but not less than FD30	Half the period of fire resistance of the wall it is fitted in but not less than E30
Riser Cupboard opening into a protected space	Half the period of fire resistance of the wall it is fitted in but not less than FD30S	Half the period of fire resistance of the wall it is fitted in but not less than E30Sa
Ancillary Accommodation not opening into a protected space	Same fire resistance as the wall it is fitted in	Same fire resistance as the wall it is fitted in
Ancillary Accommodation opening into a protected space	Same fire resistance as the wall it is fitted in with smoke seals (S)	Same fire resistance as the wall it is fitted in with smoke seals (Sa)
Forming part of Fire fighting shafts	See section 20.2 of BS 9999	See section 20.2 of BS 9999
Protected lobby or Dead End	FD30S	E30Sa
Sub-dividing a corridor	FD20S	E20Sa
Lifts	FD30	E30
Door within a Cavity Barrier	FD30	E30
Compartment Line	Same fire resistance as the wall it is fitted in with smoke seals (S)	Same fire resistance as the wall it is fitted in with smoke seals (Sa)

Note: *All fire doors on escape routes should be self-closing except for doors into ancillary accommodation that should be kept locked shut and provided with appropriate signage.*

Note: *Self closing devices are to be in accordance with Clause 32.1.6.1 of BS 9999.*

A fire door that is needed to resist the passage of smoke at ambient temperature conditions (the fire doors with the S or Sa against them) should either;

- Have a leakage rate not exceeding $3m^3/h$ per metre, when tested in accordance with BS 746-31.1 with the threshold taped and subjected to a pressure of 25 Pa; or
- Meet the classification requirement of Sa when tested in accordance with BS EN 1634-3.

Note: *Smoke leakage control can be applied to non-fire-resisting doors.*

Threshold gaps for timber doors should be in accordance with BS 8214.

Note: *Threshold gaps for all other door types are to be based on the principles set out in BS 8214.*

7.6 Concealed Spaces

Concealed spaces or cavities in the construction of the building provide a ready route for smoke and flame spread, especially in voids above and below ceilings/floors. As the smoke or flames would be concealed it presents a greater danger. For more information on concealed spaces see Clause 33.1 from BS 9999.

Cavity barriers should therefore be provided to sub-divide the cavities to restrict the spread of smoke and flame spread and should be provided in the following areas;

- Around openings and to close off edges of cavities [Note 1];
- At the junction between an external cavity wall and any wall, floor or door assembly which forms a fire resisting barrier and every compartment floor or wall;
- Within cavities that exceed the distances set out within the table below.

Note 1: *Where Steel Framing Systems (SFS) is used, if the steel supports the structure, fire stopping (to the same fire resistance as the elements of structure) should be in place of cavity barriers around openings and to close top of cavities*

