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00	2022.06.22	First issue (Draft)	MUKH	BWJ	PEJO
01	2022.07.29	First issue (2nd Draft)	SIBB	MUKH	PEJO
03	2022.09.02	Issued for consultation	SIBB	MUKH	PEJO
04	**2023.02.01**	**Issued for consultation – Update**	**SIBB**	**MUKH**	**PEJO**

Table of Content

1 Introduction

1.1 General

This fire safety strategy report is issued for the development of Newport Energy from Waste (EfW) Power Plant. The Newport EfW is located on the Alexandra Docks, Tom Lewis way, Newport, Wales.

The postal address is:
Newport Energy from Waste (EfW)
Land South of 14,
Tom Lewis Way,
Alexandra Dock,
Newport,
Wales,
NP20 2WZ

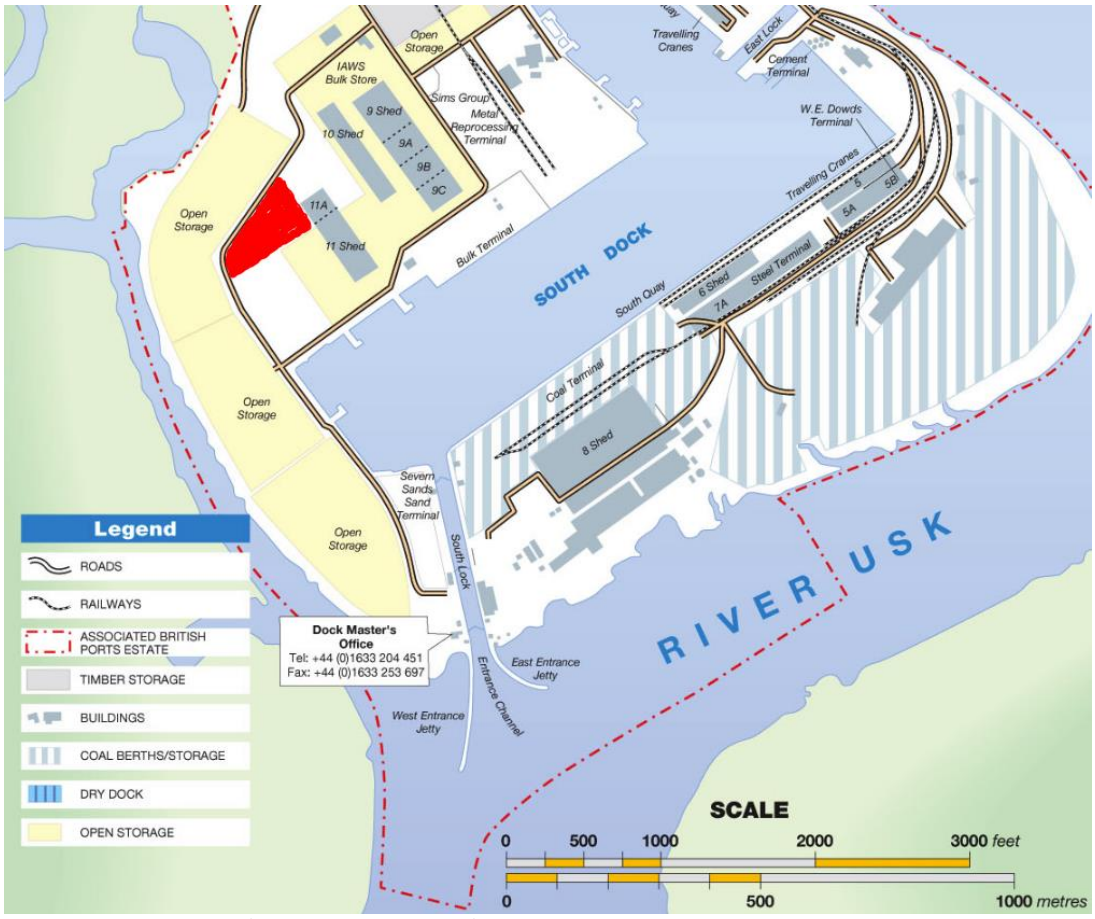


Figure 1 Newport Port Plan (development area in red)

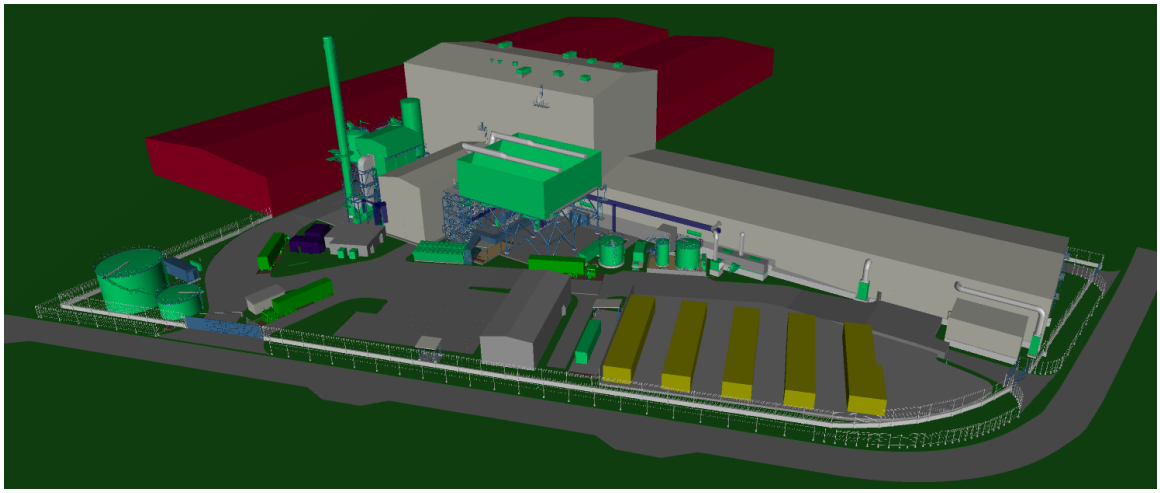


Figure 2 Site 3D model

Adjacent property to the Newport EfW Project is various mixed use open storage facilities to the North and West and APB warehouses to the South and East. Located to the South of APB warehouses is the South Dock. The total size of the development site is approx. 2 hectares.

1.2 Purpose

The purpose of this fire safety strategy report is to outline the fire safety features for the power plant incorporating both life safety and property protection features.

To demonstrate the fulfilment of the functional requirements, the BR2010, BS 9999:2017 and NFPA101:2018 will be used and referred to, where applicable.

