Fire Safety Strategy Report
For
Project Union

Reference: S20041499

Issue No: RIBA STAGE 3 – Issue 05

Revision History

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Reason for Revision: Draft Issue for comment and design development			
Prepared by:	**Reviewed by:**	**Approved by:**	**Contact:**
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Issue No: RIBA Stage 3 - Issue 02 / Option F			**Issue Date: 28/05/2021**
Reason for Revision: Draft Issue for comment and design development following new drawings for the Data Centre			
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Issue No: RIBA Stage 3 - Issue 03 / Option F & Plasma			**Issue Date: 23/11/2021**
Reason for Revision: Draft Issue for comment and design development following new PLASMA design drawings for the Block 1 of Data Centre and EC1			
Prepared by:	**Reviewed by:**	**Approved by:**	**Contact:**
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Reason for Revision: Draft Issue for comment and design development following new HV Substation, EC 1 load bank, CFD analysis, fire resistance for rating for structure and dampers.			
Prepared by:	**Reviewed by:**	**Approved by:**	**Contact:**
Stephen Brown Senior Fire Engineer	Tim Liu Principal Fire Engineer	Tim Liu Principal Fire Engineer	Manchester Office T: 44(0)161 446 4661
Issue No: RIBA Stage 3 - Issue 05			**Issue Date: 02/12/2022**
Reason for Revision: Update following new Tenancy Split Strategy in UP1, UP2 and UP3.			
Prepared by:	**Reviewed by:**	**Approved by:**	**Contact:**
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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.

Table of Contents

1 Executive Summary

1.1 Design Philosophy

Bureau Veritas has been appointed to prepare a fire safety strategy for the Project Union development which covers the Data Centre (UP1, UP2 and UP3), Energy Centre 1, Energy Centre 2, Energy Centre 3, High Voltage (HV) substation and the Visitor Reception Centre.

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:

- The fire strategy has been developed on the basis of the guidance of BS 9999 assuming:
    - An A2/A3 (depending on area) risk profile for the Data Centre, HV substation, and the Energy Centres.
    - An A2 risk profile for the Visitor Reception Centre.
- The building heights (see section 2.4) are:
    - Data Centre = 19.7m.
    - Energy Centre 1 = 15.5m.
    - Energy Centre 2 = 10.0m.
    - Energy Centre 3 = 10.0m.
    - HV substation = 3.0m.
    - Visitor Reception Centre 1 = 3.2m
    - Visitor Reception Centre 2 = 0m (single storey).
- The evacuation strategy for each building will be simultaneous evacuation (see section 5.1).
- Each of the buildings will be protected by a minimum of a Category L2 automatic fire alarm and detection system (see section 5.3).
- The Data Centre, MV Energy Centre 1, MV Energy Centre 2 and MV Energy Centre 3 will be provided with a combination of suppression systems (see section 5.3) including:
    - Gaseous suppression
    - Watermist systems
    - Sprinkler systems
- Extended travel distances (see section 5.4)
- Ventilation systems to protect firefighting access corridors (see section 6) including extended access corridor. Note CFD modelling will be required to demonstrate performance of mechanical systems at RIBA Stage 4.
- Fire curtains will be provided to protect firefighting access corridor (see section 6).
- The buildings will be provided with the following levels of structural fire resistance (see section 7):
    - Data Centre = 90mins.
    - MV Energy Centres 1 = 90 mins
    - MV Energy Centres 2 and 3 = 60mins.
    - HV substation = 120 mins
    - Visitor Reception Centre = 30mins.
- The external envelopes of the buildings should meet the external fire spread requirements in section 8.
- Fire service access to the Visitor Reception Centre will be by way of perimeter access (see section 6).
- The Data Centre will be provided with 5 firefighting shafts (see section 6) incorporating dry risers and firefighting lifts. Additional riser outlets will be provided at each above ground level of the Data Centre within protected (and ventilated) corridors to reduce house laying distances to areas of the external cooling decks/gantry (see section 6).
- MV Energy Centre 1 will be provided with 2 stairs of which only the main central open stair will also serve as firefighting access incorporating open firefighting stair with firefighting mains.
- In MV Energy Centre 1, the load bearing elements of the external steel structures at the gantries have been agreed by the approving authorities to have a minimum fire resistance of 15 minutes.
- MV Energy Centre 2 will be provided with 2 stairs of which one will also serve as part of a firefighting shaft incorporating firefighting stair and lobby with firefighting mains.
- MV Energy Centre 3 will be provided with 2 stairs of which one will also serve as part of a firefighting shaft incorporating firefighting stair and lobby with firefighting mains.
- The HV substation building consist of a ground and first floor, with a fault on the ground and the control room and 11KV switch room. The building is divided into two compartments which provide independent access to each compartment. The construction of the walls is built to 120 minutes fire resistance and are blast resistance. Adequate means of escape for the control room and switch room are adequate and there is suitable access for the fire service.

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 Building Regulations, in order to achieve statutory approval under 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	NWA	NWA-0471-SW-ZZ-DR-A-A85-000SP	P01
EC1 Floor Plans	NWA	NWA-0571-EC1ZZ-DR-A-03-005P	P03
EC1 Building Elevations	NWA	NWA-0571-EC1ZZ-DR-A-03-700P	P03
20 – GENERAL ARRANGEMNT EC2 GA Floor Plans	NWA	NWA-0473-EC2ZZ-DR-A-A20005SP	
20 – GENERAL ARRANGEMNT EC2 GA Floor Plans	NWA	NWA-0473-EC2ZZ-DR-A-A20006SP	
20 – GENERAL ARRANGEMNT EC2 GA Floor Plans	NWA	NWA-0473-EC2ZZ-DR-A-A20007SP	
EC2 Building Elevations	NWA	NWA-0571-EC2ZZ-DR-A-03-700P	03
EC2 Building Sections	NWA	NWA-0571-EC2ZZ-DR-A-03-800P	03
20 – GENERAL ARRANGMENT EC3 GA Floor Plans	NWA	NWA-0473-EC3ZZ-DR-A-A20005SP	P02
20 – GENERAL ARRANGMENT EC3 GA Floor Plans	NWA	NWA-0473-EC3ZZ-DR-A-A20006SP	P02
20 – GENERAL ARRANGMENT EC3 GA Floor Plans	NWA	NWA-0473-EC3ZZ-DR-A-A20007SP	P02
EC3 Building Elevations	NWA	NWA-0571-EC3ZZ-DR-A-03-700P	01
EC3 Building Sections	NWA	NWA-0571-EC3ZZ-DR-A-03-800P	01
VR1 Floor Plans Building Sections Elevations and Top View	NWA	NWA-0571-VR1ZZ-DR-A-03-005P	02
VR2 Floor Plans, Building Sections, Elevations & Top View	NWA	NWA-0571-VR2ZZ-DR-A-03-005P	P01
A04 – FIRE STRATEGY B1 Ground Floor Plan	NWA	NWA-0471-UP1-00-DR-A-A04000SP	P03
A04 – FIRE STRATEGY B1 First Floor Plan	NWA	NWA-0471-UP1-01-DR-A-A04010SP	P03
A04 – FIRE STRATEGY B1 Second Floor Plan	NWA	NWA-0471-UP1-02-DR-A-A04020SP	P03
A04 – FIRE STRATEGY B1 Third Floor Plan	NWA	NWA-0471-UP1-03-DR-A-A04030SP	P03
A04 – FIRE STRATEGY B1 Fourth Floor Plan	NWA	NWA-0471-UP1-04-DR-A-A04040SP	P02
A20 – GENERAL ARRANGEMENT B2 Ground Floor Plan	NWA	NWA-0472-UP2-00-DR-A-A02000SP	P01
A20 – GENERAL ARRANGEMENT B2 First Floor Plan	NWA	NWA-0472-UP2-01-DR-A-A02010SP	P01
A20 – GENERAL ARRANGEMENT B2 Second Floor Plan	NWA	NWA-0472-UP2-02-DR-A-A02020SP	P01
A20 – GENERAL ARRANGEMENT B2 Third Floor Plan	NWA	NWA-0472-UP2-03-DR-A-A02030SP	P01
A20 – GENERAL ARRANGEMENT B2 Fourth Floor Plan	NWA	NWA-0472-UP2-04-DR-A-A02040SP	P01
A20 – GENERAL ARRANGEMENT B3 Ground Floor Plan	NWA	NWA-0473-UP3-00-DR-A-A02000SP	
A20 – GENERAL ARRANGEMENT B3 First Floor Plan	NWA	NWA-0473-UP3-01-DR-A-A02010SP	
A20 – GENERAL ARRANGEMENT B3 Second Floor Plan	NWA	NWA-0473-UP3-02-DR-A-A02020SP	
A20 – GENERAL ARRANGEMENT B3 Third Floor Plan	NWA	NWA-0473-UP3-03-DR-A-A02030SP	
A20 – GENERAL ARRANGEMENT B3 Fourth Floor Plan	NWA	NWA-0473-UP3-04-DR-A-A02040SP	
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 project includes the construction of a large new Data Centre and associated buildings in Hayes, London.

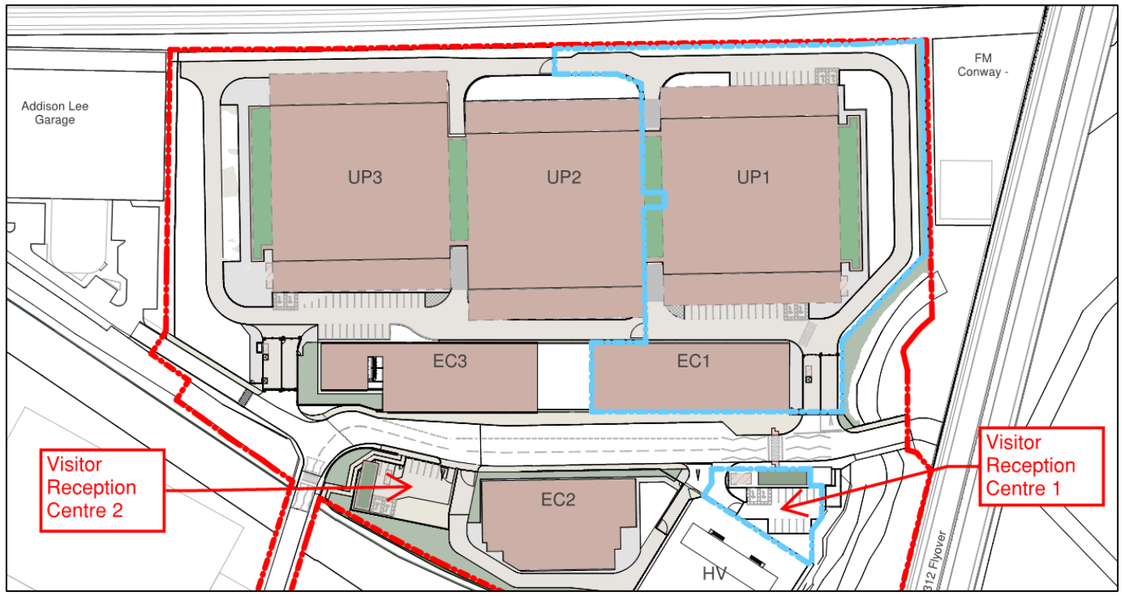

Figure 1 – Site Plan

This document presents the fire safety strategy for the following buildings on the site:

- Data Centre (UP1, UP2 and UP3)
- EC 1 MV Energy Centre
- EC 2 MV Energy Centre
- EC 3 MV Energy Centre
- High Voltage Substation
- Visitor Reception Centre 1
- Visitor Reception Centre 2

The site will be owned by ARK Data Centres who will have over-arching control.

The data centre comprises of three Blocks (UP1, UP2 and UP3 as shown in the figure above). However, UP3 will form one tenancy while UP1 and UP2 will form a different tenancy, thus effectively forming two separate buildings with no direct access available between the two.

Energy Centre 1 will serve UP1 while Energy Centres 2 and 3 will serve UP2 and UP3.

The site will therefore effectively be split into two separate areas based on access for each block.

2.4.1 Data Centre

The Data Centre will comprise of ground and three upper levels. In addition, the roof level will include photovoltaic panels.

The building will be split into three blocks (UP1, UP2 and UP3) and has a total footprint of approximately 11,440m^2 (Note: this excludes the area covered by cooling gantries). The building height (measured from fire service access level to the third floor) is approximately 18.6m.

Notes:

1. *The height of a building (as defined by BS 9999) is the distance of the surface of the highest point of the floor of the highest storey (excluding any such storey consisting exclusively of plant rooms) to the fire and rescue service access level measured at the centre of that face of the building where the distance is greatest.*
2. The height must be confirmed by the design team.

The data centre is provided with five main stairs which will also serve as part of firefighting shafts. Block UP3 will be served by two of the stairs whilst Blocks UP1 and UP2 will be served by the remaining three stairs.

A typical upper floor general layout is provided in the figures below for each block:

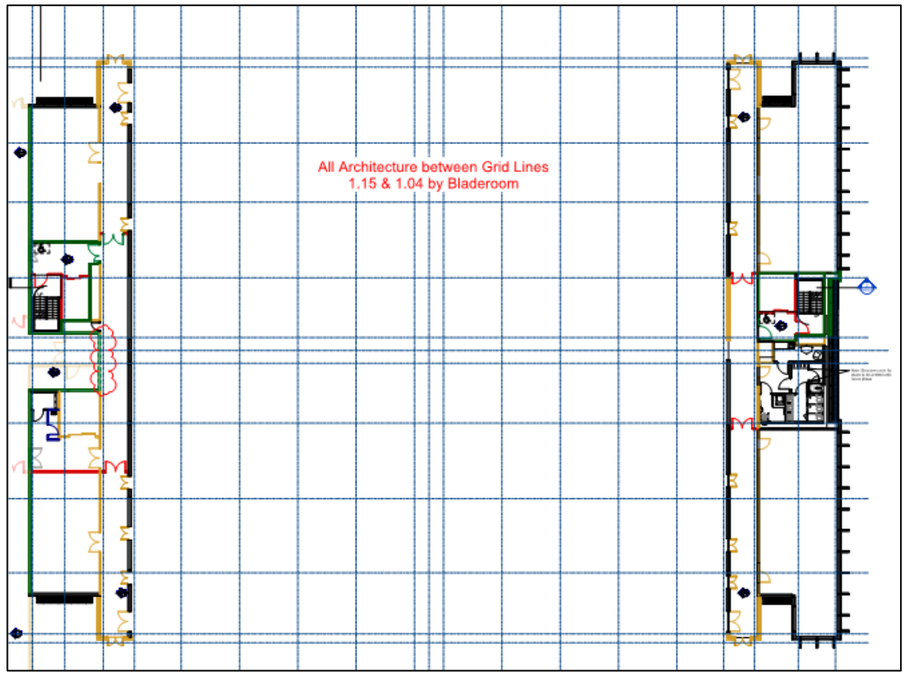

Figure 2 – Typical Upper Floor General Layout – UP1

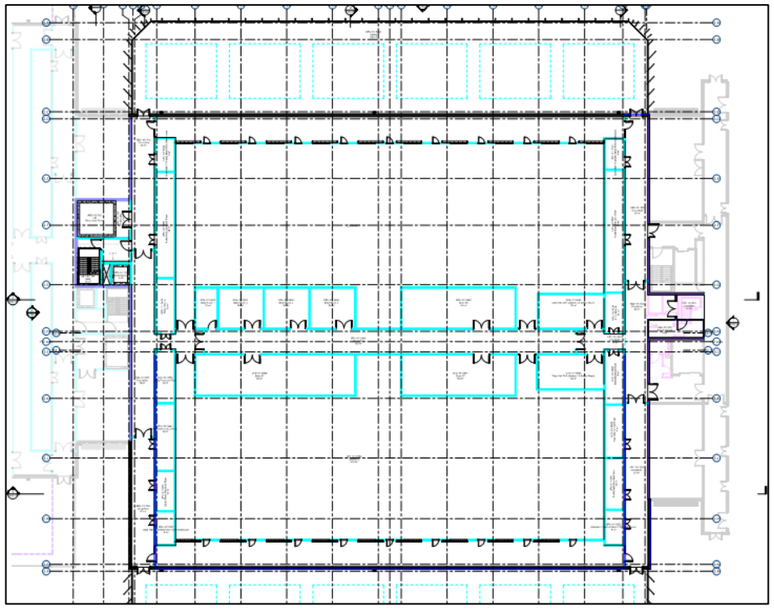

Figure 3 – Typical Upper Floor General Layout – UP2

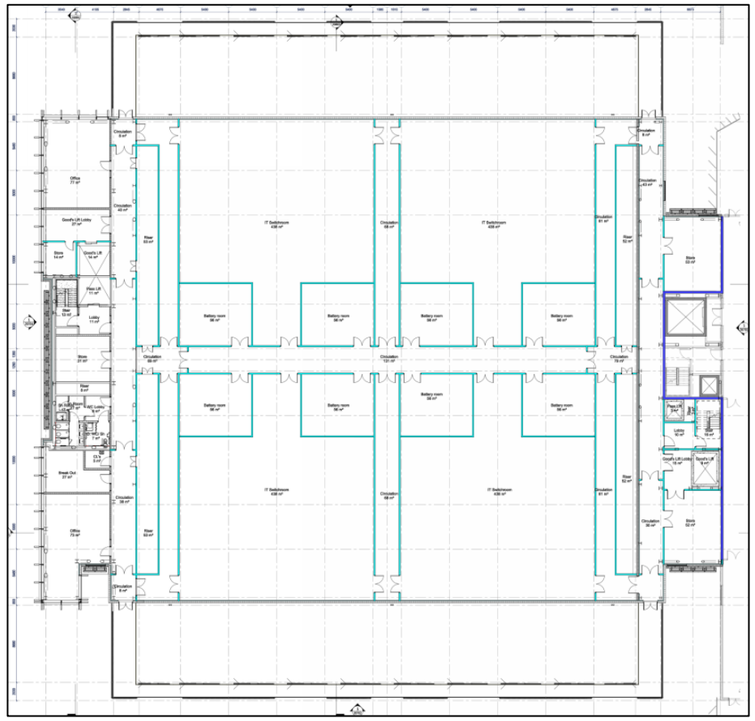

Figure 4 – Typical Upper Floor General Layout – UP3

2.4.2 EC 1 MV Energy Centre

EC 1 MV Energy Centre comprises of a ground floor and three upper levels. The central section comprises an enclosed block of mainly switch rooms at each level with access provided by an open stair. On either side of the central block are large generators units effectively in open air which are located at ground level and Level 2. The generators at Level 2 are accessed either by the central open stair or an additional dedicated open stair from one side of the deck.