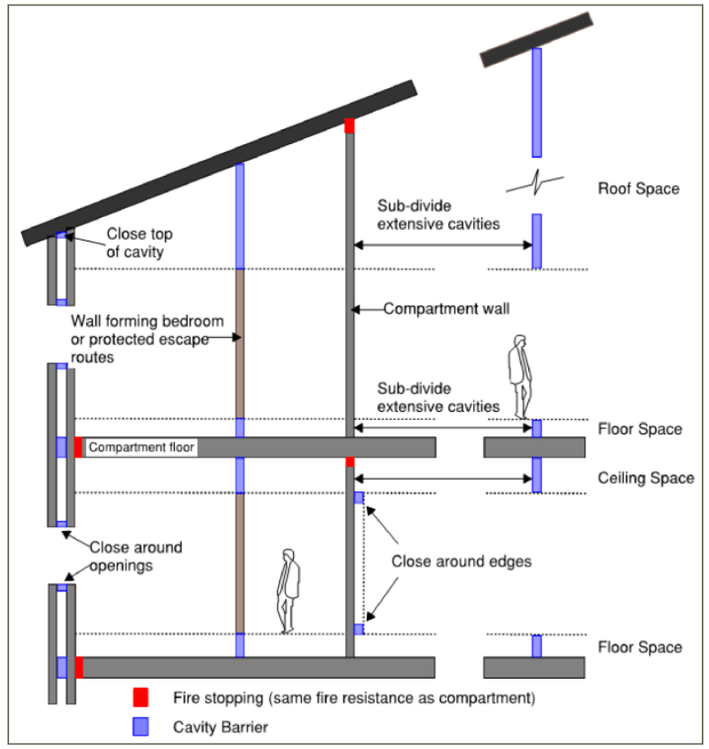

Figure 8 – Provisions of Cavity Barriers and Fire Stopping

Cavities that may exist above or below any fire resisting construction because the construction is not carried to full storey height or, (in case of the top storey) to the underside of the roof covering should be either:

- Fitted with cavity barriers on the line of the partitions (as indicated within the figure above); or
- For cavities above the partitions, enclosed on the lower side by a fire resisting ceiling which extends throughout the building, compartment or separated part.

The maximum dimensions of concealed spaces are indicated within the table below.

Table 11 - Maximum Dimensions of Cavities

Location	Class of Surface Exposed	Max Dimension in any Direction
Between a roof & a ceiling	Any Class	20m
Any other Cavity	Class C-s3,d2 / Class 1	20m
	Any Class	10m

***Note**: the national classifications do not automatically equate to the equivalent classifications in the European classifications.*

The provisions in the table above do not apply to any cavity described below;

- In a wall which should be fire resisting only because it is load bearing;
- In a masonry or concrete external cavity wall (two leaves of brick or concrete each at least 75mm thick, cavity closed around gaps and to close of edges of cavities);
- Formed behind the external skin of an external cladding system with a masonry or concrete inner leaf at least 75mm thick, or by over-cladding an existing masonry (or concrete) external wall, or an existing concrete roof, provided that the cavity does not contain combustible insulation and the building is not put to a residential or institutional use;
- Between double skinned corrugated or profiled insulated roof sheeting, if the sheeting is a material of limited combustibility and both surfaces of the insulating layer have as surface spread of flame at least Class 0 or Class 1 (national) or Class – Cs3, d2 or better (European) and make contact with the inner and outer skins of cladding;
- In any floor or roof cavity above a fire resisting ceiling (at least 30 minutes FR) which extends throughout the building or compartment, subject to a 30m limit on the extent of the cavity;
- Below a floor next to the ground or oversite concrete, if the cavity is less than 1000mm in height or if the cavity is not normally accessible by persons unless there are openings in the floor such that it is possible for combustibles to accumulate in the cavity (in which case cavity barriers should be provided and access should be provided to the cavity for cleaning).
- Cavities that specifically protected by a sprinkler system in accordance with BS EN 12845

***Note:** For more information see Clause 33.2 from BS 9999*

Where a single room exceeds 20m in any direction, cavity barriers within the ceiling void (and within any floor voids) need only to be placed on the line of enclosing walls/partitions of any room and where services penetrate any fire-resisting floors to avoid vertical and horizontal voids meeting, provided that:

- The cavity barriers are no more than 40m apart; and
- The surface of the material/product exposed in the cavity being Class 0 or Class 1 (national class) or Class C-s3, d2 or better (European Class).

Every cavity barrier should be constructed to at least 30 minutes fire resistance as indicated in Section 6.2.2. It may be formed by any construction provided for another purpose if it meets the provisions for cavity barriers. Cavity barriers in a stud wall, or provided around openings should follow the guidance from Clause 33.1 from BS 9999.

The cavity barriers wherever possible be tightly fitted to a rigid construction and mechanically fixed in position. Where this is not possible the junction should be fire stopped.

7.7 Protection of Openings and Fire-stopping

7.7.1 Fire Stopping

If the fire separating element is to be successful, every joint or imperfection of fit, or opening to allow services to pass through the element, should be adequately protected by sealing or fire stopping so that the fire resistance of the element is not impaired.