With a project of this nature there are additional fire safety features that are recommended for incorporation to limit the potential for loss of productivity and property in the event of fire. In this regard the employer's specification, Insurer's requirements and the application of NFPA 850 are described in section 15 of this report.

1.3 Building Occupancy

The total occupancy of the Power Plant during normal operation is estimated to be maximum 30 people including operatives and fuel delivery drivers.

1.4 Layout of the Power Plant

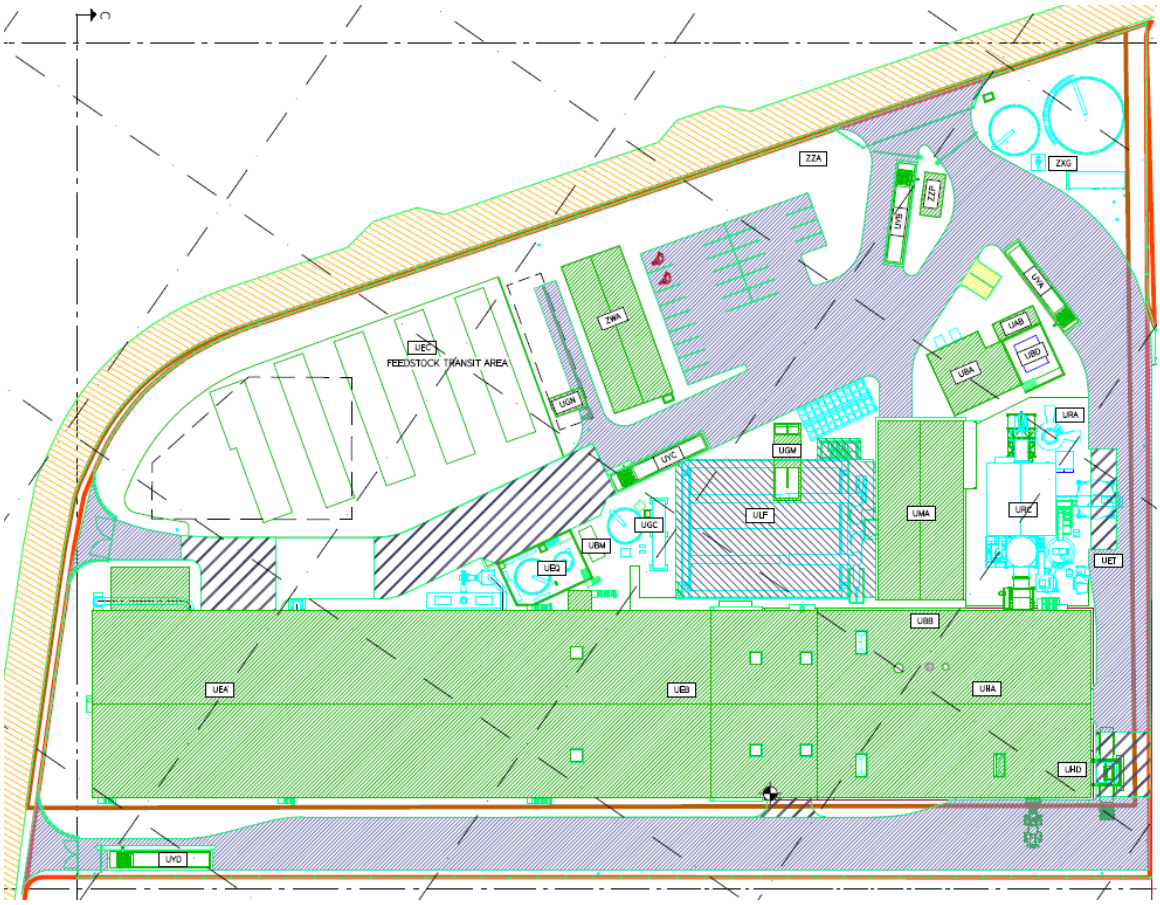


Figure 3 Site Layout

The following abbreviations (RDS-PP) for the buildings will be used throughout this report:

RDS-PP	**Building**
UAB	33 kV Substation
UBA	Switchgear Building
UBB	Electrical Annex
UBD	Step-up Transformer Area
UBM	Diesel Generator
UCT	Control Room
UEA	Unloading Solid Fuels Building
UEB	Fuel Bunker Building
UEC	Unloading Solid Fuel Building
UEQ	Fuel & Urea Tank Area

UET	Ash & Residues Storage Area
UGC	Water Treatment Area
UGM	Sedimentation Basin
UGN	Trade Effluent Treatment
UHA	Boiler Building
UHD	Slag Storage Building
ULF	Air Cooled Condenser Area
UMA	Turbine Building
URA	Stack Area
URC	Flue Gas Treatment Area
UYA	Weighbridge Area In
UYB	Weighbridge Area Out
UYC	Weighbridge Area In
UYD	Weighbridge Area Out
ZWA	Welfare Building
ZXG	Raw Water & Fire Equipment Area
ZXT	Workshop Building
ZST	Mechanical Workshop
ZZA	Remaining Site
ZZP	Gate House

Table 1 - RDS-PP

1.5 Plant description

The Newport EfW Project is a single line waste to energy Power Plant, which at full load, generate approximately 20 MW electrical power to the grid. The fuel for the Power Plant will be non-hazardous waste originating from Municipal, Commercial and Industrial Waste (as each is defined in section 75 of the Environmental Protection Act 1990). The Power Plant infeed fuel requirement at full load is some 27 tonnes per hour.

The Power Plant is designed to provide an enclosed process, from delivery, processing and storage of the feedstock, steam production in the boiler to the steam turbine generator set and finally electrical distribution. Open baled RDF storage (Feedstock Transit Area) is an emergency measure, planned for use during “long” weekends only.

Fuel is delivered to the Waste Fuel Unloading Area (Feedstock receiving area) by a single ISO accredited fuel supplier and unloaded directly into the reception/storage bunker by truck. Alternatively, the Fuel is delivered as baled RDF and temporarily stacked in the open Feedstock Transit Area. From the Transit Area, the bales are then transferred into the reception/storage bunker by telehandler.

From the reception/storage bunker the Fuel will be transferred by crane to the transfer area in the same bunker and from here the fuel is finally transferred by a second set of cranes to the receiving hopper for the boiler for combustion.

Combustion gas provides the heat to the boiler which produces steam for the steam-turbine-generator set producing electricity.

2 Relevant Legislation

2.1 Building Regulations 2010 (BR2010)

With regard to fire related issues, Newport EfW Project must be demonstrated to achieve compliance with the Building Regulations 2010.