Note: The second floor generator deck is effectively open to the ground floor generator deck (i.e. open mesh/grating walkways forming the floor) and does not have any roof above.

The building including the outdoor generator areas has a footprint of approximately 1,650m^2. The building height (measured from fire service access level to Level 3) is approximately 15.5m.

The building will be provided with two open stairs of which the central one will also serve as access for firefighting.

General layouts for each of the levels are provided in the figures below:

Figure 5 – EC 1 MV Energy Centre – Ground Level Deck

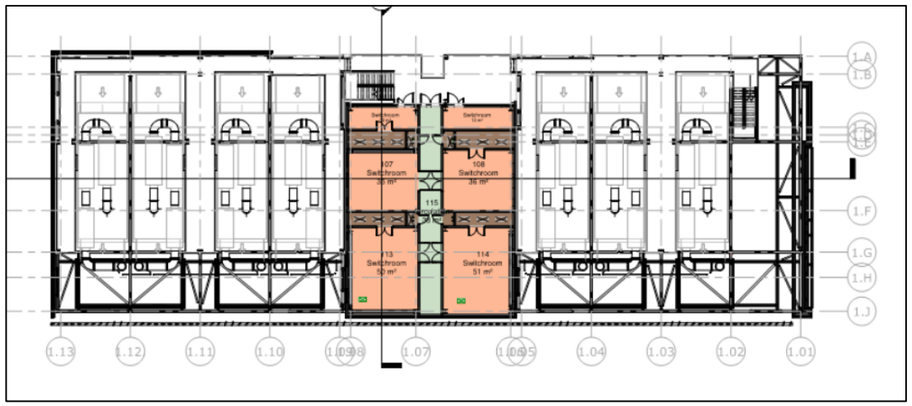

Figure 6 – EC 1 MV Energy Centre – First Level Deck

Figure 7 – EC 1 MV Energy Centre – Second Level Deck

Figure 8 – MV EC 1 Energy Centre – Third Level Deck

2.4.3 EC 2 MV Energy Centre

EC 2 MV Energy Centre comprises of a ground floor and three upper levels. The building comprises of an open-air gantry structure which will house large generators units which are located at ground and Level 2. There will be two enclosed blocks containing mainly switch rooms at each level.

Note: The second floor generator deck is effectively open to the ground floor generator deck level (i.e. open mesh/grating walkways forming the floor) and does not have any roof above.

The building has a footprint of approximately 1,500m^2. The building height (measured from fire service access level to the second floor) is approximately 15.5m. The building will be provided with two open stairs, one of which will also serve as access for firefighting.

General layouts for each of the levels are provided in the figures below:

Figure 9 – EC 2 MV Energy Centre– Ground Floor

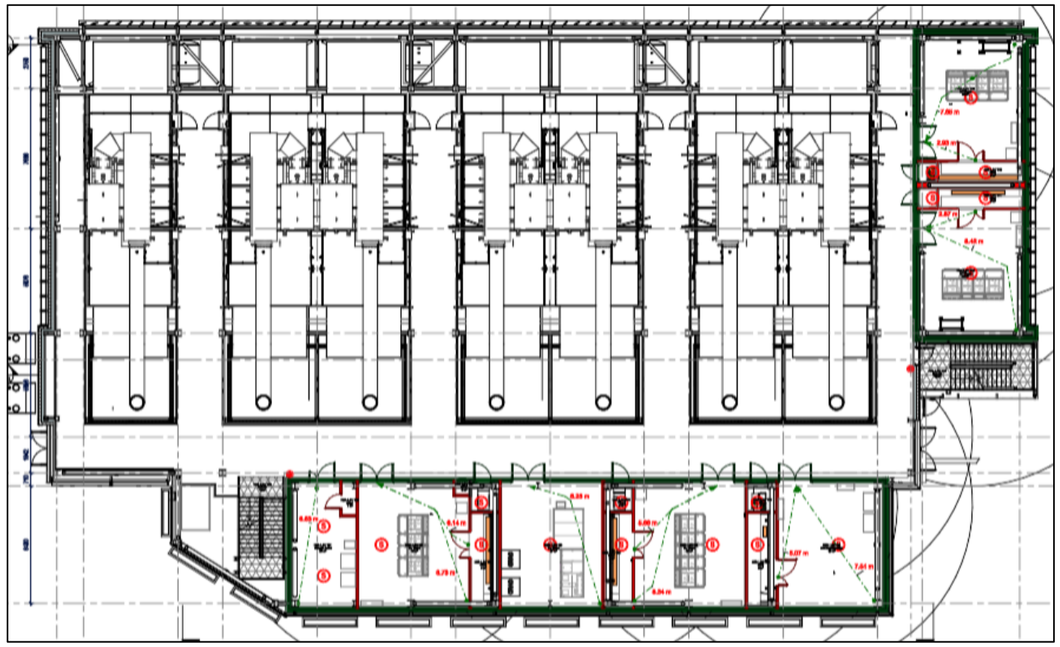

Figure 10 –EC 2 MV Energy Centre – First Floor

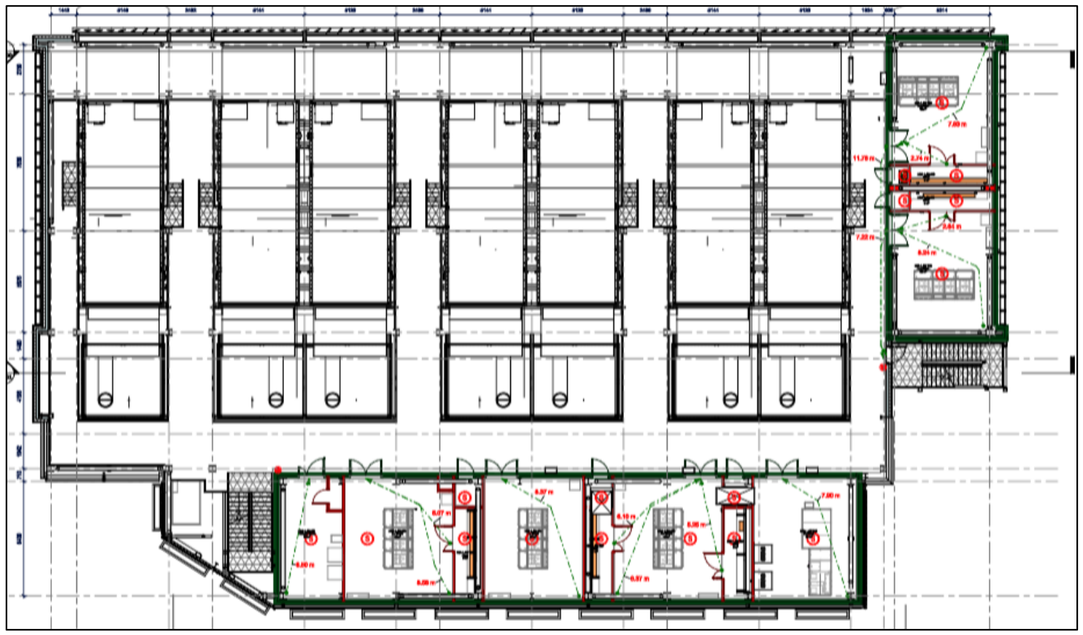

Figure 11 – EC 2 MV Energy Centre – Second Floor

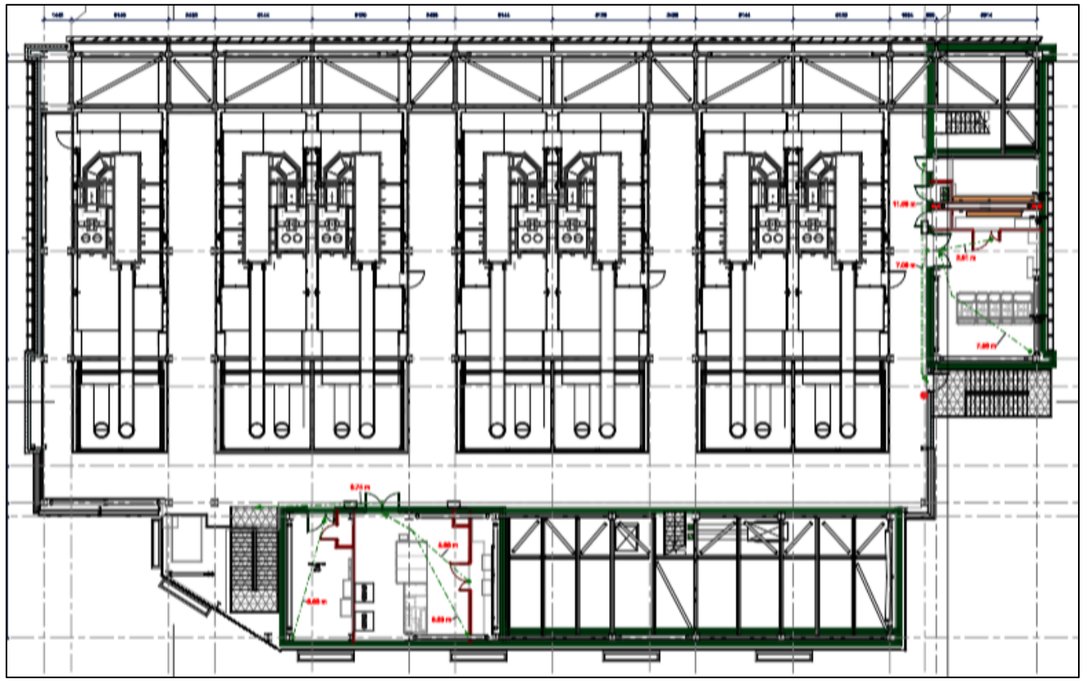

Figure 12 – EC 2 MV Energy Centre – Third Floor

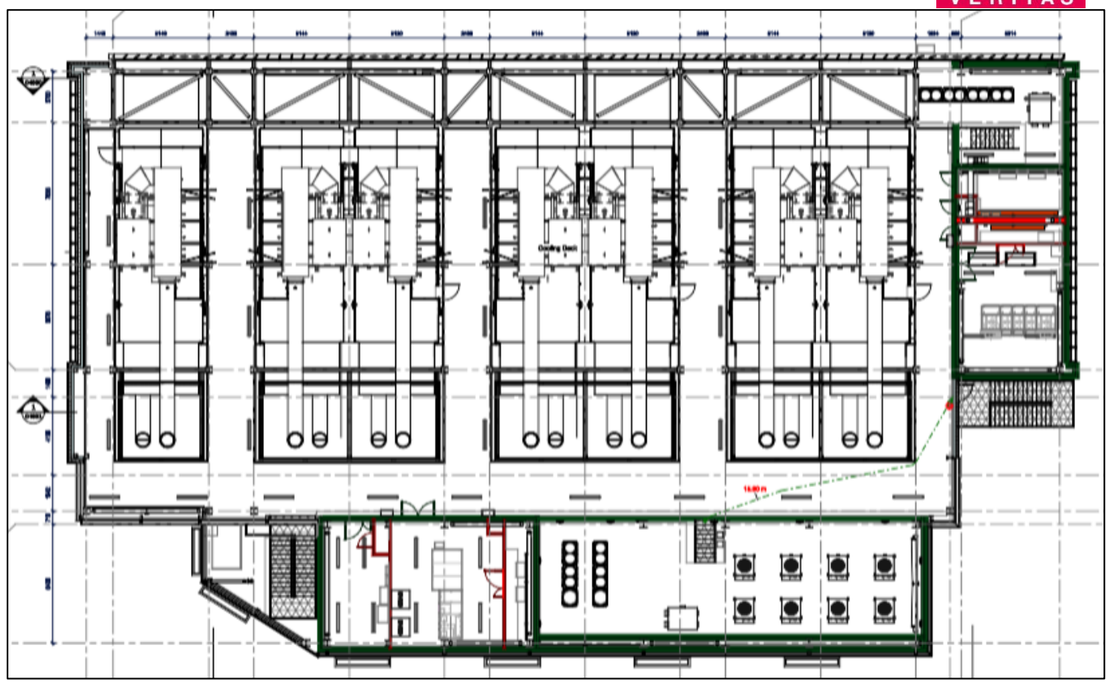

Figure 13 – EC 2 MV Energy Centre – Cooling Deck

2.4.4 EC 3 MV Energy Centre

EC 3 MV Energy Centre comprises of a ground level and three upper levels. The building comprises of an open-air gantry structure which will house large generators units which are located at ground level and Level 2. In the central section of the gantry, there will be an enclosed block of mainly switch rooms at each level.

Note: The second floor generator deck is effectively open to the ground floor generator deck level (i.e. open mesh/grating walkways forming the floor) and does not have any roof above.

The building has a footprint of approximately 1,600m^2. The building height (measured from fire service access level to the second floor) will be approximately 15.5m. The building will be provided with two open stairs, one of which will also serve as access for firefighting.

General layouts for each of the levels are provided in the figures below:

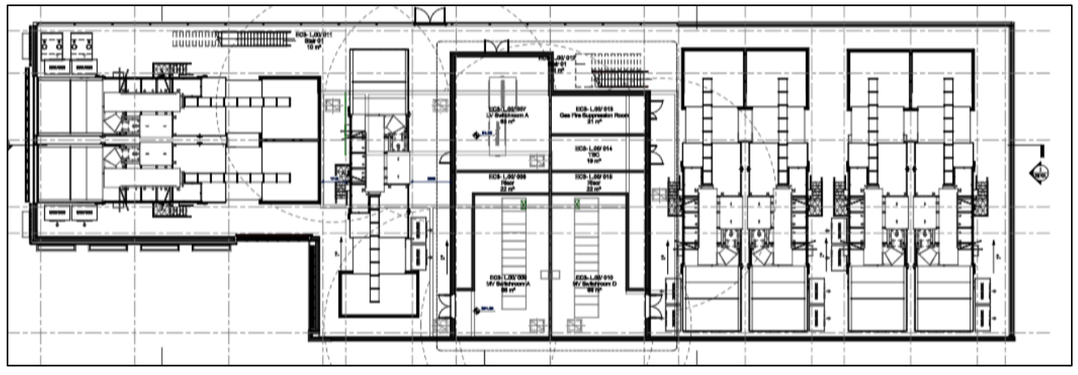

Figure 14 – EC 3 MV Energy Centre – Ground Level

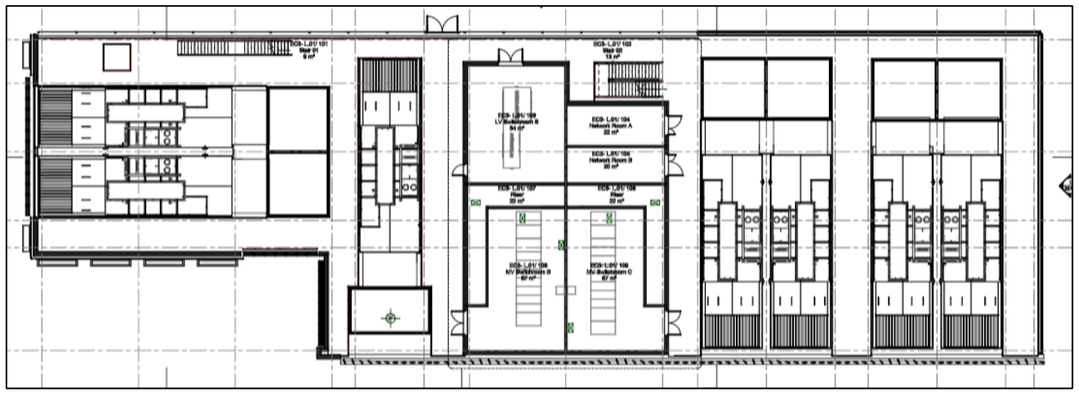

Figure 15 – EC 3 MV Energy Centre – First Level

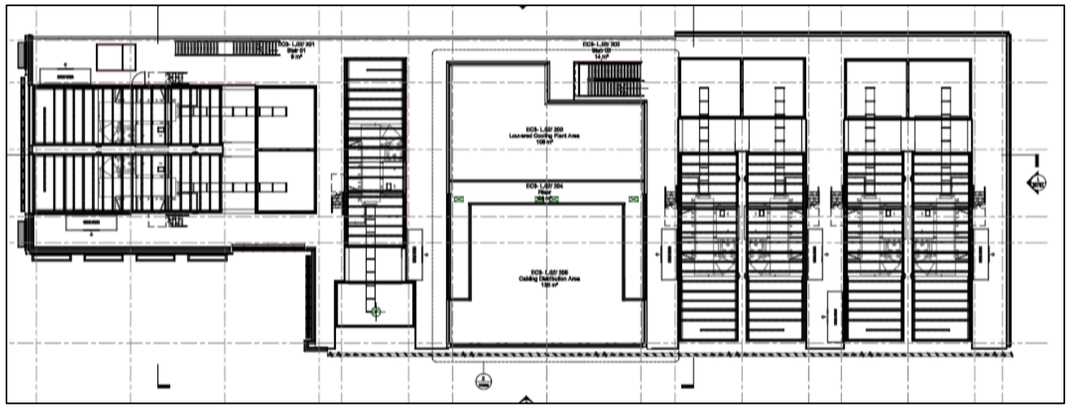

Figure 16 – EC 3 MV Energy Centre – Second Level

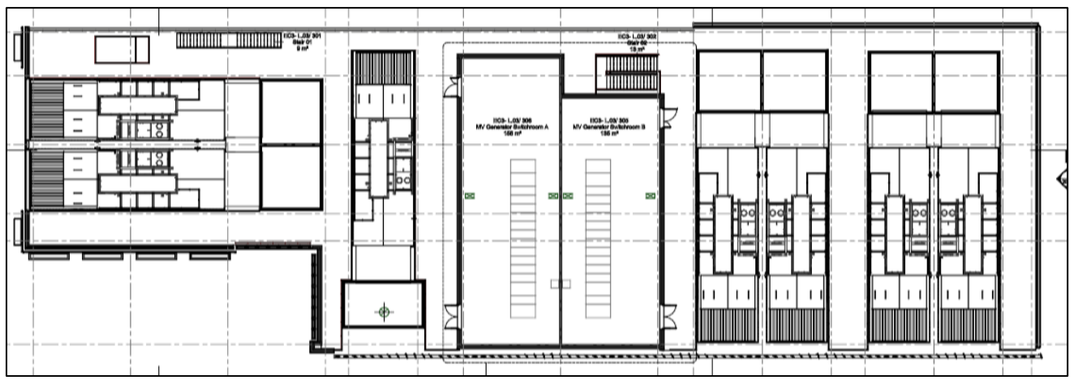

Figure 17 – EC 3 MV Energy Centre – Third Level

2.4.5 Energy Centres – Cable Chambers

All the cable chambers located within the Energy centres below ground level should be considered as confined spaces/permit to work areas and meet HSE requirements via building management processes. Escape from these areas will be provided via several hatches. It is noted these areas will mainly be accessed for maintenance purposes and that the floor separating them from Ground floor is an open mesh grill. This would allow firefighters to fight an eventual fire at basement from ground floor.

The design of these areas is subject to review and sign off of the HSE Officer.

2.4.6 High Voltage Substation and Control Building

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 of the building. The building is raised due to the cable intake and the HV substation and is positioned to the South of North Hyde Gardens Road next to the Visitor Reception Centre.

The control room and switch room buildings will be constructed to 120 minutes fire resistance and provided with compartmentation to separate the control rooms. The construction will provide a blast proof structure in the event of an explosion from the 66kV transformer, in accordance with BS EN 61936-1.

The means of escape within the substation building are adequate as the control room and switch room have independent access and there are two external stairs serving the first floor. Penetrations through the compartment walls and floors will be fire stopped where any services pass through, and the external doors should be fire rated to protect escapees along their escape route.

Oil-Insulated transformer details can be found in Section 10 of this report.

A general layout of the substation is detailed below:

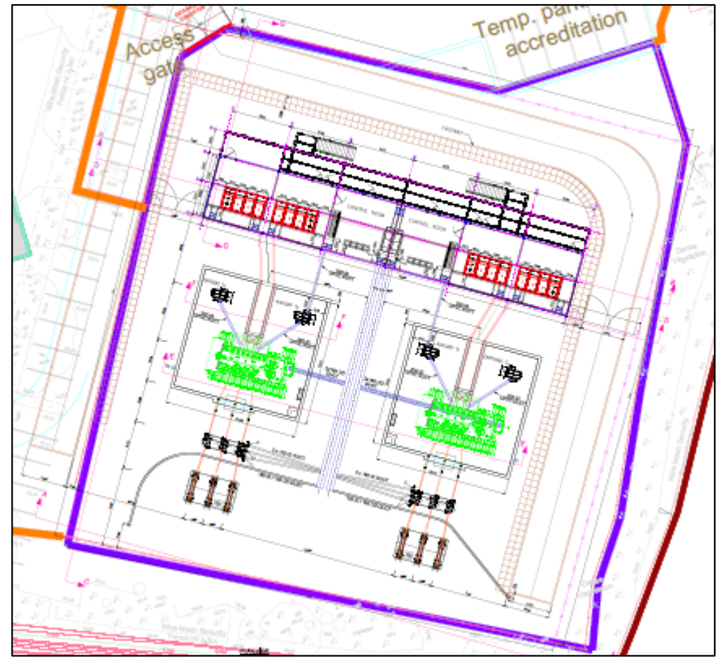

Figure 18 – High Voltage Substation

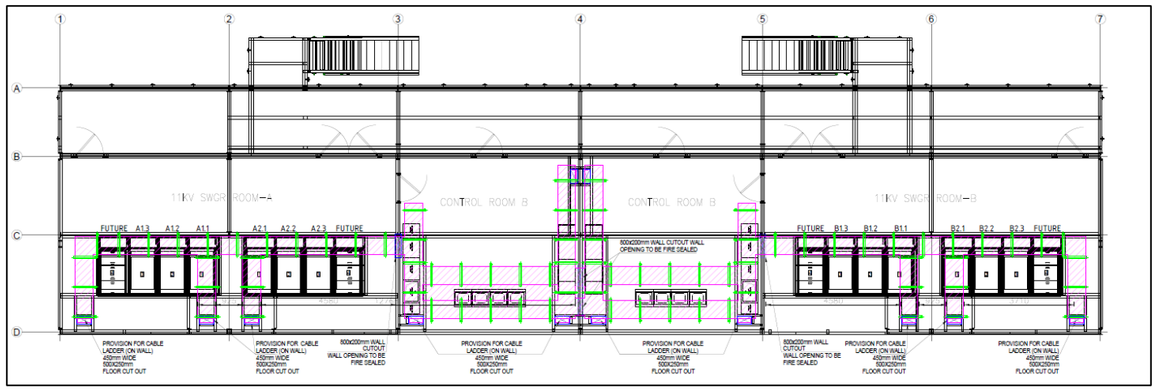

Figure 19 – Substation Floor Plan

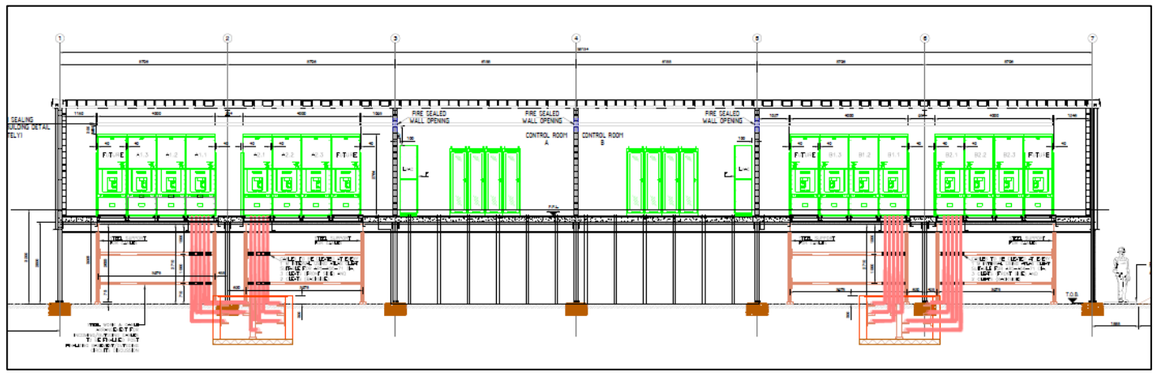

Figure 20 – Substation Section

2.4.7 Visitor Reception Centre 1

The Visitor Reception Centre 1 is a small two-storey building (Ground and first floor). Accommodation includes induction room, tea point and security office at ground floor, and control room security room and an Individual Distribution Frame room at the first floor.

The building has a footprint area of approximately 97m^2.

A general layout is provided in the figures below:

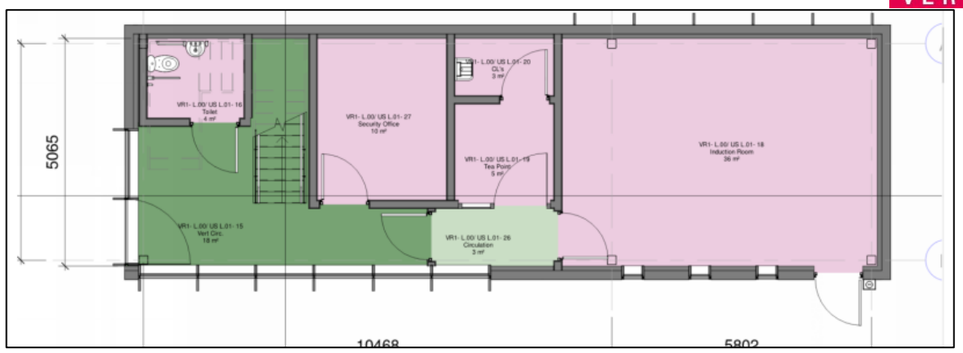

Figure 21 – Visitor Reception Centre 1 – Ground Floor

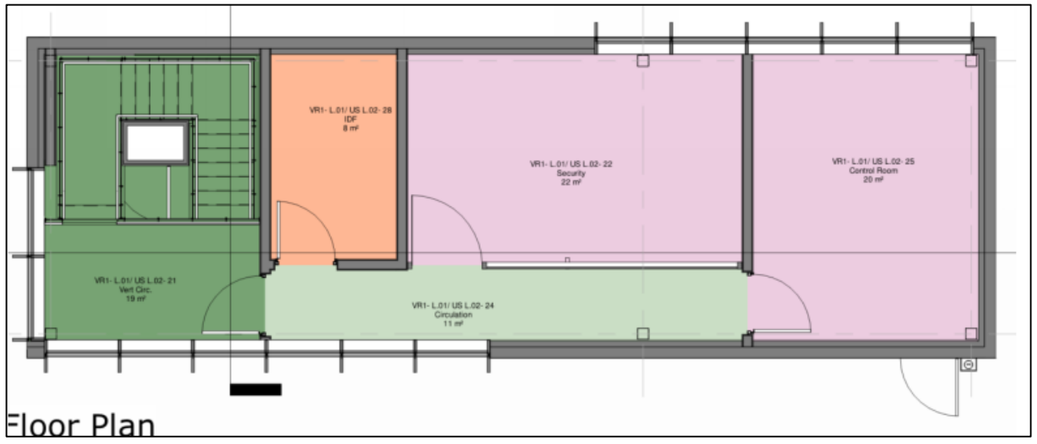

Figure 22 – Visitor Reception Centre 1 – First Floor

2.4.8 Visitor Reception Centre 2

The Visitor Reception Centre 2 is a small single storey building. Accommodation includes a main lobby, a control room and tea point.

The building has a footprint area of approximately 97m^2. A general layout is provided in the figure below:

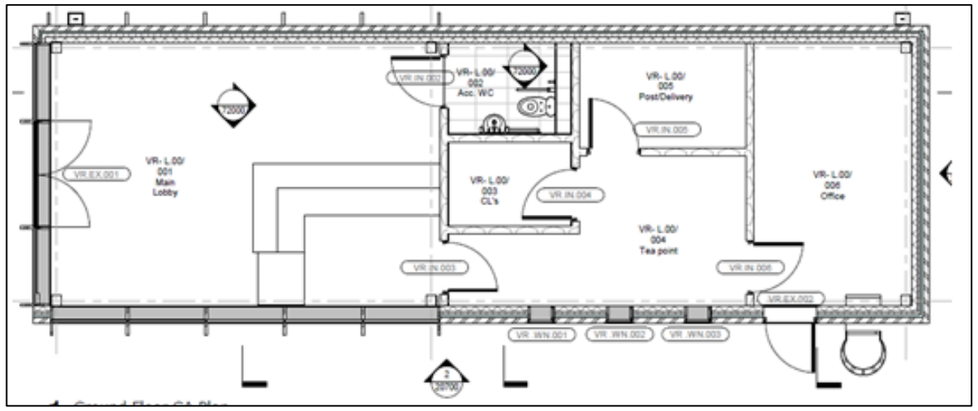

Figure 23 – Visitor Reception Centre 2

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:

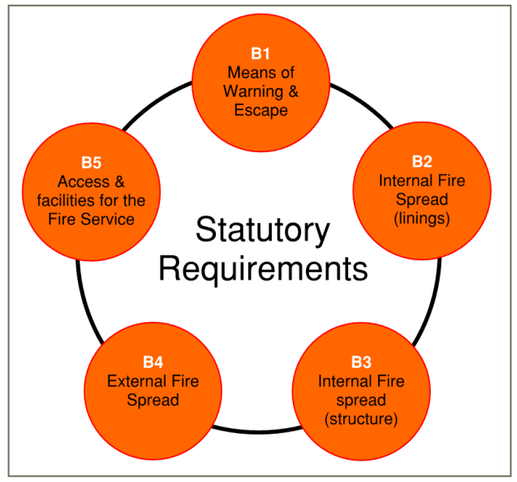

Figure 24 - Part B of The Building Regulations

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 throughout each of the buildings on the basis that all occupants should be awake and familiar with the premises. Any visitors to the Visitor Reception Centres, Data Centre and Energy Centres should be accompanied by a member of staff.

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.

4.2.1 Data Centre, MV Energy Centres and High Voltage Substation

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 buildings, which are classified as special fire hazard areas (such as Transformers and High Voltage Switch Rooms), could have an ultrafast fire growth rate (4) due to the increased fire risk.

In addition, it is understood that the data halls within Block UP1 and UP2, as part of the Plasma design, will utilise server racks that will include in-rack Battery Backup Units (BBUs). Each rack will contain 12 BBUs (six on a row towards the bottom and six on a row towards the top of the rack separated only by 0.8m) and each BBU will comprise 84 lithium cells. Each data hall will contain 378 racks and therefore there will be in the region of 4536 BBU's (381,024 Lithium Cells). The inclusion of the large number of lithium cells is considered to increase the potential fire growth from fast (3) to ultrafast (4) in these data halls in Block UP1 and UP2.

NOTE: If data halls in block UP3 are to utilise a similar system, this will impact on the fire strategy for this block as well (Design team to confirm).

In consideration that the Data Centre and MV Energy Centres are proposed to be protected by a combination of sprinklers, water mist and gaseous suppression systems the fire growth rate can be reduced by one level in these areas.

In respect to the High Voltage substation, it is noted that this comprises of two external transformers located approximately 10m away from the substation control building. Therefore, the transformers do not impact the means of escape for the occupants of the substation control building. In addition, it is noted that the control building will be provided with a significant level of compartmentation. Based on these considerations, it is concluded that the risk of rapid uncontrolled fire growth which may pose an unduly onerous risk to life, is considered marginal. Therefore, these will be treated as Fast (3) fire growth areas.

Therefore, taking into account areas protected with suppression systems and the above considerations, estimated fire growth rates are as follow:

- Medium (2) fire growth –Data Centre (except data halls in Blocks UP1 and UP2) and MV Energy Centres.
- Fast (3) fire growth - Data Halls in Blocks UP1 and UP2 (due to Lithium cells) and places of special fire hazard including 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.