Pipes that pass through a fire separating element, should meet one of the following provisions;

- **Proprietary seals** - Provide a proprietary sealing system which has been shown by test to maintain the fire resistance of the wall, floor or cavity barrier;
- **Restricted pipe diameter** - Where a proprietary sealing system is not used, fire stopping may be used around the pipe, keeping the opening as small as possible. The nominal internal diameter of the pipe should not be more than the relevant dimension given in the table below;

Table 12 - Maximum Nominal Diameter of Pipes Passing Through Elements

Situation	Pipe Material and Maximum Nominal Internal Diameter (mm)		
	Non-Combustible Material	Lead, Aluminium, Aluminium Alloy, uPVC, Fibre Cement	Any Other Material
Structure enclosing a protected shaft which is not a stairway or a lift shaft	160	110	40
Any other compartment	160	40	40

***Note:** Any non-combustible material which, if exposed to a temperature of 800^{O}C, will not soften or fracture to the extent that flame or hot gas will pass through the wall of the pipe.*

Where more than two small (<40mm) service penetrations occur within 40mm of each other, they should either be treated as a single penetration and a suitable proprietary seal should be used to protect the combined opening area as described above or be individually fire stopped with a suitable proprietary seal as described above.

7.7.2 Ductwork

Where air handling ducts pass through compartmentation / fire resisting construction the integrity of these compartments should be maintained. There are four basic methods in order to prevent smoke and flame spread through the building/ compartment. For more information see Clause 33.4.3 from BS 9999:

The requirements for each option are indicated below;

***Method 1** – Thermally actuated fire dampers;*

- Fire dampers that are thermally operated can be provided where ductwork goes though fire resisting construction.
- Fire dampers are not suitable for protected escape routes

***Note:** Fire dampers should be tested to BS EN 1560:2010. They should have an E classification equal to or greater than 60 minutes.*

***Note**: Method 1 is not suitable for ductwork serving kitchen extracts.*

***Method 2** - Fire resisting enclosures;*

- The fire resisting enclosures should achieve the same fire resistance as the wall the ductwork penetrates which forms a compartment known as a protected shaft. This allows a multiplicity of services to be transferred together with the duct to traverse a number of compartments within the building without the need for further sub divisions. Fire dampers (thermally or actuated by AFD) will only be required where the ductwork enters or leaves the protected shaft.
- Method 2 can only be used on ductwork that passes through an escape route providing the ductwork does not serve the escape route it passes through.

Method 3 *- Protection using fire resisting ductwork.*

- The ductwork itself forms a protected shaft. The ductwork should achieve the same fire resistance as the wall the ductwork penetrates. The fire resistance can be achieved by the ductwork material itself, or through the application of a protective material.
- Method 3 can only be used on ductwork that passes through an escape route providing the ductwork does not serve the escape route it passes through.

Note: *The supporting hangers should be capable of supporting the ductwork for not less than the period of fire resistance of the ductwork.*

Method 4 *– Automatically actuated fire and smoke dampers triggered by smoke detectors*

- Method 4 may be used for extract ductwork passing through the enclosures of protected escape routes, both where the ductwork does and does not serve the escape route.

Note*: Method 4 is not suitable for ductwork serving kitchen extracts.*

Note: *Fire and smoke dampers should be tested to BS EN 1560:2010. They should have an ES classification equal to or greater than 60 minutes.*

7.8 Air Transfer Grilles

Care should be taken in the positioning of air transfer grilles to ensure that they do not allow the passage of fire and smoke. In general, the installation of air transfer grilles should be avoided in any construction required to be fire-resisting, particularly those forming compartment boundaries. Air transfer grilles should not be installed in:

- Elements of construction enclosing compartments or protected shafts;
- Enclosures to protected stairways, protected lobbies, protected corridors, firefighting stairways or firefighting lobbies;

Air transfer grilles fitted in any construction or door that needs to be fire resisting should be of the intumescent type or fitted with fire dampers. Where these grilles are within the enclosure of protected escape routes, they should incorporate fire and smoke shutters operated by adjacent automatic smoke detectors. Fire and smoke shutters should be in accordance with Method 4 or achieve the same performance standard as an FD 30S as part of the door assembly.