2.1.1 Approved Document B (ADB)

It should be observed that ADB is not legislative and provides only one method by which BR2010 compliance can be achieved.

The "Use of Guidance" section of ADB states that:
"*The Approved Documents are intended to provide guidance for some or more common building situations. However, there may well be alternative ways of achieving compliance with the requirements.* ***Thus, there is no obligation to adopt any particular solution contained in an Approved Document if you prefer to meet the relevant requirement in some other way.***"

Therefore, BR2010 may be demonstrated to have been satisfied by:

- Compliance with the prescriptive guidance contained in ADB, BS 9999, CIBSE Guide E or any other associated documents referenced therein; or
- A fire engineered solution that is demonstrated to provide an acceptable level of protection to the occupants of the building, by use of the guidance of BS 7974, its associated published documents and/or any other relevant engineering documentation; or
- The use of one document to supplement the other in support of a fire engineered solution.

Where applicable the design of the Power Plant will be based on the recommendations contained in BS 9999. Where an element of the development cannot be assessed against BS 9999 (for example the boiler building, turbine hall, fuel storage etc.) then appropriate alternative guidance will be applied such as NFPA or a risk engineered approach adopted.

2.2 The Regulatory Reform (Fire Safety) Order 2005 (FSO 2005)

Once the building is completed and handed over to the client, the FSO 2005 becomes the governing legislation. The FSO 2005 replaces legislations such as the Fire Precautions (Workplace) Regulation 1997 and the Fire Precaution Act 1971 and imposes the general duty to take relevant fire precautions to ensure the safety of the building users and those in the vicinity.

As mentioned in the FSO 2005, the responsible person is required to carry out a risk assessment of the premises which must be suitable and sufficient to minimize the risk and exposure of the occupants to such risks.

In the FSO 2005 "responsible person" means:
(a) in relation to a workplace, the employer, if the workplace is to any extent under his control;
(b) in relation to any premises not falling within paragraph (a)—
(i) the person who has control of the premises (as occupier or otherwise) in connection with the carrying on by him of a trade, business or other undertaking (for profit or not);
or
(ii) the owner, where the person in control of the premises does not have control in connection with the carrying on by that person of a trade, business or other undertaking.

The order also places responsibility on the relevant person for the servicing and maintenance of all fire safety systems throughout the life of the building.

2.3 Construction (Design and Management) Regulations 2015

Under the Construction (Design and Management) Regulations 2015 (CDM) designers are required to minimize or design out hazards.

2.4 Construction Phase Plan and Health and Safety Manual

During the construction phase the Regulatory Reform (Fire Safety) Order 2005 and the Construction (Design and Management) Regulations 2015 comes into act as well.

3 Supplementary Fire Safety Recommendations

3.1 Adopted Guidance

In addition to the scope of BR2010 there is a requirement to minimize the potential for loss of production and loss of capital investment in the event of fire. International standards will be adopted for particular risk items (ref. section 15 of this report)

The provision of additional fire safety measures is incorporated into the fire safety strategy as a whole and provides an integrated fire safety regime for the Power Plant.

The following guidance has been adopted in this report:

- Employer's Specification, room data sheets etc.
- Guidance Document, Waste Processing Plant – Fire Systems, Issue 2.0, dated 19 May 2017(*1)
- Guidance Document, Energy from Waste – Fire Systems, Issue 3.0, dated 19 May 2017(*1)
- NFPA850 (2020) - Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations.

4 Risk Profiles – BS 9999

Central to the application of the recommendations contained within BS 9999 is a risk assessment of all buildings within the premises recommended to be carried out to determine the risk profile or profiles, as different areas might result in different risk profiles. The risk profiles indicate the potential for fire risk to the building occupants and are used in the design of fire safety systems, compartmentation, means of escape etc.

Risk profiles are given as a combination of occupancy characteristic and fire growth rate.

4.1 Occupancy characteristic

Ref. BS 9999, table 2
The occupancy characteristic covering all areas within the premises is determined in accordance with Table 2 to be: Occupancy (including people with disabilities) characteristic A
Based on the following:

- Occupants who are awake and familiar with the building
- Office and Industrial premises

Further, the Power Plant occupants will be aware of the fire safety provisions and precautions and visitors including contractors to the site will be accompanied and/or inducted in order to maintain characteristic A.

Occupancy characteristic	Description	Examples
A	Occupants who are awake and familiar with the building	Office and industrial premises
B	Occupants who are awake and unfamiliar with the building	Shops, exhibitions, museums, leisure centres, other assembly buildings, etc.
C (Ci to Ciii)	Occupants who are likely to be asleep	(Ci) Individual flats without 24 h maintenance and management control on site (Cii) Serviced flats, halls of residence, sleeping areas of boarding schools (Ciii) Hotels
D	Occupants receiving medical care	Hospitals, residential care facilities

Table 2 - Occupancy Characteristics

4.2 Fire growth rate

Ref. BS 9999, table 3

The fire growth rate is the rate at which it is estimated that a fire will grow. The fire growth rates are divided into four categories 1 to 4 as per the following:

Category	Fire growth rate	Fire growth parameter (kJ/s^3)	Description	Typical examples
1	Slow	0.003	Evenly distributed low level fire load, small discrete packets of fuel or material of limited combustibility	Reception areas, concourses (without concession outlets) and halls with limited fire load such as sports stadia and foyers
2	Medium	0.012	Evenly distributed low to mid-level fire load comprising a mix of combustible materials	Offices, lounges, class-rooms, auditoria, seating areas, galleries and car parks
3	Fast	0.047	Stacked combustibles (on or off racking and shelving but excluding high rack storage), some small quantities of materials other than materials of limited combustibility (or where larger quantities are stored in separate fire-resisting enclosures), process, manufacturing or storage of combustible materials	Shop sales area, workshops, factories and small storage buildings
4	Ultra-fast	0.188	Medium to large quantities of materials other than materials of limited combustibility, high racked storage, flammable liquids and gases or were rapid uncontrolled fire growth could occur	Warehousing, processing plants and car parks E) utilizing a car stacker or similar method where there is no fire separation between stacked cars

Table 3 - Fire Growth Rate Categories

Within table 3 – Descriptions, various types of combustible and flammable materials are listed for each category, as well as Typical examples of commodities (refer to BS 9999 for further details).