4.2.2 Visitor Reception Centres

Generally, the fire load distribution and materials found within the building are associated with a medium (2) fire growth**.**

4.3 Risk Profile

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

- Visitor Reception Centres and main areas of Data Centre (except data halls in Blocks UP1 and UP2) and MV Energy Centres – **A2**
- Data Halls in Block UP1 and UP2 (due to Lithium cells), Special Fire Hazard Areas, Generator Decks, High voltage substation control building – **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 base line 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 A2 Risk Profile	Category M fire alarm	Category L2 automatic fire detection and alarm.	15% increase to travel distance and 15% decrease in door and stair width requirements
Areas with an A3 Risk Profile	Category L2 automatic fire detection and alarm	None	No additional increase in these areas.
Areas with an A2 Risk Profile	Floor-to-ceiling height less than 3m	Floor-to-ceiling height 5m or above but less than 6m	Further 15% increase to travel distance and decrease in door and stair width requirements, in accordance with Table 14 of BS 9999:2017
Areas with an A3 Risk Profile	Floor-to-ceiling height less than 3m	Floor-to-ceiling height 5m or above but less than 6m	Further 15% increase to travel distance and decrease in door and stair width requirements, in accordance with Table 14 of BS 9999:2017
Areas with an A2 Risk Profile	Floor-to-ceiling height less than 3m	Floor-to-ceiling height 4m or above but less than 5m	Further 10% increase to travel distance and decrease in door and stair width requirements, in accordance with Table 14 of BS 9999:2017
Areas with an A3 Risk Profile	Floor-to-ceiling height less than 3m	Floor-to-ceiling height 4m or above but less than 5m	Further 10% increase to travel distance and decrease in door and stair width requirements, in accordance with Table 14 of BS 9999:2017

5 Means of Detection, Warning & Escape

5.1 Evacuation Strategy

The proposed evacuation strategy for each of the buildings is based on a single-stage simultaneous evacuation approach. 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: Block UP3, the energy centres and visitor reception centres will evacuate on their own (independently). Block UP1 and UP2 will both evacuate together as they are being treated as a single building/occupancy.**

5.2 Expected Number of Occupants

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

The occupancy in MV Energy Centre 1, MV Energy Centre 2, MV Energy Centre 3, HV Substation control building and the Visitor Reception Centres will be less than 60 people per building.

The occupancy of the Data Centre is based on the assumption that each of the three blocks will have no more than 60 people per level within the block.

For Blocks 1 and 2 this gives a total occupancy per level of 120 people with a total occupancy for the building across all floors of 480 people. This is considered very conservative for the type/use of the building.

For Block 3 this gives a total occupancy per level of 60 people, with a total occupancy for the building across all floors of 240 people. This is considered very conservative for the type/use of the building.

***Note 1**: The design team should confirm that the occupancies 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 A2 Risk Profile is a Category M system.

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.

However, the installation of a minimum of Category L2 automatic fire detection and alarm system is proposed throughout each of the buildings 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 Automatic Suppression Systems

General

The Data Centre and all Energy Centres will utilise a combination of Sprinklers, Watermist and Gaseous suppression systems.

These systems should be designed and installed as life safety systems. In addition, Section 38 of BS9999, recommends that data processing equipment should be protected in accordance with BS 6266. This should be taken into account in the design of the suppression systems to be installed.

The Sprinkler systems should be designed and installed in accordance with BS EN 12845.

The Watermist systems should be designed and installed in accordance with BS 8489-1. It is understood that Watermist systems will be used within data halls and covering generators within the Energy Centres. **In addition, Watermist systems will be provided within each of cooling units located on the gantries.**

Gaseous suppression systems should be designed and installed in accordance with the relevant British Standard for the type of system selected.

Note: Section 6.5 of BS 9999 states that Watermist may be used as an alternative to a sprinkler system where relevant fire test protocols exist.

The system designers must confirm that their systems are suitable for the proposed applications and provide evidence that appropriate fire test protocols exist. This must take account of the specific risks, layouts (including server racking) and the ventilation/air flows.

It is understood that the rooftop cooling plant in the Energy Centres will not be provided with automatic suppression.

Suppression for in-rack Lithium Ion Battery Back up

As discussed above under risk profiles, it is understood that the data halls within Blocks UP1 and UP2, as part of the Plasma design, will utilise server racks that will include in-rack Battery Backup Units (BBUs).

Each rack contains 12 BBUs (six on a row towards the bottom and six on a row towards the top of the rack) and each BBU comprises 84 lithium cells. Each data hall contains 378 racks and therefore there will be in the region of 4536 BBU's (381,024 Lithium Cells).

The inclusion of a large number of lithium cells is considered to have the potential to lead to an ultrafast (4) fire growth in the data halls in Blocks UP1 and UP2.

Suppression specific to the risk is required to reduce the risk profile from an ultrafast fire growth to a fast fire growth. **The type of suppression to be provided to cover this risk within the server racks is to be confirmed by the design team.**

As with the other suppression systems, the system designer must confirm that their system is suitable for the proposed applications and provide evidence that appropriate fire test protocols exist. This must take account of the specific risks (e.g. lithium cells), layouts (including server racking) and the ventilation/air flows.

NOTE: Appropriate protection against thermal runaway should be provided which may need to include battery monitoring systems linked to a constantly attended location and automatic controls to enable action to reduce the chance of thermal runaway to be implemented (e.g. that disconnects batteries from chargers or rectifiers or switches off chargers or rectifiers). The system will need to be designed by a specialist. No current UK guidance is in place and therefore the use of international standards/guides such as NFPA/FM Global may be considered. The system design proposal is to be fully agreed with Approval Bodies.

Data Centre - Sprinkler pump room

The sprinkler pump room should comply with Clause 8.4 of BS EN 12845:2015+A1:2019 and should be accessed via a protected corridor.

5.3.3 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
B	All escape routes (including external escape routes)
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.

5.3.4 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.
- Sprinkler systems
- Gaseous suppression systems.
- Watermist.
- Firefighting lifts.
- Smoke ventilation 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 2 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.*

The numbers set in Table 2 are the absolute minimum; the actual number of escape routes and exits that will be needed depends on the risk profile, the number of occupants in the room, tier or storey in question, and the limits on travel distance to the nearest storey exit and is likely to be higher than the numbers in the table.

Where alternative escape routes are provided, they should be sited so as to minimize the possibility of all being rendered unavailable at the same time. Alternative escape routes should therefore be separated at the point of divergence by an angle of 45° or more.

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 A2 – 22m and 55m for single and two-way travel respectively.
- 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
Data Centre	A2	4 - 5m 10%	Yes 15%	Actual	26m	68.75m
Data Centre	A2	5 - 6m 15%	Yes 15%	Actual	26m	71.5m
Data Centre	A3	4 - 5m 10%	No	Actual	19.8m	49.5m
Data Centre (Inc. data halls Blocks 1 and 2)	A3	5 - 6m 15%	No	Actual	20.7m	51.75m
Energy Centres (enclosed section)	A2	4m 10%	Yes 15%	Actual	26m	68.7m
Energy Centres Generator Gantries (effectively open air)	A3	NA	NA	Actual	60Note3	200mNote 3
Visitor Reception Centres	A2	No	Yes 15%	Actual	25.3m	NA
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.*

***Note 3:** Level 2 of Energy Centre 2 and the gantry of Energy Centre 1 have been treated similar to a roof arrangement. The two principal elevations are mostly open to outside and the floor/roof above (i.e. chiller level) is an open mesh/grating system.*

There are extended travel distances from the central sections of the cooling gantries at each level of the data centre (up to approximately 87m in some circumstances - see figure below for example). However, this is considered acceptable in these instances as:

- The cooling gantries are effectively in open air;
- Other than short dead ends when accessing cooling plant, travel is available in two directions along the gantries;
- Once off the gantries, travel within the building will be via protected corridors to the protected stairs.

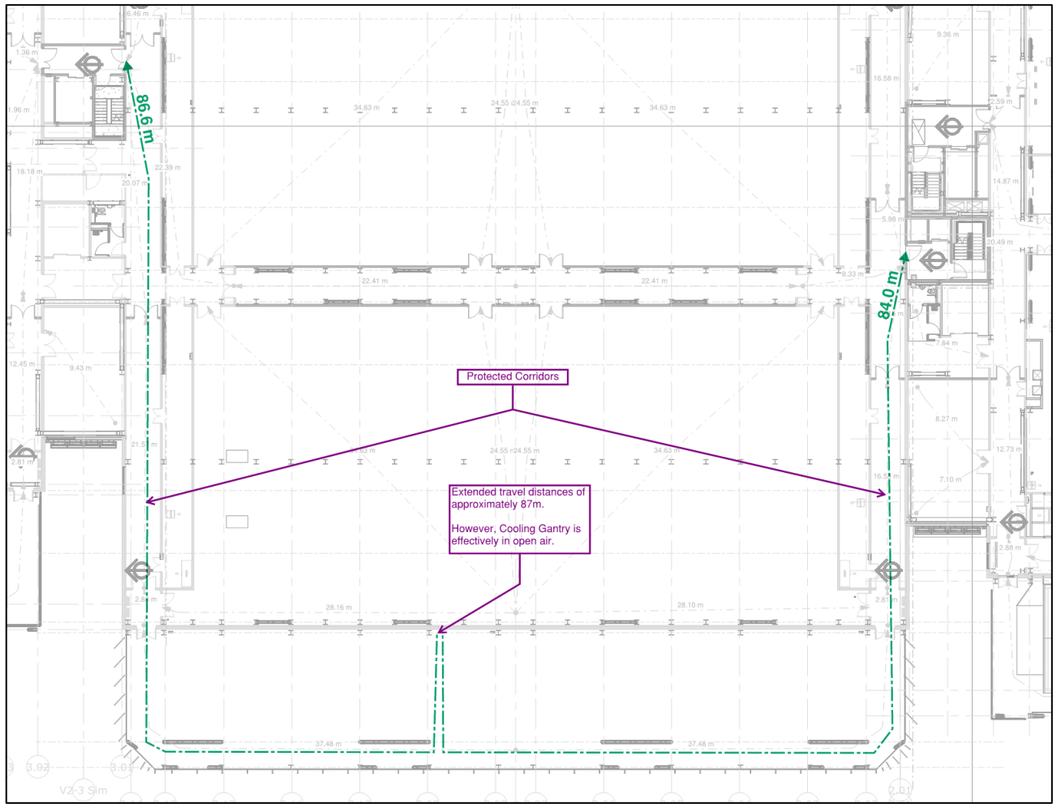

Figure 25 – Example of area on Cooling Gantry with extended travel distances

In some instances, there are extended single direction travel distances from the rooms located either side of the central cores (e.g. offices) of approximately 33-35m (see figure below for example). Note, it is assumed that escape routes via the gantries and the data halls are not to be used by occupants in these rooms.

However, this is considered acceptable in these instances as:

- The travel distance within the rooms will be within the single direction travel distance limit;
- Once outside of the room, travel will be via protected corridors leading to the stair;
- Occupants would be aware of a problem early on due to the comprehensive fire detection being provided.
- Rooms/corridors will be provided with Sprinkler, Watermist or Gaseous Suppression systems.

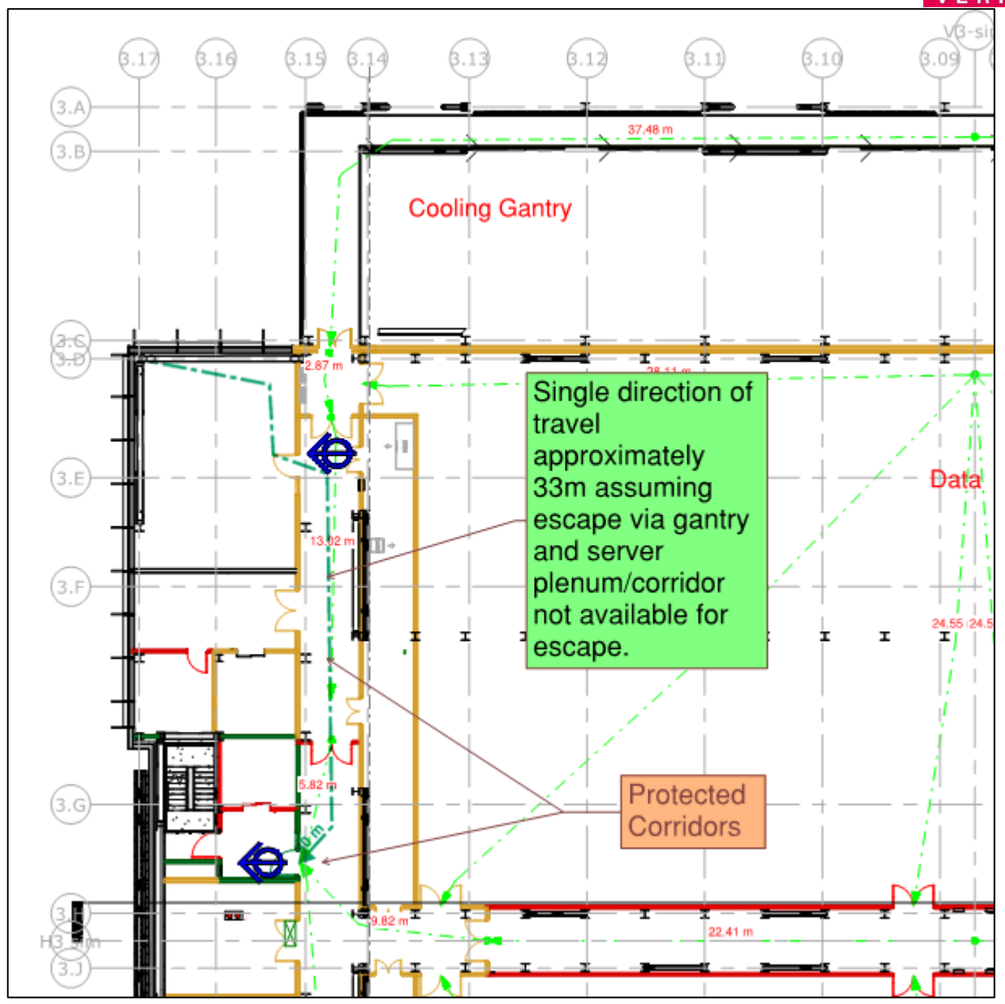

Figure 26 – Example of area with extended single direction of travel

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, in the Data Centre doors on escape routes from stairs to outside should open in the direction of escape due to the number of people potentially using these routes.**

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.

The Substation doors externally are constructed to 60 minutes fire resistance in accordance to Table 29 of BS 9999 and as a consequence of persons passing the doors for the means of escape.

Where final exits include routes under the gantries, these will be provided with 30 minute fire resisting ceilings below the gantry floor to protect the escape route from anything falling from the floor above.

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 need to meet the above minimum widths.

Every door on escape routes from stairs should be as wide as the stair they serve.

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.

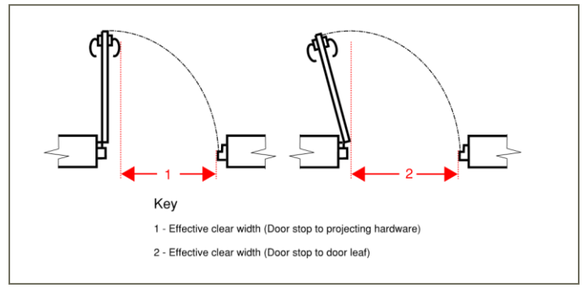

Figure 27 – Clear Exit Width

5.4.5 Corridors and Escape Routes

For the purpose of this report, the width of an escape route is the width at 1500mm above the pitch line when defined by the walls or the minimum width of passage available between any fixed obstruction (handrails fixed to the wall are ignored if less than 100mm).

The width of a door in a corridor should be not less than the corridor width minus 150mm.

The width of a corridor or escape route should be not less than the calculated width of any door leading onto it, or 1200mm, whichever is the greater.

Note: *Where the corridor is not accessible to wheelchair users, the minimum width may be reduced to 1000 mm.*

Where a corridor exceeds 12m in length and connects two or more storey exits it should be subdivided by a self-closing fire door (and associated screens) positioned approximately mid-way between the storey exits.

5.4.6 Inner Rooms

An Inner room is defined under BS 9999 as a normally occupied room from which the only escape route is through another room. The room that provides the escape route from an inner room is known as an access room.

Where inner rooms are included (e.g. in the Visitor Reception Centre and areas of the Data Centre such as the conference rooms off the reception areas) it is proposed to provide automatic fire detection within the access rooms to give early warning to the inner room occupants as noted within Section 5.3.1 above and in accordance with BS 5839 Part 1. This arrangement is in line with Clause 16.3.4 from BS 9999 in consideration that all of the following conditions are met.

a) the occupant capacity of the inner room does not exceed 60 (30 where the occupants require assistance escaping);
b) the inner room is not a bedroom;
c) the inner room is entered directly from the access room;
d) the escape route from the inner room does not pass through more than one access room;
e) the travel distance from any point in the inner room to the exit(s) from the access room does not exceed the allowable one-way travel distance;
f) The access room is not a place of special fire hazard and is in the control of the same occupier as the inner room.

5.4.7 Storeys Divided into Different Occupancies

It is understood that Block UP3 will form a single tenancy while Blocks UP1 and UP2 will form a different, combined tenancy. These two tenancies are effectively treated as separate buildings for the purpose of this report.

However, if either of these buildings are split further into different tenancies the following guidance should be applied.

Where a storey is divided into separate occupancies (i.e. where there are separate tenancies of different organizations):

a) the means of escape from each occupancy should not pass through any other occupancy; and
b) If the means of escape include a common corridor or circulation space, it should be either a protected corridor, or a suitable automatic fire detection and fire alarm system should be installed throughout the storey.

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.

However, as stairs will form part of a firefighting shaft they should have a minimum width of 1100mm.

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 Data Centre

The Data Centre will be provided with five stairs (two serving Block UP3 and three serving Blocks UP1 and UP2) each of which will also serve as part of a firefighting shaft. The stairs should therefore have a minimum width of 1100mm.

Block UP3

In accordance with Table 13 of BS 9999, **for Block UP3** based on an A2 Risk Profile and a stair serving three floors, the capacity of the stair is calculated on the basis of 3.25 mm/pers.

The capacity of an 1100mm wide stair serving three floors is therefore 338 people. Note: this does not include the benefit of increased ceiling height which would increase the capacity further.