Where it is necessary for air transfer grilles to be fitted with fire dampers, the fire dampers should be in accordance in Clause 32.5.2.5 of BS 9999.

8 External Fire Spread

The guidance from Volume 2 of Approved Document B: 2019 has been used when considering external wall construction and combustibility of wall construction. This is based on the latest legislation.

8.1 External Wall Construction

The external envelope of a building should not provide the medium for fire spread if it is likely to be a risk to health or safety. The use of combustible materials in the cladding system and extensive cavities may present such a risk in tall buildings.

External walls should either meet the guidance given in paragraphs 12.3 to 12.9 of Approved Document B or meet the performance criteria given in the BRE report 'Fire performance of external thermal insulation for walls of multi storey buildings (BR 135) for cladding system using full scale test data from BS 8414 – 1: 2002 or BS 8414 -2: 2005.

Both the criteria for surface spread of flame and combustibility of the elevational build up should be met independently, as the acceptability of the surface spread of flame criteria does not necessarily ensure acceptability of the combustibility criteria for tall buildings.

8.1.1 Combustibility of Wall Construction

Where a building has a storey over 18m any cladding material, insulation product, filler material (not including gaskets, sealants and similar) etc. used in the external wall construction should be of limited combustibility [European Class A2-s3, d2 or better] unless the wall is of masonry construction. See paragraphs 12.5 to 12.9 of Approved Document B.

This does not apply to the HV Sub Station, however the use of non-combustible materials is still strongly recommended.

Surface Flame Spread

For each elevation of each boundary, the relevant boundary is greater than 1m from the elevation. It should be noted that relevant boundaries between buildings on the site have not been considered on the basis that they are not assembly or residential occupancies and the site will be owned and under the control of the same organisation. **This approach should be agreed with the approval bodies as well as the insurers of the development.**

Table 13 - Provisions for External Surfaces or Walls

Area/Distance from Relevant Boundary	Height of the Wall	External Wall Surface Classification
High Voltage Substation Building – 1m or more	Less than 18m above ground	No Provision

8.2 Roof Coverings

Roof coverings refer to the external material layers, not the roof structure as a whole. The table below describes the separation distances according to the type of roof covering as described within Clause 35.4 from BS 9999.

Table 14 - Roof Covering Spacing

Designation of Covering of Roof or Part of Roof		Minimum Distance from any Point to Relevant Boundary			
National Class	European Class	Less than 6 m	At Least 6m	At Least 12 m	At Least 20 m
AA, AB or AC	B_{ROOF}(t4)	Acceptable	Acceptable	Acceptable	Acceptable
BA, BB or BC	C_{ROOF}(t4)	Not acceptable	Acceptable	Acceptable	Acceptable
CA, CB or CC	D_{ROOF}(t4)	Not acceptable	Acceptable (1)(2)	Acceptable(2)	Acceptable
AD, BD (or CD(2))	E_{ROOF}(t4)	Not acceptable	Acceptable(1)	Acceptable	Acceptable
DA, DB, DC (or DD(2))	F_{ROOF}(t4)	Not acceptable	Not acceptable	Not acceptable	Acceptable(1)

Note (1)*: Acceptable on buildings if part of the roof is no more than 3m^2 in area and is at least 1500mm apart from any other similar section of roof, with roof between the parts covered with a material of limited combustibility*

Note (2): *Not acceptable on any of the following buildings;*

- *Buildings with a volume of more than 1500m^3*

For more information on roof coverings see Clause 35.4 of BS 9999.

8.3 Space Separation between Neighbouring Buildings

To prevent the risk of external fire spread to and from buildings opposite, the amount of unprotected area that is allowed on an elevation should be limited or the separating distance increased such that the risk is reduced. It is necessary to calculate the amount of unprotected area that is allowed on the building's façade using the enclosing rectangle method from BR 187 (Second Edition) as suggested in Clause 35 of BS 9999.