Additionally, to assist in determining the fire growth parameter for the various areas the following document has been consulted: 11th IAFSS Symp. pp. 517-530

4.3 Risk profile

The following table indicates the risk profiles allocated to each of the main areas of the Power Plant:

Area	RDS	Risk profile	Comment / Fire growth parameter [kJ/s^3]
External RDF Stockyard	EAE	A3 (4)	(1)
33kV Substation	UAB	A1	(2) ~0,0009 (<0,002) Note: The building is not addressed regarding fire detection, fire suppression or means of escape within this report. The building is operated and owned by the utility company.
11kV Substation - Dry-type transformer	UAB	A1	(2) ~0,0009 (<0,002)
Step-Up Transformer Area	UAB	A2 (3)	(1)
Electrical rooms	UBB	A1	(2) ~0,0029 (<0,012)
Control Room	UCT	A1	(2) ~0,00883 (<0,012)
Welfare Building	ZWA	Mixed	Mixed
- Electrical rooms		A1	(2) ~0,0029 (<0,012)
- Spare part storage room		A2	(2) ~0,0232 (<0,047)
- Office		A2	(1)
Waste Fuel Unloading Area	UEA		(7) Recommended storage time for waste
- Bunker		A3 (5)	(1)
- Tipping hall		A3 (3)	(1)
Waste Fuel Storage Area	UEB		(7) Recommended storage time for waste
- Bunker		A3 (5)	(1)
- Boiler feed hopper		A3 (3)	
Service Tank Farm - Diesel oil (combustible liquid	UEQ	A3	(8) The diesel oil flashpoint will be minimum 56 °C and stored in the diesel oil storage tank having a capacity up to 120 m^3

with flash point at or above 37.8°C).			
Slag Storage Area	UHD	NA	
Effluent Area	UGM	NA	
Trade Effluent Treatment	AGM	NA	
Boiler Building	UHA	A1	Except for the boiler front and the area for the auxiliary burners, the building holds none or a limited amount of combustible materials.
Boiler building boiler front and auxiliary burner area.	UHA	A3 (3)	(1)(6)
Turbine Building	UMA		
- Turbine Hall		A3 (3)	(1)(6)
- Compressor room Annex		A1	(2) ~0.00803 (<0,012)
Air Cooled Condenser Area (ACC)	ULF	A1	(2) ~0,0029 (<0,012)
Fire Equipment Area	ZXG	A2 (3)	(1)
Workshops	ZXT ZST	A2	(2) ~0,0171 (<0,047)
Flue Gas Treatment Area (FGT)	URA URC UET	NA	
Weighbridges	UYA-D	NA	
Security Gate House	ZZP	A2	(1)

(1)/(2)/(6)	Fire growth rate (kW/s^2). (1) The fire growth rates are based on BS 9999, table 3 (2) The fire growth rates are based the 11th IAFSS Symp. pp. 517-530 (6) Category considered high due to the possible quantities of combustible liquids.	
(3)	Areas are installed with fixed fire suppression system at risk areas. The risk profile has typically been reduced accordingly to the level indicated.	
(4)	The area is external and covered by the site hydrant provision.	
(5)	Fire water monitors are installed to cover the area. The fire water monitors will be located to allow for coverage of all pit areas with two (2) streams operating simultaneously. The risk profile has not been reduced.	
(7)	Combustible waste type	Max. storage time
	Non-shredded or similarly treated wastes (that is wastes whose particle size has not been reduced)	6 months
	Baled and compacted wastes	6 months

	Shredded and similarly treated wastes (that is wastes whose particle size has been reduced)	3 months
	Combustible fines/dusts and very small particle size wastes	1 month
	Ref. *WASTE 28 Reducing fire risk at waste management sites issue 2 – April 2017*	
(8)	The HSE guidelines HSG176, Storage of flammable liquids in tanks. Section 10: The document defines flammable liquids as liquids having a flashpoint of 60 °C or below. Section 78: table 1, recommend a minimum separation distance of 8 m for single 'small' tanks (larger than 33 m3 and less than or equal to 100 m3) from site boundaries, buildings, process areas and fixed sources of ignition. Section 14: The precautions described in this document may not be necessary for those flammable liquids whose temperature is always likely to be significantly below the flashpoint and where there is no potential for a flammable mist or spray to form. Advice on less restrictive measures for these liquids is given in the chapter 'Higher flashpoint liquids. Where no variation is given, the advice in the main text applies. Section 277: Where the flashpoint of the liquid is significantly above the highest operational temperature, some of the precautions described may be relaxed. Under these circumstances such liquids will not normally produce a flammable atmosphere. The risk assessment required under regulation 5 of DSEAR (see paragraph 17–18) should be used to determine which, if any, of the precautions can be relaxed. In general, a difference of at least 10 °C between the highest temperature and the flashpoint is recommended before such relaxations are permitted. **The temperature of the diesel oil inside the storage tank should not, with the given maximum ambient temperature of 33 °C, be able to increase to a temperature to 10 °C less than the flashpoint of 56 °C. Consequently, the separation distance is considered acceptable to be less than 8m.** NFPA 30 (2018), Flammable and Combustible liquid code Chapter 22.8.2: Fixed-roof tanks storing Class II and Class III liquids at temperatures below their flashpoint and floating-roof tanks storing any liquid shall not require protection when installed in accordance with this chapter (i.e. Chapter 22). **The diesel oil tank is not installed with a fire suppression system.**	

Table 4 - Risk Profiles

Means of escape provisions are assessed in the following sections using the above risk profiles where appropriate for the area concerned.

5 Means of warning

5.1 Requirements

The building shall be designed and constructed so that there are appropriate provisions for the early warning of fire, and appropriate means of escape in case of fire from the building to a place of safety outside the building capable of being safely and effectively used at all material times.

5.2 Fire detection and alarm system

A fire detection system is installed for monitoring the power plant. The fire detection system shall -

1. by means of the installed visual and audible devices, alert occupants for evacuation of the area in which the detection system is activated.
2. inform the plant operator about location in which the detection system is activated for immediate action (firefighting, require assistance etc.) to prevent a possible fire to develop.

The fire detection system comprises the following main elements:

- a main fire alarm panel
- a mimic panel for the fire department for easy identification of the area in which the detection system is activated. The mimic panel will be located in the gate house (to be agreed with the local Fire Authority)
- fire control panels
- fire detectors and visual and audible alarm devices.