The total above ground occupancy of Block UP3 is 180 (assuming 60 people per block per floor). **The capacity of the two stairs provided is therefore more than adequate for the number of occupants even if an entire stair is discounted.**

Blocks UP1 and UP2

In accordance with Table 13 of BS 9999, for Blocks UP1 and UP2 based on an A3 Risk Profile (assumed worst case due to BBUs presence) and a stair serving three floors, the capacity is calculated on the basis of 4 mm/pers.

The capacity of an 1100mm wide stair serving three floors is therefore 275 people. Note: this does not include the benefit of additional fire protection measures which would increase the capacity further.

The total above ground occupancy of Blocks UP1 and UP2 is 360 (assuming 60 people per block per floor). **The capacity of the three stairs provided is therefore more than adequate for the number of occupants even if an entire stair is discounted.**

5.5.2 EC 1 MV Energy Centre

The EC1 MV Energy Centre will be provided with two open stairs. Only the central open stair will also serve for firefighting.

The central open stair should have a minimum width of 1100mm. The other stair which only serves Level 2 gantry should have a minimum width of 1000mm.

5.5.3 EC 2 MV Energy Centre

The EC2 MV Energy Centre will be provided with two external stairs, one of which will also serve for firefighting. The firefighting stairs should have a minimum width of 1100mm. The other stair should have a minimum width of 1000mm.

5.5.4 EC 3 MV Energy Centre

The EC 3 MV Energy Centre will be provided with two external stairs, one of which will also serve for firefighting. The firefighting stairs should have a minimum width of 1100mm. The other stair should have a minimum width of 1000mm.

5.5.5 High Voltage Substation Building

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

5.5.6 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.

5.5.7 Final Exits from Stairs

The final exit from a stair should be at least the same clear width as the stair it serves.

Where exit routes from a stair do not exit direct to outside but exit via a protected corridor, all doors on the route should be at least as wide as the stair they serve.

As highlighted above, doors should open in the direction of escape where they could serve more than 60 people which includes all exit routes from stairs.

Note: These points will need to be addressed.

A number of exits serving stairs also serve the ground floor levels, however, considering the very low occupancy numbers and oversized stairs for means of escape it is not considered necessary to increase the widths of exits to accommodate merging flows.

5.6 Escape for People with Mobility Impairments

Refuges for disabled persons should be provided in either the escape stairs or a protected lobby that serves the escape stair and located so that it does 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 Firefighting Shaft

Where a firefighting shaft is required, it should consist of the following: firefighting stair and firefighting lobbies provided with a firefighting main.

The shafts should include the following provisions:

- Firefighting stair of minimum width 1100mm with a 1m^2 AOV at the head of the stair.
- Naturally or mechanically ventilated fire-fighting lobbies.
- A dry riser outlet located within the fire-fighting shaft.
- Fire appliance access is required to within 18m of the inlet point to the dry fire mains.

6.1.1 Layout of Firefighting Shaft

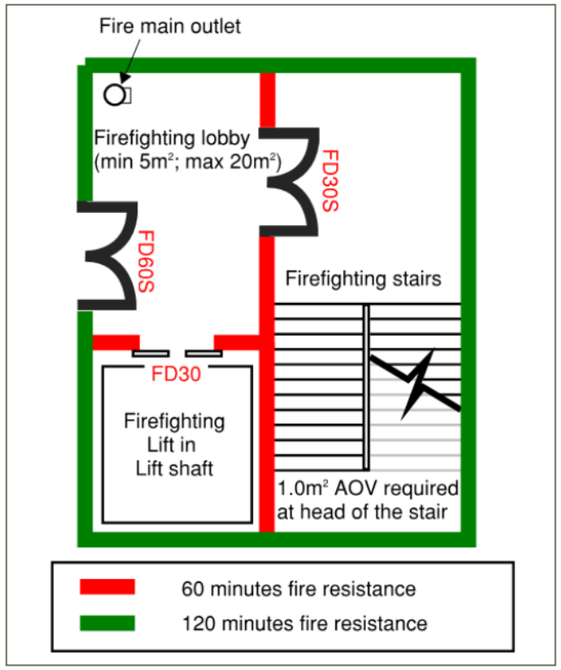

Figure 28 – Firefighting Shaft layout

6.1.2 Firefighting Stair

The firefighting stairs are to be designed in accordance with Clause 20.2.4 from BS 9999. The stairs are to be sufficiently wide to be easily used by firefighting personnel carrying firefighting equipment. Firefighting stairs are to be designed in accordance with BS 5395 Part 1 with a width of not less than 1.1 metres. The width should be maintained clear for a vertical distance of 2 metres measured from the pitch line or landing floor level with the following exceptions:

- Stringers, each protruding into the stair not more than 30mm; and
- Handrails each intruding into the stair not more than 100mm.

An Automatic Opening Vent (AOV) with a 0.7m^2 aerodynamic free area is required at the head of each firefighting stair. This is to be designed in accordance with Table 21 from BS 9999 and BS EN 12101 Part 2.

6.1.3 Firefighting Lobby

The firefighting lobbies are to be designed in accordance with Clause 20.2.5 from BS 9999. Firefighting lobbies should have a minimum area of 5m^2 and a maximum area of 20m^2. All principal dimensions should be not less than 1.5 metres and should not exceed 8 metres.

6.1.4 Firefighting Lift

Firefighting lifts should be in accordance with Clause 20.4 from BS 9999.

BS 9999 recommend that firefighting lifts should not also serve as goods lifts. However, due to the number of firefighting lifts required it is not practicable to avoid these lifts being used as good lifts with significant additional costs. This is considered acceptable in this instance due to the type of premises (e.g. not commercial premises such as shops) and on the basis that there will be strict management procedures in place that will ensure items are not stored in the firefighting shafts/lifts. This is a deviation from guidance and it is subject to agreement with approving authorities.

6.1.5 Mechanical ventilation

The firefighting shafts within the data Centre are to be mechanically ventilated. This proposal will need to be supported by CFD analyses.

In accordance with BS9999, a mechanical smoke ventilation system should demonstrate equivalent or better conditions in the lobby and stairs than would be provided by a natural shaft conforming to 27.1.4.2.3 of BS 9999 and as described in BRE Project Report 79204.

Additional Computational Fluid Dynamics (CFD) analyses will be performed for the extension of the firefighting shafts access corridors at ground level being more than 18m, within the Data Centre.

The design of the system should be in accordance with section 27.1.3 of BS 9999.

6.1.6 Data Centre

BS 9999 recommends that where firefighting shafts are accessed by a protected corridor it does not exceed 18m in length. However, due to the internal location of the central firefighting cores, this is exceeded (ranging from approx. 20m to 37m) in some cores. In addition, access to the central firefighting shafts will be under the gantry.

These arrangements are considered acceptable in this instance, as:

- The Data Centre has a total of five firefighting cores.
- The firefighting shafts have firefighting lifts which will help to reduce the strain on firefighters accessing floors above ground.
- The corridor will be over 2.5m wide and fully protected (120 mins) with any accommodation (other than the toilet, cleaner's cupboard and loading bay) accessed via ventilated lobbies/corridors (see figure below). The ventilation conditions will be assessed through CFD analyses.
- **The block UP3 waste storage area and the block UP1 staging area will include fire curtains** on the inside of doors that open on the firefighting shaft/access that will descend on activation of smoke detection in the vicinity of the door after a time of 2.5minutes to allow plenty of time for any occupants to escape. Controls will be provided on either side of the door to allow the curtain to be raised if required.
- The access route under the gantries will be provided with 30 minute fire resisting ceilings below the gantry floor to protect the access route from anything falling from the floor above.

This approach will need to be agreed with the approval bodies.

Access corridor for UP1/UP2 firefighting shaft

Blocks UP1 and UP2 will form a single tenancy/occupancy and the firefighting access corridor will be less than 18m, therefore the following arrangement is proposed:

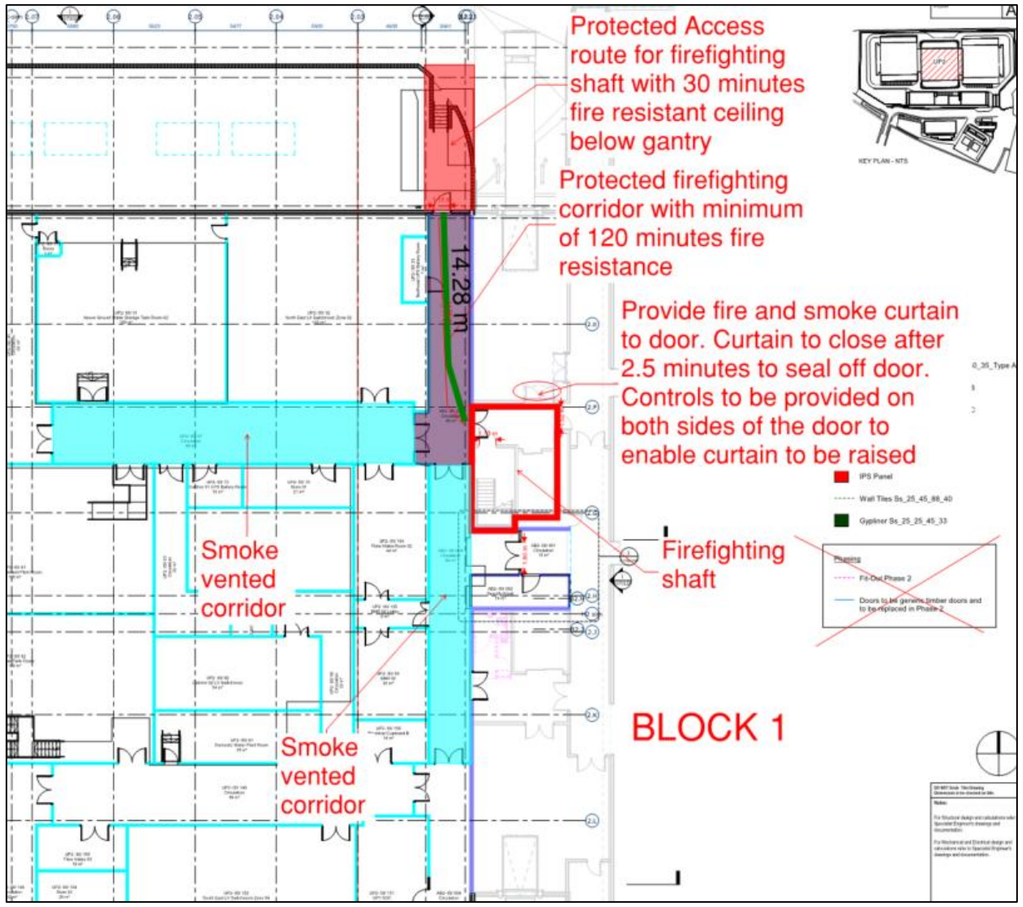

Figure 29 – Data Centre –Access corridor and protection arrangements for central firefighting shaft of Blocks 1 & 2

Access corridor for Block UP2 firefighting shaft

The firefighting access corridor is longer than 18m, therefore the following arrangement is proposed:

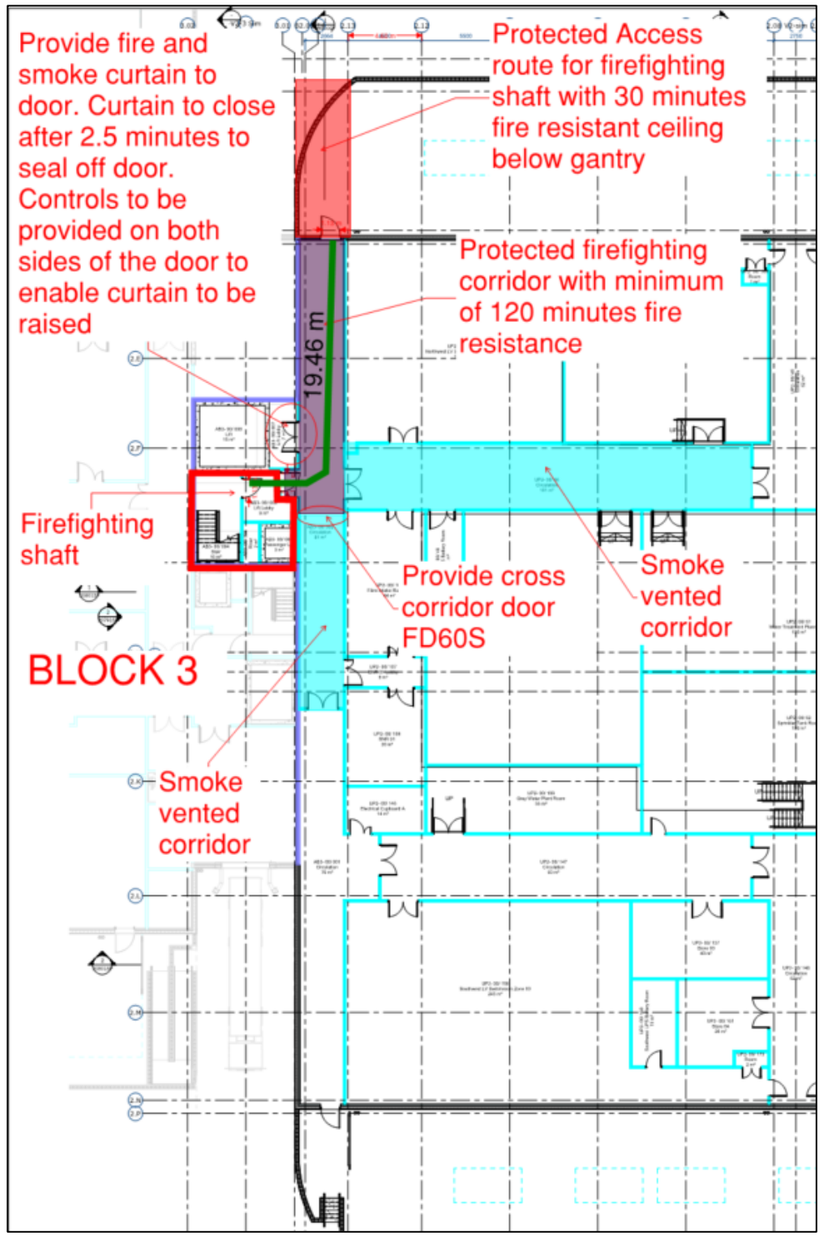

Figure 30 – Data Centre - Access corridor and ventilation/protection arrangements for firefighting shaft of Block UP2

Access corridor for Block UP3 firefighting shaft

The firefighting access corridor is longer than 18m, therefore the following arrangement is proposed:

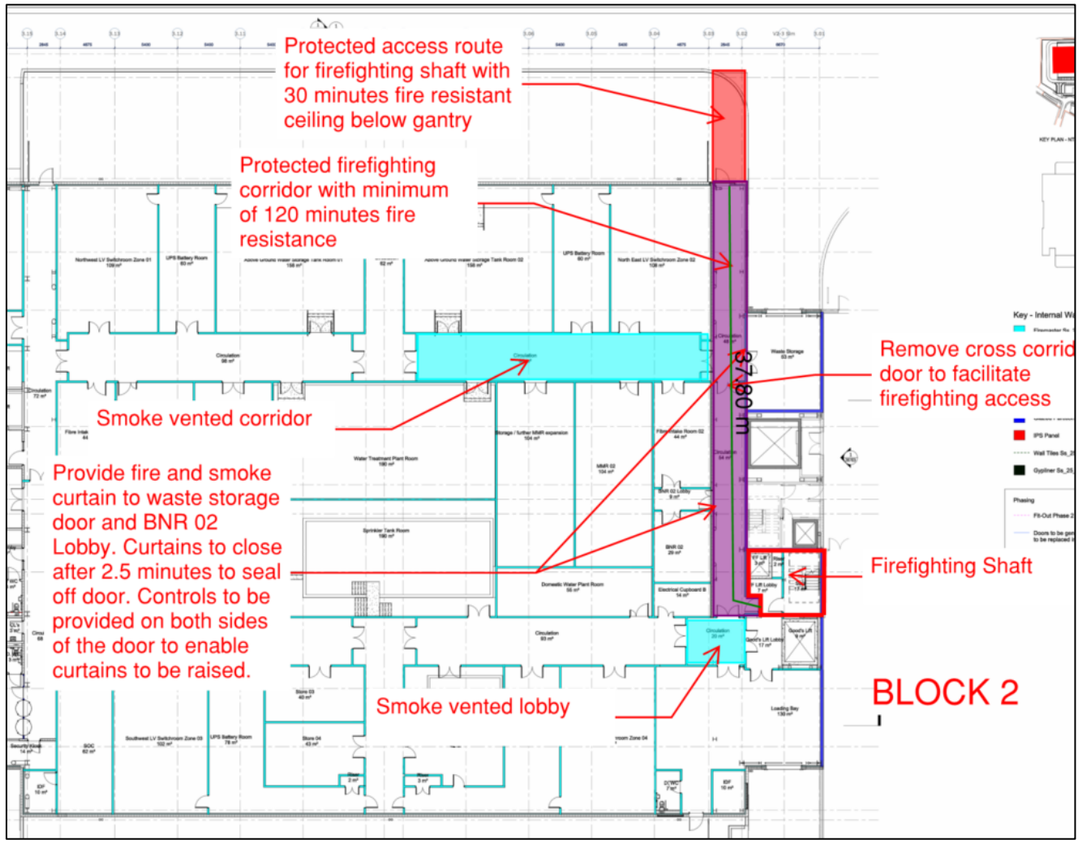

Figure 31 – Data Centre - Access corridor and ventilation/protection arrangements for firefighting shaft of Block 3

The remaining two firefighting shafts serving Blocks UP1 and UP3 will discharge directly to outside.