For each elevation of each boundary, the relevant boundary is greater than 1m from the elevation, refer to general Fire Strategy report covering the whole site. It should be noted that relevant boundaries, and hence fire spread, between buildings on the same site have not been considered for life safety purposes on the basis that they are not assembly or residential occupancies and the site will be owned and under the control of the same organisation.

This approach should be agreed with the approval bodies as well as the insurers of the development.

However, to demonstrate the risk of fire spread between buildings on the same site an analysis is presented.

8.3.1 High Voltage Substation Building

Due to the location of the substation in relation to the 66KV transformer the construction of the building provides 120 minutes fire resistance, and any opening including windows and doors should be provided with the same fire resistance.

In the event a fire was to occur within the 11.9kV switch room of the substation, there would be no impact on adjacent buildings.

9 Fire Safety Management

9.1 Management Level

The standard or quality of a fire risk management system is referred to as the management system level within BS 9999: 2017. There are two management system levels that can be adopted in a building, namely Level 1 (enhanced type) and Level 2 (adequate type). Level 1 demonstrates best practice in which the organization's management system is determined to meet a management system standard such as PAS 7. Level 2 demonstrates good practice with a basic level of management that satisfies the minimum requirements of legislation (i.e. RRFSO: 2005). This represents the default standard that is to be taken into account when designing a building.

In consideration that no information have been provided in relation to the adoption of an enhanced management system the assumption made in this report is that a Level 2 management system will be adopted.

9.2 Management Requirements

Effective arrangements should be put in place to manage all aspects of fire safety in the premises and the details of those arrangements need to be recorded, e.g. within a fire safety management plan. The arrangements should include the following key areas:

- Development of a suitable emergency procedure;
- Staff training plan and appropriate staffing levels for the occupancy;
- Maintenance contracts for essential fire safety systems and equipment;
- Schedule of in-house checks and tests;
- Display of appropriate fire safety notices and signs;
- Communications arrangements;
- Liaison with the fire service;
- Fire prevention, including control of works on site (e.g. hot work permits);
- Contingency plans;
- Policy for provision and use of portable fire extinguishers;
- Preparation of personal emergency evacuation plans (PEEPs) for staff, occupants and visitors as necessary. To ensure an appropriately resourced response, tailored to the individual needs of the disabled person and the specific features of the building. This plan will also need to consider the evacuation of disabled visitors.
    - Individual PEEP for disabled people who are regularly in the premises – Following discussions with the individual, a plan can be developed for their specific needs which should contain details of how they will evacuate the premises.
    - PEEPs for visitors to the premises who will make themselves known to staff – visitors who are likely to require assistance in the event of an evacuation should be encouraged to make themselves known to staff.
    - The plan should ensure that reliance is not placed upon the fire service for the evacuation of disabled and wheelchair bound occupants.

***Note**: The above list is not intended to be exhaustive, only to highlight some key areas*

9.3 Fire Safety Manual

A Fire Safety Manual should be created to contain design information and operational records. The design information forms the basis of an ongoing history document to which additional material is added when the building is occupied and at regular intervals thereafter. The fire safety manual should;

- Provide a full description of the assumptions and philosophies that led to the fire safety design, including explicit assumption regarding the management of the building, housekeeping and other management functions;

- Provide the nature of the fire safety planning, construction and systems designed into the building, and their relationship to overall safety and evacuation management;
- Provide documentation produced at the design stage to describe the use of the various protection systems in each type of incident, and the responsibilities of the staff;

Provide a continuously updated record of all aspects of the building and the building users that affect its fire safety.

10 Specific Requirements for the Facility

10.1 Oil-Insulated Transformer Installed Outdoors

Combustible material, combustible buildings, and parts of buildings, fire escapes, and door and window openings shall be safeguarded from fires originating in oil-insulated transformers installed on roofs, attached to or adjacent to a building or combustible material. In cases where the transformer installation presents a fire hazard, one or more of the following safeguards shall be applied according to the degree of hazard involved:

- Space separations
- Fire-resistant barriers
- Automatic fire suppression systems
- Enclosures that confine the oil of a ruptured transformer tank.