The following fire detection and alarm provisions are to be included as part of the fire safety measures:

Area	RDS	Manual call point	Automatic detection	Alarm
External RDF Stockyard	EAE	NA	NA	NA
33kV Substation (refer to note in table 4)	UAB	NA	NA	NA
11kV Substation	UAB	Yes	Yes	Yes
Electrical Rooms	UBB	Yes	Yes	Yes
Welfare Building	ZWA	Yes	Yes	Yes
Step-Up Transformer Area	UAB	Yes	Glass bulb (sprinkler release)	Yes
Waste Fuel Unloading Area	UEA	Yes	Yes	Yes

			(flame detectors and thermal cameras)	
Waste Fuel Storage Area	UEB	Yes	Yes (flame detectors and thermal cameras)	Yes
Diesel Fuel and Urea Tanks	UEQ	Yes	Yes	Yes
Slag Storage Area	UHD	None	None	None
Effluent Area	UGM	None	None	None
Trade Effluent Treatment	AGM	None	None	None
Boiler Building	UHA	Yes	Yes	Yes
Turbine Building.	UMA	Yes	Yes	Yes
Air Cooled Condenser Area (ACC)	ULF	None	None	None
Fire Equipment Area	ZXG	Yes	Yes	Yes
Workshops	ZXT ZST	Yes	Yes	Yes
Flue Gas Treatment Area (FGT)	URA URC UET	Yes	Yes	Yes
Weighbridges	UYA UYB UYC UYD	None	None	None
Security Gate House	ZZP	Yes	Yes	Yes
Attenuation Pond	ZXH	None	None	None

Table 5 - Fire Detection and Alarm Provisions

Fire detection and alarm system is designed in accordance with BS5839 Pt 1. Manual call points are provided at all storey and final exits, plant stair landings. Distribution of manual call points should, after final fit out of the premises, be such that no one need travel more than 45 m to reach the nearest manual call point.

The following categories of detection and alarm are considered appropriate:

- Administration and ancillary areas (offices etc.) – L1/P1 (systems installed throughout all areas of the building)
  and -

- Process and plant areas (Indoor, - boiler building, turbine hall, fuel storage and transportation etc.) – L2/P2 (systems installed only in defined parts of the building)

Note:
Designing the fire detection system to comply with level L2/P2; - the detection system will be provided and installed to monitor areas that have been identified as risk areas during review of the plant and carrying out the fire risk assessment. As the fire risk assessment most likely will develop throughout execution of the project and should this call for additional areas to be installed with fire detectors, the fire detection system to be installed will allow for extension.

Automatic detectors will be selected to minimise the risk of false alarms caused by ambient conditions (e.g. dust levels in fuel storage areas, shredder areas etc.).

5.3 Battery room

In case of black-out on the Power Plant various systems e.g. the DC systems and the emergency lube oil pump are emergency supplied by the batteries (UPS - Uninterruptable Power Supplies) located in the battery room.

Small amounts of hydrogen gas are released during charging of the batteries.

As hydrogen gas is flammable with a lower explosive limit of 4 vol. % and an upper explosive limit of 75 vol. %, an explosive mixture with air may form if the room is not sufficiently ventilated.

To maintain the hydrogen concentration below the lower explosive limit, the room is subject to monitored ventilation (redundant) with a minimum air exchange rate specified according to BS EN 50272.

Battery room – Classified ATEX zone 2
Should the redundant ventilation system fail, charging of the batteries for e.g. the DCS will change to emergency charging. However, charging of the batteries for the emergency lube oil pump must be maintained.

Consequently, the fire detection and lighting are rated and installed as ATEX zone 2 equipment.

5.4 Fire detectors

The following table provides an indication of the type of detection available to be used depending on perceived risk in the various areas:

Detector type:	Installation area:	Applicable for areas such as:	Not suitable for detection of:
Heat Detector, fixed temperature	Fog- and Misty Areas, Dusty areas, Smoky areas, Steamy areas. In areas/ zones where a rapid (hot) fire is capable to develop more heat than smoke. Process: Rapid oxidation of materials in the exothermic chemical process of combustion releasing heat (Hot Fire).	Outdoor substations. Generators. Solid fuel handling and storage areas.	Slow (shouldering) fires, Low heat fires
Heat Detector, rate-of-raise	Fog- and Misty Areas, Dusty areas, Smoky areas, Steamy areas. In areas/ zones where a rapid (hot) fire is capable to develop more heat than smoke. Process: Rapid oxidation of materials in the exothermic chemical process of combustion releasing heat (Hot Fire).	Outdoor substations. Generators. Solid fuel handling and storage areas.	Slow (shouldering) fires, Low heat fires
Line heat cable, fixed temperature	Small enclosed areas, cable-trays, tunnels etc. Fog- and Misty Areas, Dusty areas, Smoky areas, Steamy areas. In areas/ zones where a rapid (hot) fire is capable to develop more heat than smoke. Process: Rapid oxidation of materials in the exothermic chemical process of combustion releasing heat (Hot Fires).	Enclosed conveyors, Drag Conveyors, Conveyors, Detection in between electrical cables	Slow (shouldering) fires, Low heat fires
Smoke Detection, Ionisation element	Relative clean, steam and dust-free environments/ areas where a fire will develop a concentration of smoke from material emits as it burns.	Switchgear rooms, Offices, Server and computer rooms	Dusty areas with high air velocity, Steamy areas
Smoke Detection, Optical element	Relative clean, steam and dust-free environments/ areas where a fire will develop a concentration of smoke from material emits as it burns.	Electrical cables and machinery, Plastics, Air-conditioned areas, Computer rooms	Dusty areas, Steamy areas
Aspiration detection combined with CO detection	Aspiration detects smoke generated by flaming or smouldering fires. CO detectors detect and warn about dangerous CO-gas build-up	Very Dusty & Smoky Areas e.g. Open structures. Explosion risk areas. Gas accumulation areas.	
Flame	Flammable gases, Explosion risk areas, Smokeless areas, Areas with air movement, Chemical fires, Fuel handling, Hydrocarbon fires	In areas were an open flaming fire flame is a mixture of reacting gases and solids emitting visible, infrared, and sometimes ultraviolet light, the frequency spectrum of which depends on the chemical composition of the burning material and intermediate reaction products.	Smoky fires, Smouldering fires, Areas with obstructions to line of sight
Smoke optical beam	Ducts, Large open areas, Corridors	Warehouses, Computer room, Turbine halls	Dusty areas, Areas with obstructions to line of sight
Flammable & Explosion Gas Detection	Areas where explosion or flammable gases can occur.	Indoors or outdoors, Ventilation plenums	Areas containing Sulphur, Toxic gas detection

Table 6 - Fire Detector Types and Usage

The type of detectors mentioned in table 6 shall not be considered as mandatory to be installed in a specific risk area but listed for guidance only. There might be alternative type of detectors which provide equally monitoring and protection of a specific area. Additional to the detector types mentioned above thermal imaging cameras will be accepted to be installed in areas to assist e.g. identifying a hot area/spot in the storage building.