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
High Reach	3.7m	3.1m	4.0m	17.0 tonnes	26.0m	29.0m

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

6.2.1 Data Centre

The data centre has a top floor greater than 18m and therefore the building requires the provision of firefighting shafts with firefighting lifts.

Each of the five stair cores will be constructed as firefighting shafts which will each include a firefighting lift.

Due to the layout of the building, with external cooling gantries, hose laying distances would significantly exceed the recommended maximum of 60m (e.g. up to 87m in some locations). It is therefore proposed to provide additional fire main outlets within 90 minutes protected and ventilated corridors. The outlets would be fed via horizontal fire mains that spur off the riser serving the closest firefighting shaft.

The horizontal fire mains in these corridors would normally be closed off at a junction within the firefighting lobby at that level and there will be a simple selection system (e.g. clearly identified levers/valves) within the lobby to allow the fire service to open the horizontal section of the fire main if required.

The firefighting shafts are to be ventilated mechanically. The sections of corridor with outlets are to be ventilated naturally (either 1.5m^2 vent direct to outside or a 2m^2 vent ducted to outside depending on the location.). In between these two areas will be a further section of protected corridor that will not be provided with ventilation (see figure below). This will help to avoid conflicts between the natural and mechanical ventilation systems.

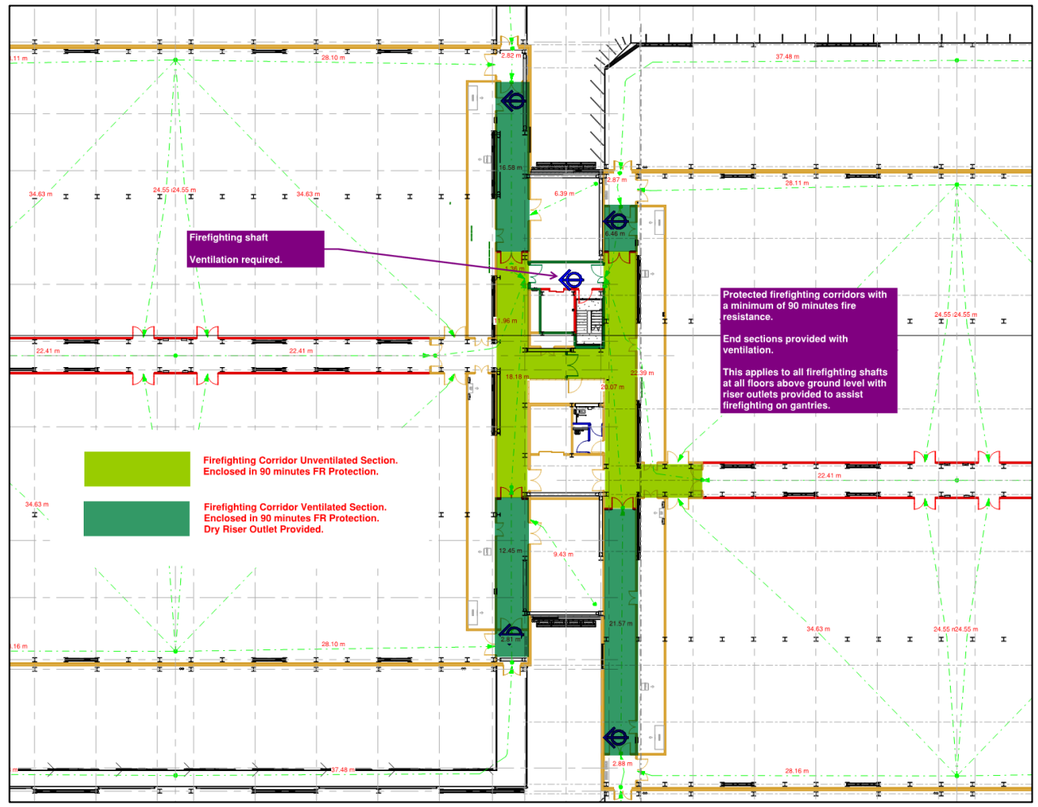

Figure 32 – Example of firefighting corridors with riser outlets

It should also be noted that the building appears to have good vehicle access around the entire building such that the fire service may be able to assist with fighting a fire on the cooling gantries externally (subject to height).

Barriers on the road surrounding the building that restrict access between the different sections of the site should either open automatically on activation of the fire alarm, of be opened by a member of staff on activation of the fire alarm as part of the management procedures of the site to facilitate fire service vehicle access.

The Design team should confirm access complies with Table 6 above.

6.2.2 Energy Centres

As the Energy Centre buildings all have a height greater than 7.5m (but less than 18m) and they include A3 Risk Profile areas, they should be provided with firefighting shafts, comprising a fire-fighting stair and a fire-fighting lobby fitted with a dry riser fire main. However, in consideration that all escape stairs serving the energy centres are external, it is considered that the presence of a lobby would not add any additional benefit to it. Therefore, lobbies are not proposed. However, dry risers will be provided as necessary.

The firefighting stairs are to be designed in accordance with Clause 20.2.4 from BS 9999. The stairs are to be sufficiently wide to be easily used by firefighting personnel carrying firefighting equipment. Firefighting stairs are to be designed in accordance with BS 5395 Part 1 with a width of not less than 1.1 metres. The width should be maintained clear for a vertical distance of 2 metres measured from the pitch line or landing floor level with the following exceptions:

- Stringers, each protruding into the stair not more than 30mm; and
- Handrails each intruding into the stair not more than 100mm.

6.2.3 EC 1 MV Energy Centre

EC 1 MV Energy Centre has a top floor over 7.5m (i.e. 15.5m) and includes areas with an A3 risk profile. The use falls within a factory type arrangement (i.e. generating power). On this basis the building should be provided with firefighting shafts.

The premises comprises a ground level and three upper levels. The central section comprises an enclosed block of mainly switch rooms at each level with access provided by an open stair. On either side of the central block are large generators units effectively in open air which are located at ground and Level 2. The generators at Level 2 are accessed either by the central open stair or an additional dedicated open stair from one side of the deck.

Note: It is understood that the second floor generator deck is effectively open to the ground floor generator deck level (i.e. open mesh/grating walkways forming the floor).

The building including the outdoor generator areas has a footprint of approximately 1,650m^2. However, the enclosed central section of the building has an area of less than 300m^2 at each level. The building height (measured from fire service access level to the Third floor) will be 15.5m.

Based on the arrangements it is proposed that the central open stair will also serve as access for firefighting. Although the stair is not a protected stair, it is in open air which should help ensure that the stair does not become smoke logged. A dry riser will also be provided to serve the open stair with riser outlets at each level on the gantry in close proximity to the stair. The central enclosed section that has accommodation at each level will be separated from the stair by fire resisting construction including a 120 minutes fire resisting wall directly between the accommodation and the open stair. Fire suppression will also be provided.

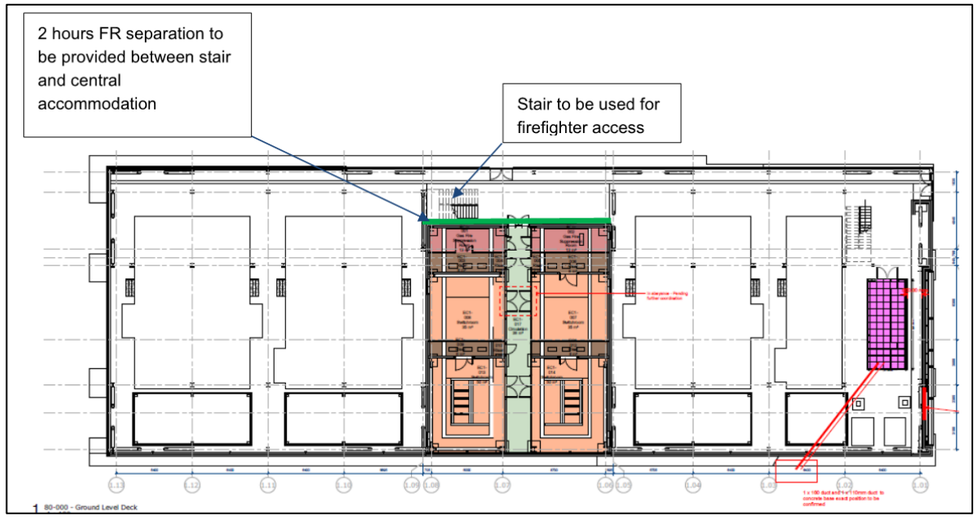

Figure 33 – EC 1 MV Energy Centre – Firefighting arrangements

Arrangements should ensure that 60m hose laying distances are not exceeded.

6.2.4 EC 2 MV Energy Centre

EC 2 MV Energy Centre has a top floor over 15.5m to the third level deck and includes areas with an A3 risk profile. The use falls within a factory type arrangement (i.e. generating power). On this basis the building requires the provision of firefighting shafts.

The external stair in the bottom left adjacent to the enclosed accommodation will be separated from it by 120 minutes fire resisting construction and be approached directly from outside. A dry riser will be located near the stair. Additional ventilation usually associated with a firefighting shaft (i.e. to the lobby) is not considered necessary to prevent smoke from entering the stair as the stair is external.

The stair will provide access to the switch room areas. In case of fire in one generator the Fire Brigade should operate from the outside of the building.

Figure 34 – EC 2 MV Energy Centre– Firefighting arrangements

Arrangements should ensure that 60m hose laying distances are not exceeded.

6.2.5 EC 3 MV Energy Centre

EC 3 MV Energy Centre has a top floor over 7.5m (i.e. 15.5m to the third level deck) and includes areas with an A3 risk profile. The use falls within a factory type arrangement (i.e. generating power). On this basis the building requires the provision of firefighting shafts.

The external stair adjacent to the enclosed core will be separated from it by 120 minutes fire resisting construction and will be approached directly from outside. A dry riser should be located near the stair. Additional ventilation usually associated with a firefighting shaft (i.e. to the lobby) is not considered necessary to prevent smoke from entering the stair as the stair is external.

The stair will provide access to the switch room areas. In case of fire in one generator the Fire Brigade should operate from the outside of the building.

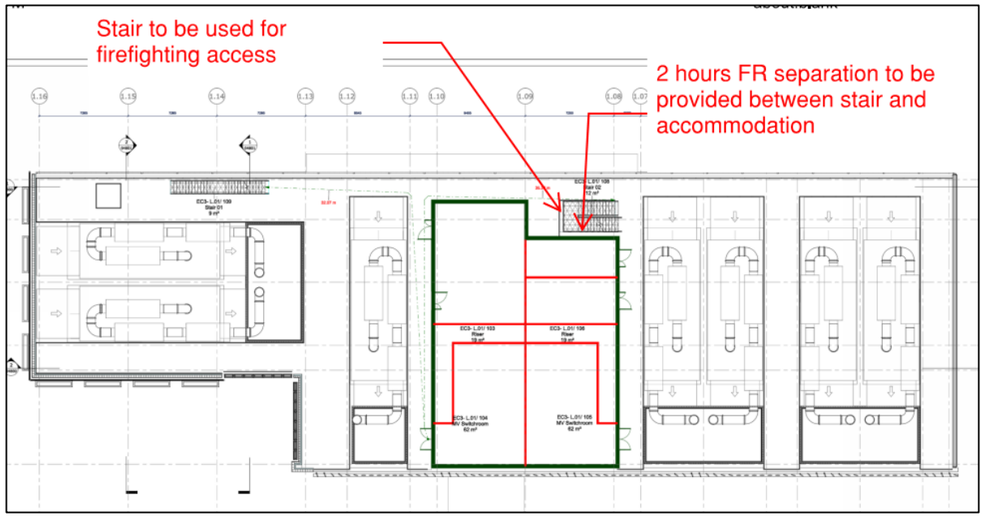

Figure 35 – EC 3 MV Energy Centre – Firefighting arrangements

Arrangements should ensure that 60m hose laying distances are not exceeded.

6.2.6 Visitor Reception Centres 1 and 2

Fire service vehicle access is available to over 35% of the perimeter. In addition, vehicle access will be within 45m of all areas on a route suitable for laying hose.

For Visitor Reception Centre 2 fire appliance should be able to park within 18 m of an entrance door.

6.2.7 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.

6.3 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 (including entry points to firefighting shafts) and fire appliance parking positions as follows:

- Hydrants should be provided within 90m of each dry fire main inlets on a route suitable for laying hose.
- A hydrant should also be provided within 90m of the entry point to the Visitor Reception Centres.

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

6.4 Rising Mains

Dry rising mains are required in the firefighting stair core or lobbies. In addition, the open stairs of the Energy Centres that are also serving as access for firefighting should be provided with dry risers.

Outlets should be provided at every level served by the fire-fighting shafts where the outlet point is included within the fire-fighting lobby. See also requirements for additional outlets in Data Centre as discussed above in section 6.2.1.

Note: The provision of automatic suppression systems (Sprinklers, Watermist and Gaseous) has been taken into account and considered comparable to the provision of a sprinkler system throughout.

Access for a pumping appliance should be provided within 18m of each fire main inlet connection point, typically on the face of the building, and the inlet should be visible from the appliance.

6.5 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

7.2.1 Minimum Fire Resistance Performance – Data Centre

The building height is greater than 18m but less than 30 (excluding the roof). Therefore, for an A2/A3 risk profile the structural fire resistance for the building should be 90 minutes.

The minimum fire resistance performance requirements are noted within the table below. For more information see Table 22 from BS 9999.

The structural fire resistance to the cooling gantries can be reduced to 30 minutes**. **This is considered adequate on the basis that:

- *The gantries are not normally occupied spaces.*
- *The structure should be designed such that failure of the gantry does not cause failure of the main building*
- *The gantries are effectively open air spaces*
- *The gantries will only include low risk cooling units which will also be protected by internal Watermist.*
- *The gantries will be separated from the main building by fire resisting walls. However, openings in these walls for services (i.e. running between the cooling units and the data halls) will not be protected. This is considered acceptable on the basis that the data halls are protected by suppression systems and each of the cooling units on the gantries will be protected by internal Watermist.*

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	90	N/A	N/A	Exposed Faces
Load-Bearing Wall	90	N/A	N/A	Each Side Separately
Cooling Gantries structure	30	N/A	N/A	Each Side Separately
Floors	90	90	90	From Underside
Compartment Walls	90	90	90	Each Side Separately
Compartment Floors	90	90	90	From Underside
Roofs Note 2				
➢ Any floor forming part of an escape route;	30	30	30	From Underside
➢ Any roof that forms the function of a floor	90	90	90	
External Fire Spread				
➢ Any part less than 1000mm from a point in the relevant boundary	90	90	90	Each Side Separately
➢ Any part more than 1000mm from the relevant boundary Note 1	90	90	15	From Inside the Building
➢ Any part adjacent to an external escape route or stair	30	30	N/A	From Inside the Building
Firefighting Shafts				
➢ Construction separating firefighting shaft from rest of building	120	120	120	From Side Remote from Shaft
	60	60	60	From Shaft Side
➢ Construction separating firefighting stair, firefighting lift shaft and firefighting lobby	60	60	60	Each Side Separately
Protected Shafts (including lifts, risers)	90	90	90	Each Side Separately
Escape Stair	90	90	90	Each Side Separately
Fire Resisting Construction	See section 7.4 of this report			Each Side Separately
➢ Ancillary Accommodation				
Cavity Barriers	N/A	30	15	Each Side Separately

***Note 1:** This does not apply to permitted unprotected areas as indicated within Section 8.3 of the fire strategy report*

***Note 2:** Structure that only supports the roof does not require fire resistance, unless;*

- *The roof performs the function of a floor, such as for means of escape*
- *The structure is essential for the stability of an external wall which needs to have fire resistance.*

Unless it is essential for the stability of the structure, the roof should only need to provide 30 minutes fire resistance to protect routes serving the photovoltaic panels.

***Note 3**: The cooling gantries should have a structural fire resistance of 30 minutes, however, floors within the gantry areas are not to be compartment floors.*

7.2.2 Minimum Fire Resistance Performance –MV Energy Centres (EC1, EC2, EC3)

The building height is greater than 5m but less than 18.

For an A2 risk profile, the structural fire resistance for the building should be 60 minutes based on table 23 of BS 9999.

It is proposed that only the central enclosed section within EC1 (Ground, 1st, 2nd and 3rd) will be provided with 60 minutes fire resistance and that the surrounding gantry structure which only has above ground equipment at 2nd floor level will be provided with 15 minutes fire resistance. The reduction from 30 to 15 minutes fire resistance has been agreed with the approving bodies through "Ark Data Centre Project Union – EC1 Block" Technical Note.

The minimum fire resistance performance requirements are noted within the table below. For more information see Table 22 from BS 9999.