The Facility contains two 66 kV oil-insulated grid transformers each with an internal oil capacity weight of 24,000kg, an indicative weight of mineral oil based transformer oil is 0.864kg/L (National Institute of Standards and Technology) therefore providing an approximate volume of 20,736 litres, which has a flash point of 140°C (Class IIIA/Class O combustible liquid).

The height of the transformer to the top of the oil reservoir is approximately 5.6m and located 9.7m from the Substation control building.

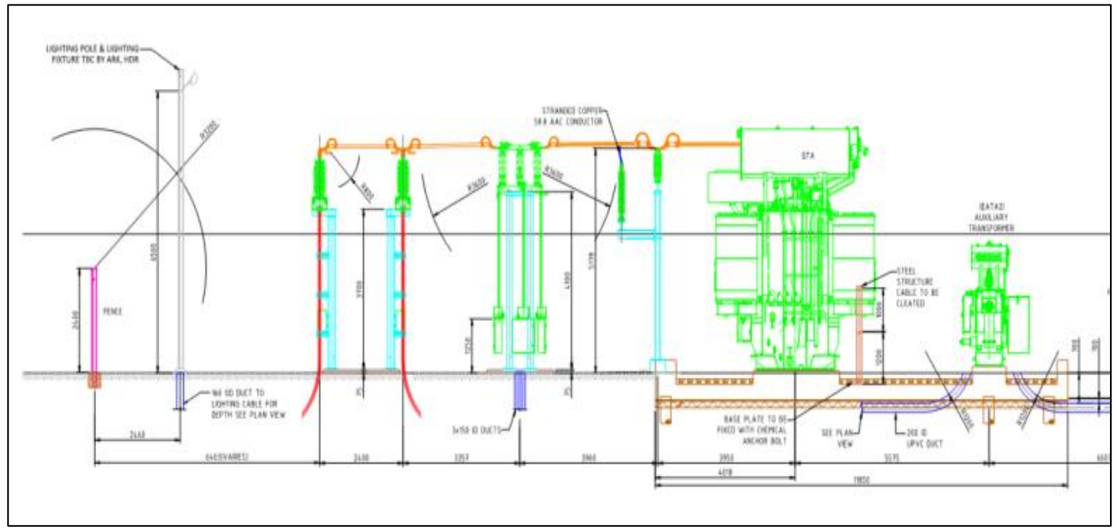

Figure 2 - Outline drawing of transformer and Auxiliary Transformer

The outdoor oil-insulated transformers will be separated from adjacent structures and from each other by firewalls, spatial separation, and provided with an enclosure that confines the oil of a ruptured transformer tank for the purpose of limiting the damage and potential spread of fire from a transformer failure.

10.2 Space Separation

The layout of an outdoor installation shall be such that burning of a transformer with a liquid volume of more than 1,000 litres will not cause a fire hazard to other transformers or objects, with the exception of those directly associated with the transformer. For this purpose, adequate clearances, G, shall be necessary.

Guide values are given in Table 3 of BS EN 61936-1 shown below:

Table 15: Minimum separation distance required for outdoor transformers (from Table 3, BS EN 61936-1)

Transformer Type	Liquid Volume (litres)	Clearance to	
		Other transformers or non-combustible building surfaces m)	Combustible building surfaces (m)
Oil Insulated transformers (O)	20,000≤ … < 45,000	10	20

Note: If automatically activated fire extinguishing equipment is installed, the clearance G can be reduced.