The level of automatic fire detection and alarm provided exceeds the minimum requirements of the Building Regulations.

The fire control panels (sub-panels) and the mimic panel are connected to the main fire alarm panel located in the Control Room.

The mimic panel will be located in the gate house to provide immediate indication of the system status to any personnel (including firefighting personnel) entering the site.

The fire control panels are located in strategic areas for local monitoring of fire detection and alarm devices. Status information from each of the fire control panels is relayed back to the main fire alarm panel in the Control Room.

6 Means of escape

6.1 Requirements

Ref. BS9999:16.1
Escape routes from each storey (or level) should be so sited that a person confronted by fire can turn away and make a safe escape through an alternative exit. Routes of travel should be free from any serious obstacle that could cause undue delay, especially to disabled people, e.g. raised thresholds or steps, or doors that are difficult to open.

6.2 Horizontal travel distances

6.2.1 Horizontal escape

Ref. BS9999
Maximum permissible travel distance for general buildings according to Table 11:

Risk Profile	Travel Distance, in metres (m)	
	Two-way travel	One-way travel
A1	65	26
A2	55	22
A3	45	18

Table 7 - Travel Distances - General Buildings

Maximum permissible travel distance for weather house plant (UHA, UEA, UEB) according to Table F.1:

Risk Profile	Travel Distance, in metres (m)	
	Two-way travel	One-way travel
A1	100	20
A2	100	18
A3	60	13

Table 8 - Travel Distances - Weather Housed Plant (UHA, UEA and UEB

For a means of escape to be deemed to have two-way travel, each route is required to be either:

- Separated from one another by an angle of not less than 45º, or
- Separated from one another by fire resisting construction, or
- Spatially separated from one another by a distance sufficient to ensure that both routes are not affected by a fire simultaneously

The width of escape routes is according to BS9999: 16.6.2
- Corridors accessible for wheelchair users will be 1,200 mm wide.
- Corridors not accessible for wheelchair users will be not less than the minimum exit widths described in Section 6.2.3 of this report.

For Industrial Equipment Access a minimum horizontal width of 560 mm of any walkway, landing or platform, is required based on the provisions of NFPA101 (2018) Table 40.2.5.3.1. This reduced width can be used in the Process areas with no public access, and all obstructions are fixed obstructions.

The 560 mm width walkway is restricted to areas adjacent equipment and is limited locations.

Platforms, handrails and stairs shall be designed according to BS EN ISO 14122 and BS5395.

The means of escape drawings for each main area are listed in section 18 and included in the attachment to this report ref. 1017.M0.J01.002 (to be added)

6.2.1.1 Waste Fuel Unloading Area and Waste Fuel Storage Area

The waste fuel unloading area and the fuel storage area are located within the same building and as such in open connection. The building is a two-storey building holding the bunker for the received fuel, the transfer bunker, and the infeed hoppers for the boilers. Building is built together with the Boiler Building separated by internal concrete structure and/or cladding (min. 120 minutes fire rated).

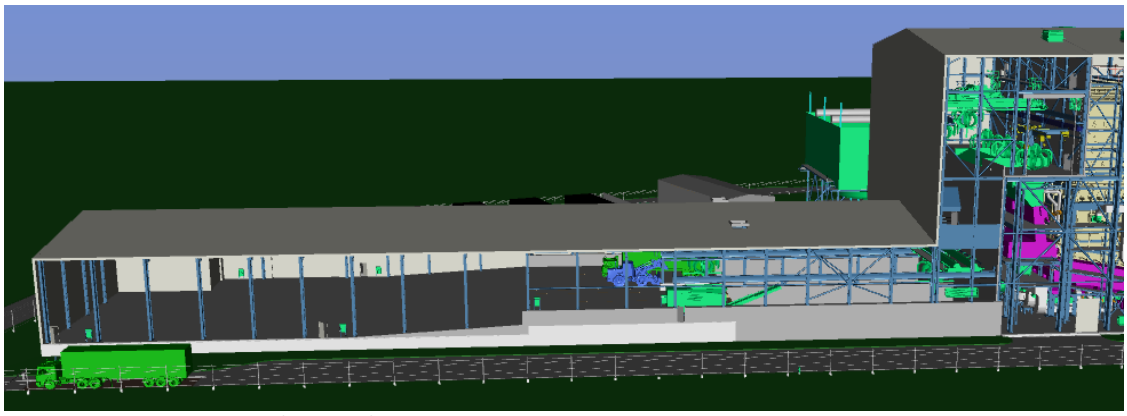


Figure 4 - Waste Fuel Handling (UEA, UEB)

6.2.2 Vertical escape – buildings

6.2.2.1 Electrical Room - UBB

The Electrical room is constructed as a three-storey internal structure inside the Boiler Building. The structure and each individual floor are considered separate fire zones and separated from the Boiler Hall (and each other) by 2hr fire separation.

The Electrical Rooms are installed with raised floors (void space height 2.0 m) covering the complete footprint of the room. Any access beneath the raised floor for maintenance will be provided by means of movable ladders from above. Access shall be supervised and carried out according to Confined Space Regulations 1997.