Table 9 - Minimum Fire Resistance Requirements (EC1 central enclosed section)

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	60	N/A	N/A	Exposed Faces
Gantry Structure (EC1)	15	N/A	N/A	Each Side Separately
Gantry Structure (EC2, EC3)	30	N/A	N/A	Each Side Separately
Load-Bearing Wall	60	N/A	N/A	Each Side Separately
Floors	60	60	60	From Underside
Compartment Walls	60	60	60	Each Side Separately
Compartment Floors	60	60	60	From Underside
Roofs Note 2 ➢ Any floor forming part of an escape route; ➢ Any roof that forms the function of a floor	 30 60	 30 60	 30 60	 From Underside
External Fire Spread ➢ Any part less than 1000mm from a point in the relevant boundary ➢ Any part more than 1000mm from the relevant boundary Note 1 ➢ Any part adjacent to an external escape route or stair (not central open stair)	 60 Note 3 60 Note 3 30	 60 Note 3 60 Note 3 30	 60 Note 3 15 N/A	 Each Side Separately From Inside the Building From Inside the Building
Firefighting Shafts ➢ Construction separating open central stair from central core	120	120	120	From Side Remote from stair
Protected Shafts (including lifts, risers)	60	60	60	Each Side Separately
Fire Resisting Construction ➢ Ancillary Accommodation	See section 7.4 of this report			Each Side Separately
Cavity Barriers	N/A	30	15	Each Side Separately

Note 1: *This does not apply to permitted unprotected areas as indicated within Section 8.3 of the fire strategy report*

Note 2: *Structure that only supports the roof does not require fire resistance, unless;*

- *The roof performs the function of a floor, such as for means of escape*
- *The structure is essential for the stability of an external wall which needs to have fire resistance*

However, in the cases of the Energy Centres the roof level also supports the chiller plant. Therefore, any elements of structure that support the plant should be provided with the required level of structural fire resistance. It is not proposed to provide fire resistance to the open mesh/grating system forming the walkways.

7.2.3 Minimum Fire Resistance Performance – Visitor Centres 1 and 2

The Visitor Reception Centre 1 is a two-storey building (ground and first) with an A2 Risk Profile (building height less than 5m as measured to the first floor). Visitor Centre 2 is a single storey building with an A2 risk profile.

The structural fire resistance for the buildings should be 30 minutes based on table 23 of BS 9999.

The minimum fire resistance performance requirements are noted within the table below. For more information see Table 22 from BS 9999.

Table 10 - 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	30	N/A	N/A	Exposed Faces
Load-Bearing Wall	30	N/A	N/A	Each Side Separately
External Fire Spread ➢ Any part less than 1000mm from a point in the relevant boundary ➢ Any part more than 1000mm from the relevant boundary Note 1 ➢ Any part adjacent to an external escape route or stair	 30 30 30	 30 30 30	 30 15 N/A	 Each Side Separately From Inside the Building From Inside the Building
Fire Resisting Construction ➢ Ancillary Accommodation	See section 7.4 of this report			Each Side Separately
Cavity Barriers	N/A	30	15	Each Side Separately

Note 1: *This does not apply to permitted unprotected areas as indicated within Section 8.3 of the fire strategy report*

Note 2: *It has been assumed that there is nothing located at roof level.*

7.2.4 Minimum Fire Resistance Performance – High Voltage Substation Building

The HV Substation control building is a two-storey building (ground plus first) with an A3 risk profile. The structural fire resistance for the building should be a minimum of 60 minutes in accordance with Table 23 of BS 9999.

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

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

Table 11 - 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 Note 1	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 ➢ Ancillary Accommodation	See section 7.4 of this report			Each Side Separately
Cavity Barriers	N/A	30	15	Each Side Separately

7.2.5 Limitations of Non-Insulated Fire Resistance Glazing

For information on non-insulated fire resisting glazing see Clause 30.3.2 from BS 9999.

7.2.6 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° 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.

Please note different requirements for firefighting shafts.

7.2.7 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.

7.2.8 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.

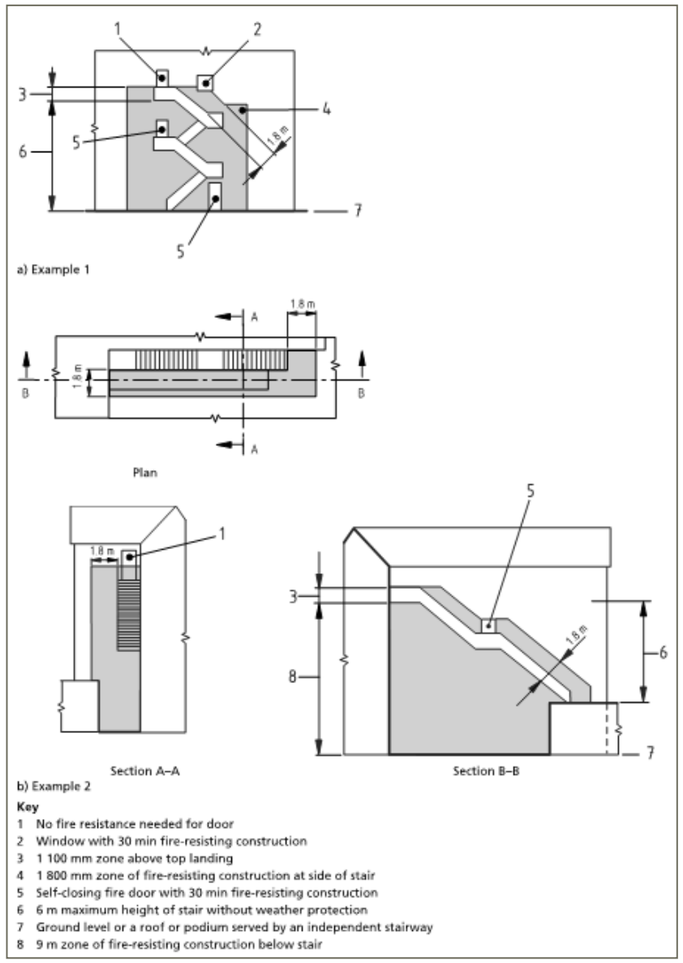

Figure 36 –Fire Resistance to External Stairs

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.

7.2.9 Corridors

Corridors should be in accordance with Clause 16.3.11 from BS 9999.

Where there are dead ends exceeding 2m in length the corridor serving the dead ends should achieve 30 minutes fire resistance.

Other corridors that are used for means of escape, but not a protected corridor, is enclosed in partitions, the partitions should be:

- Smoke retarding, even if they have no required fire resistance rating;
- Carried up to the soffit of the structural floor above, or to a suspended ceiling.
- Openings into rooms from the corridor should be fitted with doors, which need not be fire-resisting but should be close-fitting.

The partition separating the corridor where a corridor exceeds 12m in length and connects two or more storey exits should achieve 30 minutes fire resistance. The separation should continue to external walls, however the portion of wall outside the corridor need not be fire resistance unless required for other reasons but should be smoke retarding construction.

7.3 Compartmentation

7.3.1 Data Centre

The height of the top floor is over 18m but less than 30m and therefore the maximum compartment size should not exceed 4000m^2.

Each of the three blocks will be separated from one another by compartment walls.

Additional compartment walls (90 minutes) will be required within each block to separate the cooling gantries from the main building. This will also ensure that the 4000m^2 limit is not exceeded. ***However,* openings *in these walls for services (i.e. running between the cooling units and the data halls) will not be protected.***

This is because the cooling units need to provide continuous cooling to the data centres even in the event of a fire. This is considered acceptable on the basis that the data halls are protected by suppression systems and each of the cooling units on the gantries will be protected by internal Watermist and therefore the potential for fire spread will be very limited.

To reduce the chances of fire spread between levels, each floor in the Data Centre will be constructed as a compartment floor.

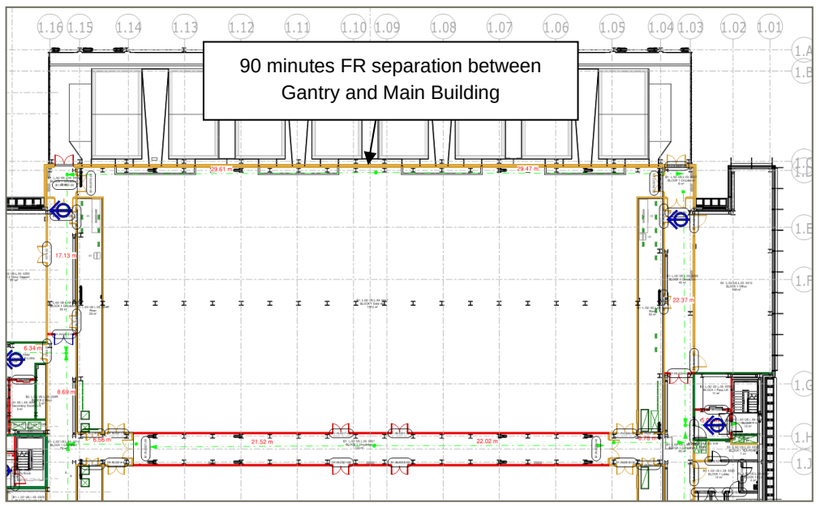

Figure 37 –Separation of gantries from main building

7.3.2 MV Energy Centres

The height of the top floors is less than 18m therefore, the maximum compartment size should not exceed 14,000m^2. This exceeds the floor area of the buildings at any level.

For EC1, EC2 and EC3 Compartment floors will be provided at each level of the enclosed sections only. The gantry deck will not form a compartment floor.

7.3.3 Visitor Reception Centres 1 and 2

Visitor reception centre 1 is less than 30m and visitor centre 2 is single storey. For both buildings there is no limit on compartment size for an A2 Risk Profile, therefore no compartmentation is required.

7.3.4 High Voltage Substation Control Building

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.

7.4 Ancillary Accommodation

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

Table 12 - 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.*

Note 2: Protection to rooms relating to fire protection systems (e.g. Sprinklers, Watermist, gaseous suppression etc.) are currently shown as enclosed in 60 minutes FR. These should be increased to 120 mins in line with the table above.

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 13 - 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*

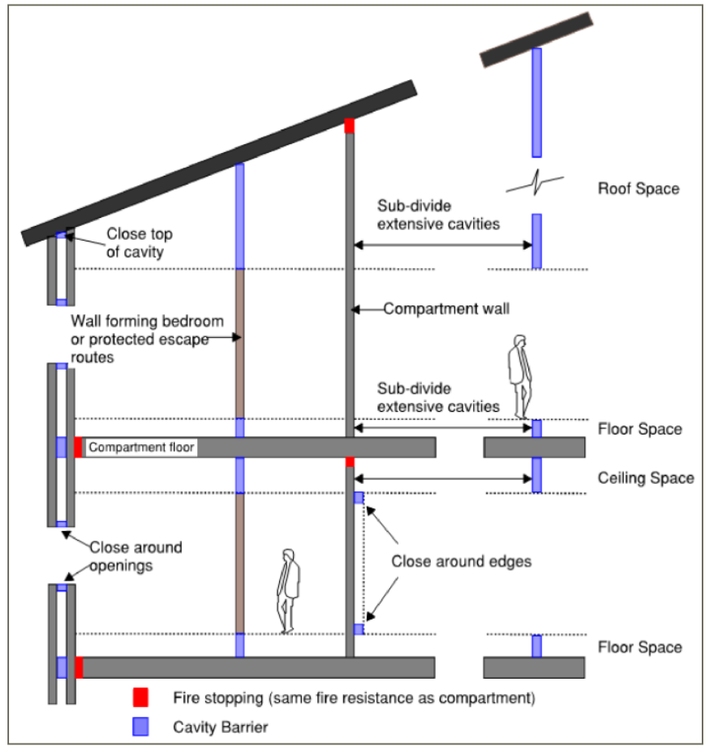

Figure 38 – Provisions of Cavity Barriers and Fire Stopping

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 14 - 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 15 - 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.*

Data Centre

NOTE: As discussed above, **openings** ***for services running between the cooling units on the gantries and the data halls will not be protected. This is because the cooling units need to provide continuous cooling to the data centres even in the event of a fire. This is considered acceptable on the basis that the data halls are protected by suppression systems and each of the cooling units on the gantries will be protected by internal Watermist and therefore the potential for fire spread will be very limited.***

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.

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 16 - Provisions for External Surfaces or Walls

Area/Distance from Relevant Boundary	Height of the Wall	External Wall Surface Classification
Data Centre - 1m or more	less than 18m above ground	Class C-s3, d2 or better
Data Centre - 1m or more	More than 18m above ground	Class B-s3, d2 or better
Energy Centres - 1m or more	less than 18m above ground	Class C-s3, d2 or better
Energy Centres - 1m or more	More than 18m above ground	Class B-s3, d2 or better
Visitor Reception Centre – 1m or more	Less than 18m above ground	No Provision
High Voltage Substation Building – 1m or more	Less than 18m above ground	No Provision

Note: The elevations of the energy centres, measured to the highest point, exceed 18m above surrounding ground level therefore the guidance for a building height more than 18m applies. Building height for external fire spread is measured in accordance with Approved Document B 2019 and is based on the latest legislation.

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 17 - 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 3m² 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 1500m³*

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 (see figure below). 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.

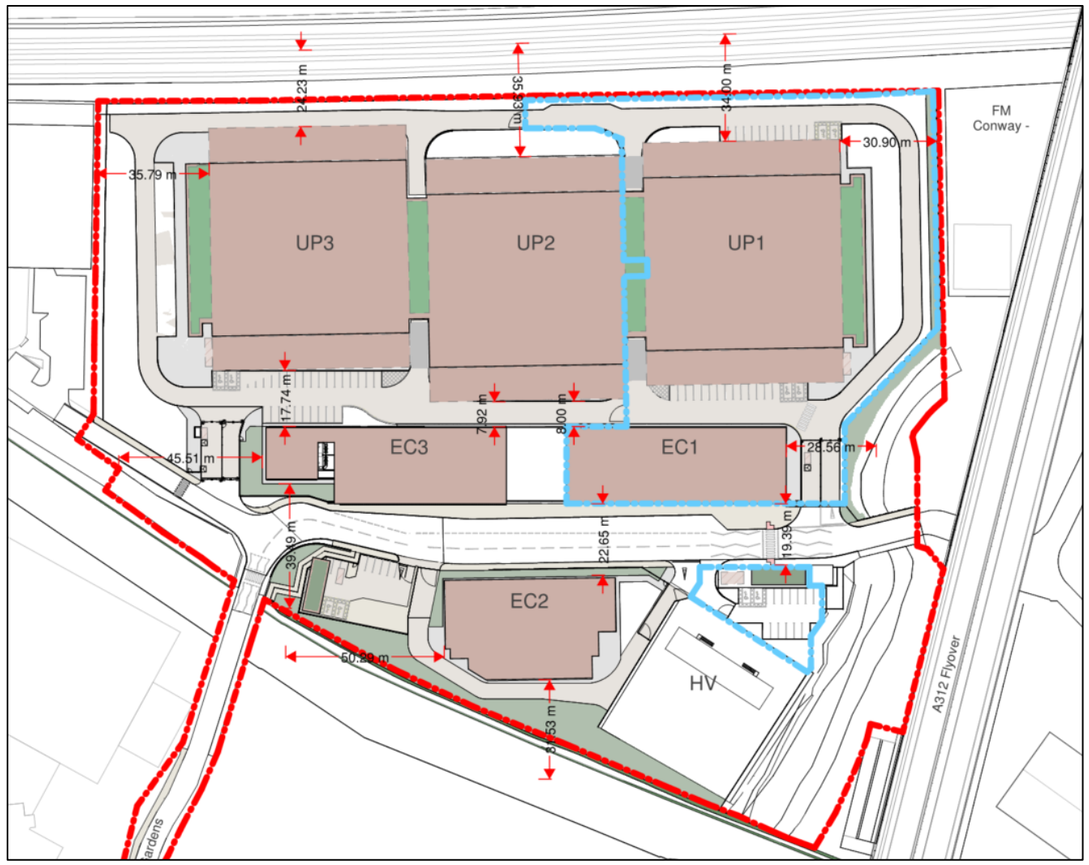

Figure 39 – Site plan with assumed boundary distances and distances between buildings on the same site highlighted

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

8.3.1 Data Centre

Space separation has been assessed for each elevation of the Data Centre and is summarised in the table below. The assessments assume:

- Floors are compartment floors and are separated from the gantries by fire resisting walls. Although openings for services will not be protected, the internal accommodation is protected by suppression and the cooling units on the gantries will have internal Watermist and therefore the potential for a fire to develop and spread is very limited.
- For elevations with cooling gantries, although unlikely, it is assumed a fire could occur within 1 of the individual cooling units but due to the provision of Watermist, it will not spread further. Units are assumed to be less than 5m wide by 5m high.
- Radiation values for lower fire load buildings (bracketed value in BS187 tables) are assumed for the East and West elevations on the basis the accommodation on these elevations is mostly offices.
- For the North and South elevations radiation values for reduced fire load buildings (bracketed value in BR187 tables) have also been used. The cooling equipment on the gantry is very low risk and will comprise very little in the way of combustible elements, it is also protected by Watermist.
- Minimum boundary distances have been halved on the basis that suppression systems are provided everywhere.