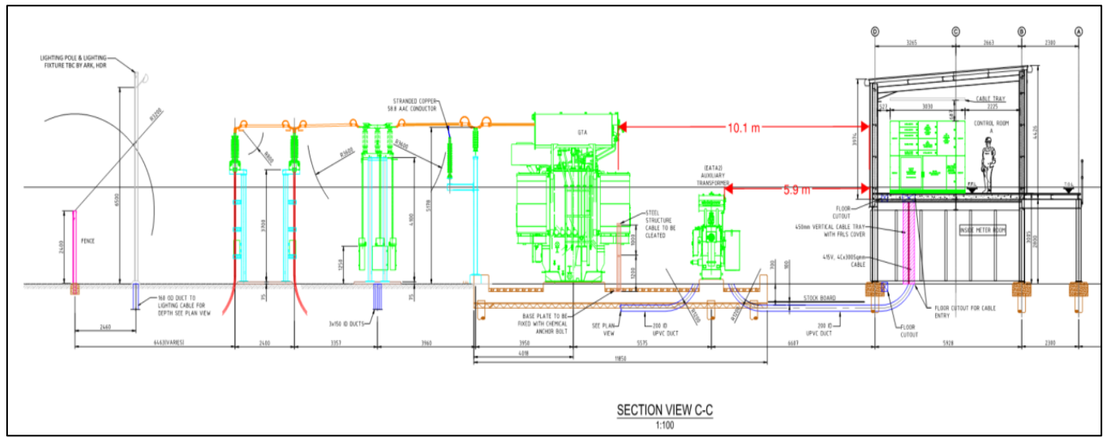

Figure 3 - Distance from Transformer to Substation Control Building

The Substation control building is provided with 120 minutes fire resistance and meets the requirements of Table 23.

10.2.1 Fire Resistance Barrier (Fire Wall)

In accordance with clause 8.7.2.1 of BS EN 61936-1 this can be achieved by providing the 120 minutes fire rated wall between the transformer and the Substation control room (see figures 11 and 12).