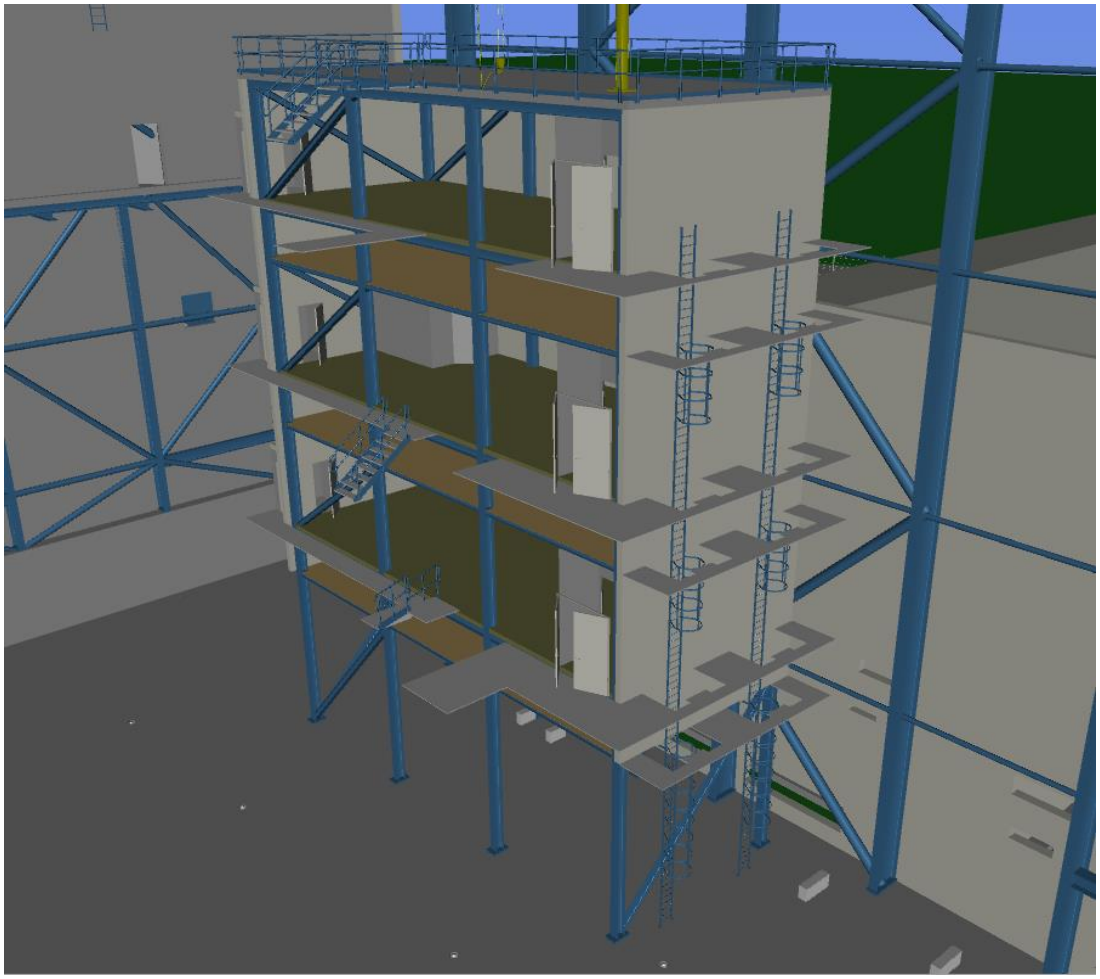


Figure 5 - Electrical Room (UEA)

Main access to the 3 floors is provided via stair links to the internal access galleries rf. below. Additionally, emergency exits are provided for each room directly to the outside and via platforms and marine ladders to the ground.

6.2.2.2 Boiler building - UHA

The Boiler building is a single storey building with a number of internal access galleries - the highest of which is some 32.6 m above ground level.

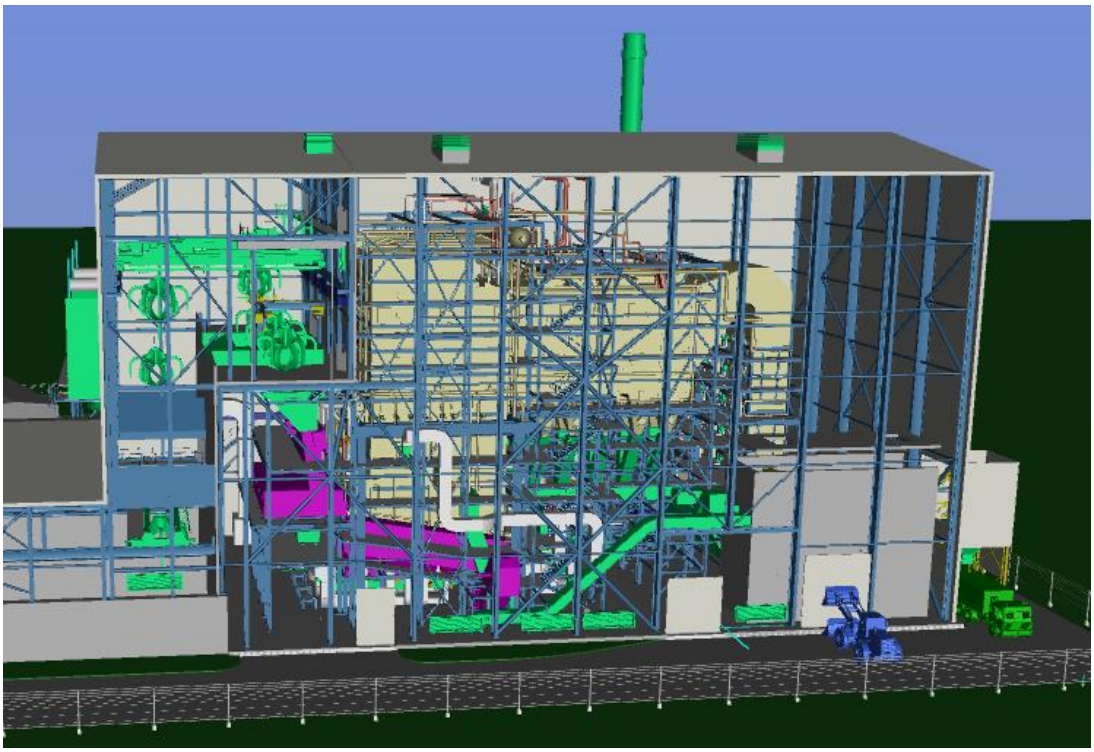


Figure 6 - Boiler Building (UHA)

All main galleries from level +32.600 to ground level +0.000 are vertically linked by means of two internal main access and egress stairs (open staircase) positioned on either side of the boilers (north and south) sized not less than 800mm mm in width.

Additional stair links are provided between vertically adjacent galleries.

The internal stairs discharge within the boiler building at ground level and alternative directions of escape are provided from the base of each stair. These alternative directions of escape could either be directly leading to outside building or leading into a separate 120-minute fire rated compartment which further lead to the outdoor. Discounting one of the stairs (spatial separation of the stairs and the sheer volume of the building mean that one will always be available for use in the event of a fire) there

will always be more than adequate capacity for vertical means of escape within the building.

A small number of dead-end conditions exist on the boiler galleries but these are of very short distance and the open nature of the galleries ensures rapid detection of any fire event by personnel in the vicinity; the short single direction travel distances are therefore deemed acceptable.