Table 18 - External Fire Spread Calculations Data Centre

Elevation	Largest Compartment Dimension (w x h)	Enclosing Rectangle (w x h)	Required boundary distance for 100% unprotected area within enclosing rectangle	Actual Boundary Distance	Unprotected % [Area] Allowed on Elevation
North	5m x 5m Note 1	6m x 6m	3m Note 4	>24.0m Note 2	Satisfactory for a cooling unit fire. Wall between main building and gantry to be protected area.
East	28m x 6m	30m x 6m	6.25m Note 4	>30.0m	100%
South	5m x 5m Note 1	6m x 6m	3m Note 4	3.96m Note 3	Satisfactory for a cooling unit fire. Wall between main building and gantry to be protected area.
West	28m x 6m	30m x 6m	6.25m Note 4	>35.0m	100%

Note:

1) *A width of 5m has been taken as the width of one cooling unit on each level. A height of 5m has been assumed.*
2) *The boundary distance has been taken to the approximate centre point of the railway line running adjacent to the elevation.*
3) *Boundary distance has been assumed to be midway between the data centre and the energy centres.*
4) *Minimum boundary distances have been halved on the basis that suppression systems are provided.*

8.3.2 EC 1 MV Energy Centre

The current site plan shows a separation gap between EC1 and EC3 (approximately 18m) and reduces the amount of the EC1 Elevation that directly faces Block UP2 of the data Centre.

Space separation has been assessed for each elevation of the EC1 MV Energy Centre. The assessments assume:

- Floors within the central enclosed section are compartment floors.
- Central section will be enclosed in 60 minutes fire resisting construction.
- The ground floor generator area and the generator deck at Level 2 are effectively in open air with large amounts of ventilation openings on the main elevations and with a grating mesh walkway.
- If a fire was to occur at generator deck level, the units are protected by suppression and therefore a fire is unlikely to spread to more than a single unit. It is therefore assumed a fire could occur within one of the individual generator units but due to the provision of suppression, it will not spread further. Units are assumed to be less than 5m wide by 7m high when end on and 12m wide by 7m high when side on.
- Radiation values have been based on those for higher fire load buildings (i.e. due to generators).
- Minimum boundary distances have been halved on the basis that suppression systems are provided everywhere.

Table 19 - External Fire Spread Calculations EC1

Elevation	Largest Compartment Dimension (w x h)	Enclosing Rectangle (w x h)	Required boundary distance for 100% unprotected area within enclosing rectangle	Actual Boundary Distance	Unprotected % [Area] Allowed on Elevation
North	5m x 7m Note 1	6m x 9m	3.75m Note 3	4m Note 4	Satisfactory for a generator unit fire.
East	12m x 7m Note 5	12m x 9m	5.25m Note 3	>28.0m	Satisfactory for a generator unit fire.
South	5m x 7m Note 1	6m x 9m	3.75m Note 3	9.7m Note 2	Satisfactory for a generator unit fire.
South (enclosed section)	15.5m x 5.15m	18m x 6m	5m Note 3	9.7m Note 2	100%
West	12m x 7m Note 5	12m x 9m	5.25m Note 3	9m Note 6	Satisfactory for a generator unit fire.

1) *Fire located in single generator unit at Ground Level or Level 2. A width of 5m has been taken as the width of one generator on each level. A height of 7m has been assumed.*
2) *Boundary distance has been assumed to be midway between the EC1 and the visitor centre.*
3) *Minimum boundary distances have been halved on the basis that suppression systems are provided.*
4) *Boundary distance has been assumed to be midway between the EC1 and the Data Centre.*
5) *Fire located in single generator unit at Ground Level or Level 2. A width of 12m has been taken as the width of one generator on each level. A height of 7m has been assumed.*
6) *Boundary distance has been assumed to be midway between the EC1 and EC3. Separation between buildings has been estimated to be at least 18m on basis of reduced footprint to EC1 for Plasma Design.* ***Design Team to Confirm****.*

8.3.3 EC 2 MV Energy Centre

Space separation has been assessed for each elevation of the EC2 MV Energy Centre. The assessments assume:

- Floors within the enclosed sections are compartment floors.
- Enclosed section will be enclosed in 60 minutes fire resisting construction.
- The generator deck at level 2 is effectively in open air with large openings on the main elevations and with a grating mesh walkway serving the roof cooling deck.
- If a fire was to occur at generator deck level, the units are protected by suppression and therefore a fire is unlikely to spread to more than a single unit. It is therefore assumed a fire could occur within one of the individual generator units but due to the provision of suppression, it will not spread further. Units are assumed to be less than 5m wide by 7m high when end on and 12m wide by 7m high when side on.
- Radiation values have been based on those for higher fire load buildings (i.e. due to generators as opposed to cooling units on gantries of the data centre).
- Minimum boundary distances have been halved on the basis that suppression systems are provided everywhere.
- Note: The equipment at roof level has not been considered for space separation as this fully in open air.
- The East elevation is proposed to be fire rated, so no external fire spread calculations have been carried out.

Table 20 - External Fire Spread Calculations EC2

Elevation	Largest Compartment Dimension (w x h)	Enclosing Rectangle (w x h)	Required boundary distance for 100% unprotected area within enclosing rectangle	Actual Boundary Distance	Unprotected % [Area] Allowed on Elevation
North	5m x 7m Note 1	6m x 9m	3.75m Note 2	11.5m Note 4	Satisfactory for a generator unit fire.
South	5m x 7m Note 1	6m x 9m	3.75m Note 2	>30.0m Note 3	Satisfactory for a generator unit fire.
West	12m x 7m Note 5	12m x 9m	5.25m Note 2	>50m Note 3	Satisfactory for a generator unit fire.

1) *Fire located in single generator unit at Ground Level or Level 2. A width of 5m has been taken as the width of one generator on each level. A height of 7m has been assumed.*
2) *Minimum boundary distances have been halved on the basis that suppression systems are provided.*
3) *The boundary distance has been taken to the approximate centre point of the public road.*
4) *Boundary distance has been assumed to be midway between the EC2 and EC3.*
5) *Fire located in single generator unit at Ground Level or Level 2. A width of 12m has been taken as the width of one generator on each level. A height of 7m has been assumed.*

8.3.4 EC 3 MV Energy Centre

Space separation has been assessed for each elevation of the EC3 MV Energy Centre. The assessments assume:

- Floors within the central enclosed section are compartment floors.
- Central section will be enclosed in 60 minutes fire resisting construction.
- The generator deck at level 2 is effectively in open air with large openings on the main elevations and with a grating mesh walkway serving the roof cooling deck.
- If a fire was to occur at generator deck level, the units are protected by suppression and therefore a fire is unlikely to spread to more than a single unit. It is therefore assumed a fire could occur within one of the individual generator units but due to the provision of suppression, it will not spread further. Units are assumed to be less than 5m wide by 7m high when end on and 12m wide by 7m high when side on.
- Radiation values have been based on those for higher fire load buildings (i.e. due to generators as opposed to cooling units on gantries of the data centre).
- Minimum boundary distances have been halved on the basis that suppression systems are provided everywhere.
- Note: The equipment at roof level has not been considered for space separation as this fully in open air.

Table 21 - External Fire Spread Calculations EC3

Elevation	Largest Compartment Dimension (w x h)	Enclosing Rectangle (w x h)	Required boundary distance for 100% unprotected area within enclosing rectangle	Actual Boundary Distance	Unprotected % [Area] Allowed on Elevation
North (generator side on)	12m x 7m Note 1	12m x 9m	5.25m Note 3	8.87m Note 4	Satisfactory for a generator unit fire.
North (generator end on)	5m x 7m Note 2	6m x 9m	3.75m Note 3	3.96m Note 4	Satisfactory for a generator unit fire.
East	12m x 7m Note 1	12m x 9m	5.25m Note 3	9m Note 5	Satisfactory for a generator unit fire.
South (Generator)	5m x 7m Note 1	6m x 9m	3.75m Note 3	>39m Note 2	Satisfactory for a generator unit fire.
South (enclosed section)	15.5m x 5.15m	18m x 6m	5m Note 3	>39m Note 6	100%
West	5m x 7m Note 1	6m x 9m	3.75m Note 3	>45m Note 5	Satisfactory for a generator unit fire.

1) *Fire located in single generator unit at Ground Level or Level 2. A width of 12m has been taken as the width of one generator on each level. A height of 7m has been assumed.*
2) *Fire located in single generator unit at Ground Level or Level 2. A width of 5m has been taken as the width of one generator on each level. A height of 7m has been assumed.*
3) *Minimum boundary distances have been halved on the basis that suppression systems are provided.*
4) *Boundary distance has been assumed to be midway between the EC3 and the Data Centre.*
5) *Boundary distance has been assumed to be midway between the EC1 and EC3. Separation between buildings has been estimated to be at least 18m on basis of reduced footprint to EC1 for Plasma Design.* ***Design Team to Confirm.***
6) *The boundary distance has been taken to the approximate centre point of the public road.*

8.3.5 Visitor Reception Centres

There are no restrictions on the amount of UPA on the proposed buildings.

8.3.6 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 level of 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.

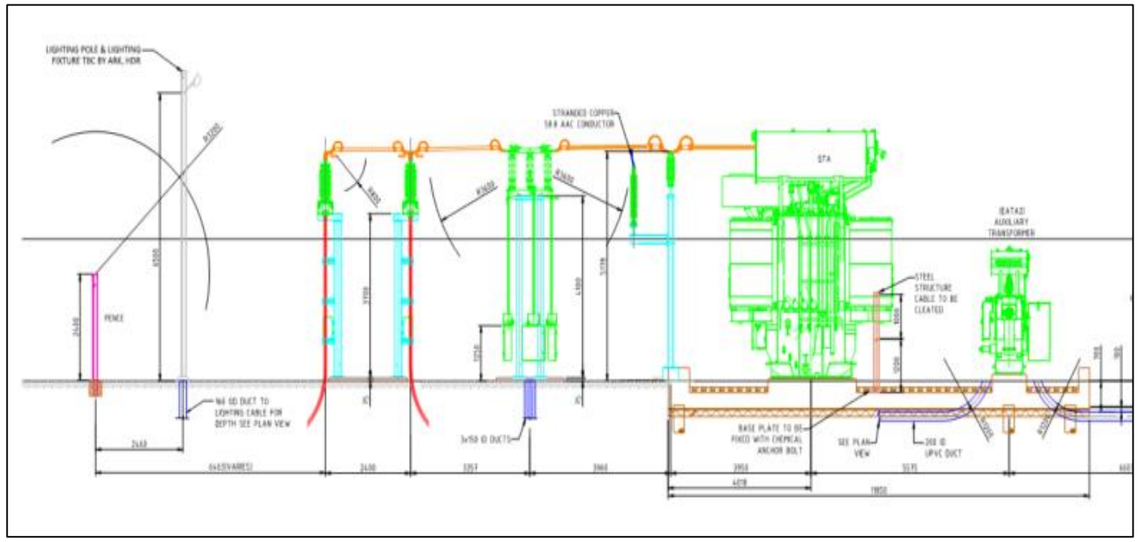

Figure 40 - Outline drawing of transformer and Auxiliary Transformer

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 1,000litres 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 22: 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.

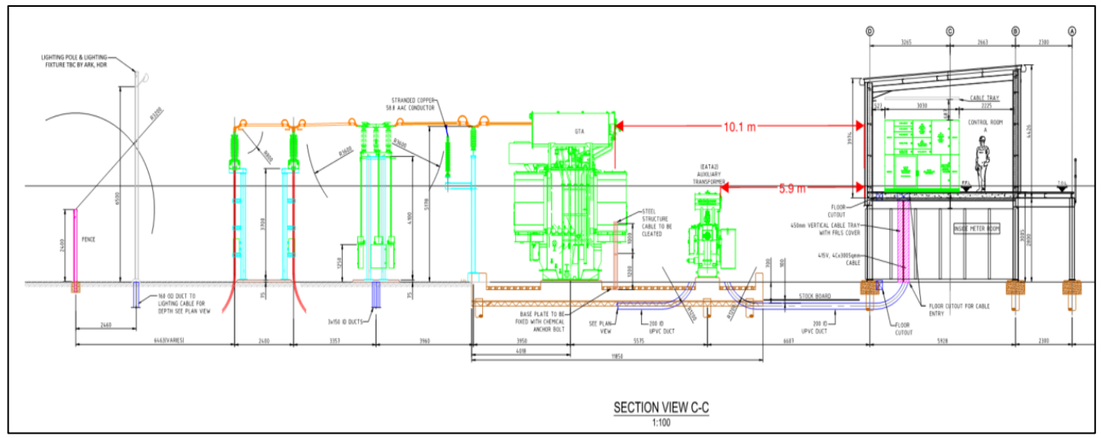

Figure 41 - Distance from Transformer to Substation Control Building

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 51 & 52).

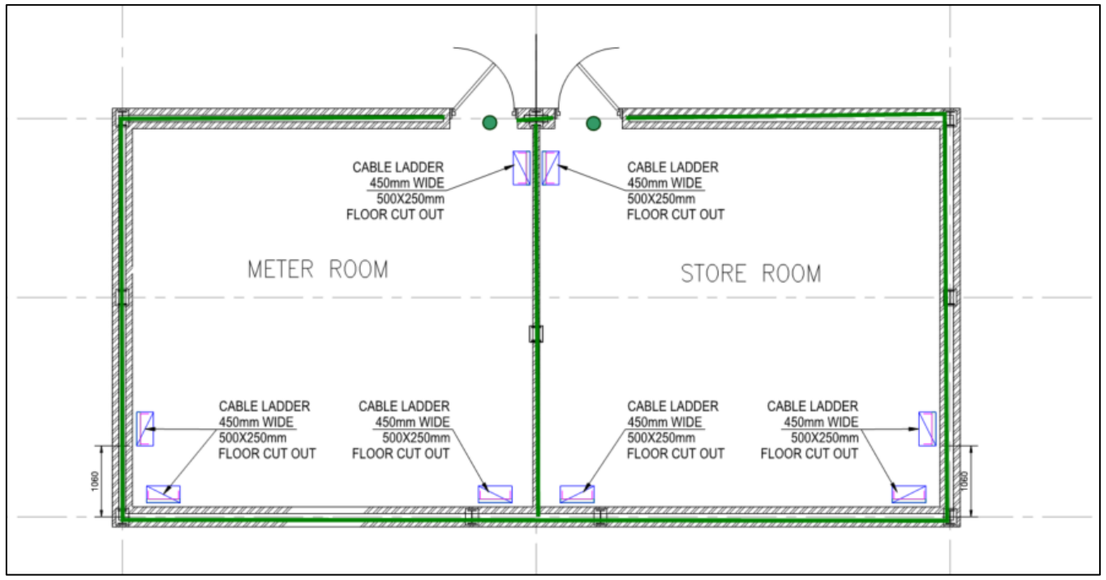

Figure 42 - Plan Drawing of fire resistance HV Substation Ground Floor

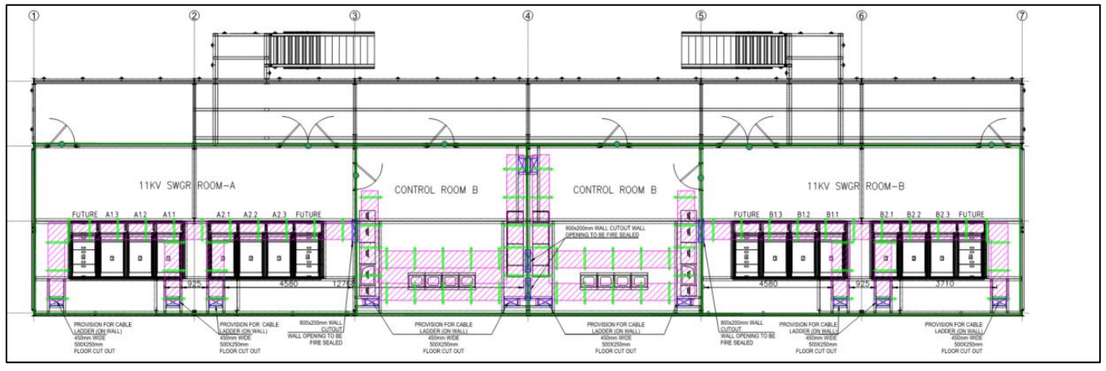

Figure 43 - Plan Drawing of fire resistance HV Substation First Floor

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 20m 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 51).

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 transformer should be calculated to ensure that a minimum of 110% can be achieved.

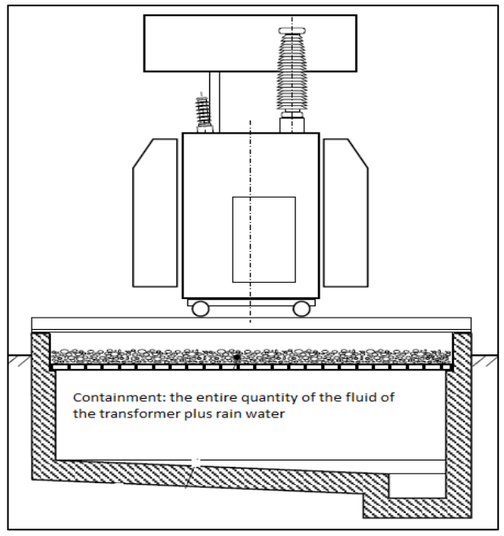

Figure 44: Sump with integrated catchment tank.