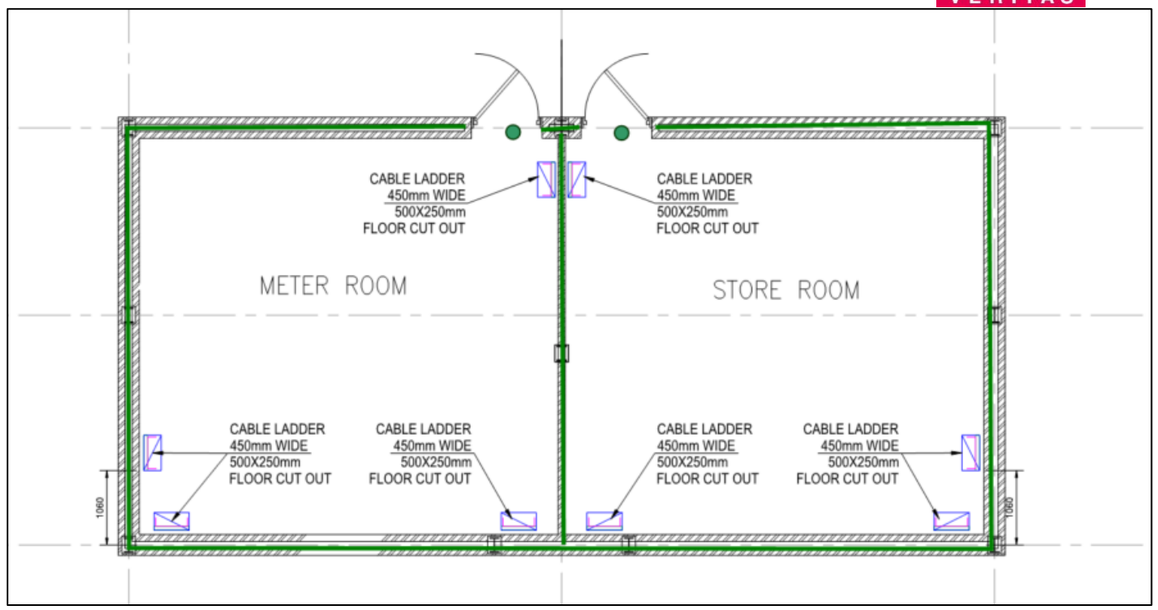

Figure 4 - Plan Drawing of fire resistance HV Substation Ground Floor

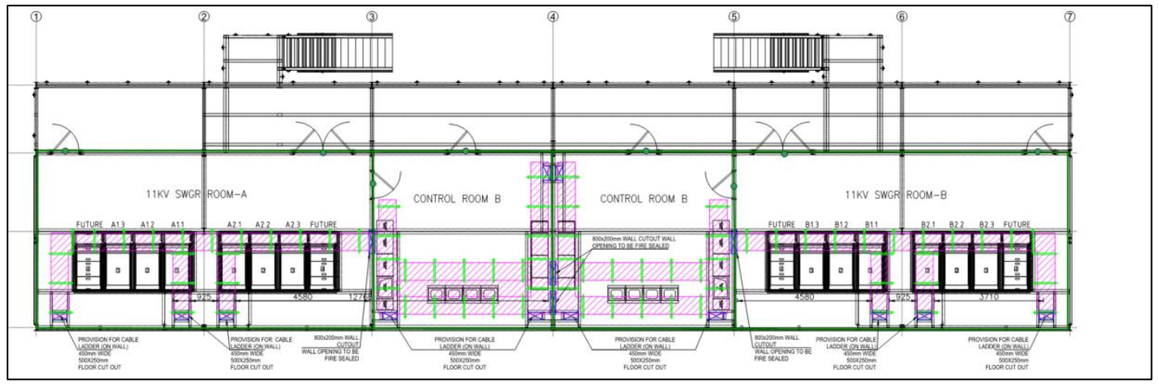

Figure 5 - Plan Drawing of fire resistance HV Substation First Floor

10.2.2 Separating Transformers

To limit the potential spread of a fire from one of the two transformers to the other separation of approximately 20 m is provided from centre point to centre point of the transformers, this is in compliance with Table 23.

10.3 Enclosures that confine the oil of a ruptured transformer tank

The containment area will need to be designed to accommodate the maximum spill from a ruptured transformer tank of 20,736 litres and should also factor in the water from rain for the protection of the environment and prevent the spread of the pool fire if ignited.

BS EN 61936-1 design for containments and holding tanks for the site is a sump with integrated catchment tank for the entire quantity of fluid (Figure 13);

Crushed stone layers, fire protection gratings or pipes filled with fluid can be used to segregate the containment area, sizing of the pit should allow for the volume of the stones and the design should address the possible accumulation of sediment or fines in the stones.

This is provided by 350mm infill of stone in the 750mm deep bund (400mm free space). The size of the plinth should provide 2% additional spare capacity after the stone infill.

The walls and the associated piping of the sump and catchment tank shall be impermeable to liquid.

A facility to drain or draw off any build-up of water should be incorporated into the design, to ensure that the capacity of the sump/catchment tank not unduly reduced by water flowing in.

It is recommended that a simple device indicating the level of liquid in the sump/catchment tank is built into the design.

The length and width of the sump shall be equal to the length and width of the transformer plus 20% of the distance between the highest point of the transformer and the upper level of the containment on each side.

The sump capacity for each transformers should be calculated to ensure that a minimum of 110% can be achieved.

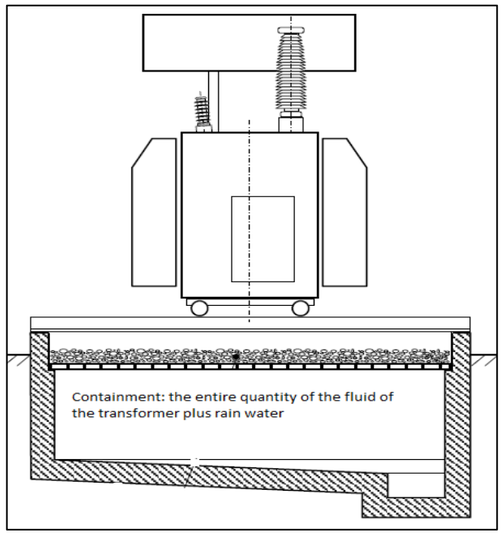

Figure 13: Sump with integrated catchment tank