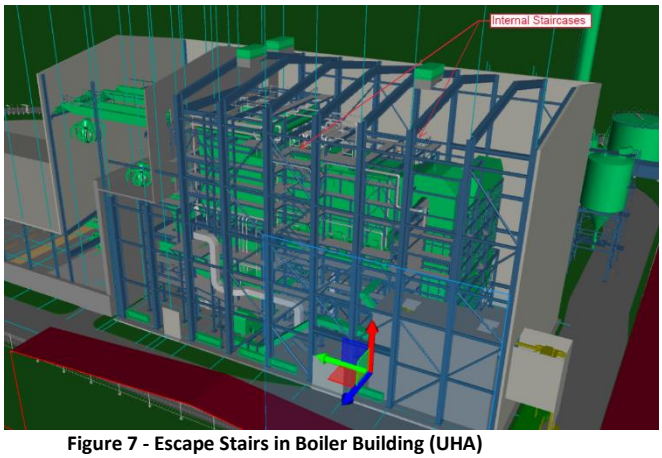


Figure 7 - Escape Stairs in Boiler Building (UHA)

6.2.2.3 Turbine building – UMA

The turbine building is provided with internal open-grate stairs, spatially separated to maintain the use of at least one in the event of fire.

6.2.2.4 Fuel storage area (boiler infeed hopper area) –UEB

Escape from the boiler infeed hopper area is provided through the boiler building. The boiler building is a separate 120-minute fire rated compartment.

6.2.3 Storey exits

Ref. BS9999: 16.6

The absolute minimum exit width for the purposes of means of escape is stated as being not less than 800mm.

According to table 12 of BS9999 the minimum door width per person should be:

- Risk profile A1 – minimum 3.3mm. 800mm door can serve 242 occupants
- Risk profile A2 – minimum 3.6mm. 800mm door can serve 222 occupants
- Risk profile A3 – minimum 4.6mm. 800mm door can serve 173 occupants

Welfare (and Administration) building:

Minimum required exit clearance width is 850 mm: This is an increase from the absolute minimum width and provided to accommodate wheelchair users.

Fuel storage area and process areas:
All exits from the fuel storage and process areas will be inherently larger than required for the occupancy of the areas due to the requirement for transportation of equipment to and from the areas.

All doors used as exits, whether they are storey or final exits shall be openable by a single simple operation without requiring the use of tools or keys. Doors held closed for security purposes shall freely open in the event of a fire.

6.2.4 Final exits

All final exits shall be designed to lead to a place of ultimate safety away from the building concerned and provide clear widths of not less than the minimum requirements in Section 6.2.1 of this report. Final exits shall lead to the place of safety via hard landscaping and the route provided with emergency lighting.

6.2.5 Means of escape for disabled persons

It is not envisaged that there will be disabled operatives in any service buildings, fuel storage or process areas. The welfare building may well have disable occupants or visitors on occasion and the following measures are recommended.

The evacuation of disabled persons is the responsibility of the building operator; no reliance can be placed on or assumed from the fire authority. The critical issue in terms of structural provisions is designing for the means of escape of mobility-impaired persons, in particular wheelchair users. The strategy for this should be rigorously developed in collaboration with the Building Management. It is also necessary to consider all disabilities, and the general principles for designing effective escape for other types of disability are summarised below.

Hearing and visual impairment: Audible alarms will as well as flashing beacons be installed throughout the plant to notify occupants to evacuate the building. Hearing and visual impaired persons should generally be assisted during evacuation of the building. Successful escape for other impaired persons is helped by ensuring legibility of the building – as recommended in BS 8300.

Disabled staff will be encouraged to produce PEEPS (Personal Emergency Egress Plans) in collaboration with the building operator; this will ensure an appropriate resource and response tailored to the individual needs of the disabled person and the specific features of the building itself (the “Building Capability”). PEEPS can also be prepared for

the "generic" types of disability, to ensure the best management response for evacuation of non-staff occupants.

As a two-storey building, the Welfare (and Administration) building will be provided with refuge points.

6.2.6 Inner rooms

The Welfare Building and the process areas holds rooms that would be classed as 'inner rooms'; these specific areas are mitigated by limited occupancy (i.e. less than 60 occupants and infrequent use). These rooms (and the rooms from which they are accessed) are fitted with automatic fire detection and audible alarm.

6.2.7 Protection of stairways

6.2.7.1 *Welfare Building - ZWA*

Stairways (staircase or ladders) adjoining the external wall of the building and forming part of an escape route will be protected for 30 minutes within 1.8 m of the façade.

6.2.7.2 *Plant areas: Boiler building - UHA, Turbine building - UMA etc.*

Stairways (staircases or ladders) adjoining the external wall of the building and forming part of an escape route are not considered to be protected. Areas for plant and equipment have been assessed in regard to fire risks and suppression systems installed.

7 Emergency lighting

Escape lighting to BS 5266: Part 1 is to be provided following standard guidance in BS 9999 and Emergency light will be provided for critical plant operation areas according to NFPA850; 6.6.2

The lighting and small power drawings for each main area are listed in section 18 of this report and included in the attachment to this report ref. 1017.M0.J01.002 (to be added)

8 Fire spread

8.1 Internal fire spread

8.1.1 Requirements – Linings

Ref. BR2010
B2,-

1) To inhibit the spread of fire within the building, the internal linings shall:
   a) Adequately resist the spread of flame over their surfaces; and
   b) Have, if ignited, a rate of heat release or a rate of fire growth, which is reasonable in the circumstances.

2) In this paragraph 'internal linings' mean the materials or products used in lining any partition, wall, ceiling or other internal structure.

The classification of the surfaces of the internal walls and ceilings will comply with the requirements of the BS 9999.

These requirements reduce the likelihood of fire spreading in a building due to the combustibility of the internal linings.

The surface linings of the internal walls and ceilings shall comply with the classifications listed below in the following tables (ref. BS 9999, table 33)

Table 33 **Classification of linings**[A]

Location	National class[B]	European class[C, D]
Small room of area not exceeding 4 m² in a residential building and 30 m² in a non-residential building and domestic garages not exceeding 40 m²	3	D-s3, d2
Other rooms (including garages)	1	C-s3, d2
Circulation spaces within dwellings	1	C-s3, d2
Other circulation spaces[D] including the common areas of flats	0	B-s3, d2

NOTE Linings which can be effectively tested for "surface spread of flame" are rated for performance by reference to the method specified in BS 476-7:1987, under which materials or products are classified 1, 2, 3 or 4, with Class 1 being the highest. Class 0 is better than Class 1. It is not identified in any BS test standard. A Class 0 product is either:

a) *composed throughout of materials of limited combustibility; or*

b) *a material having a Class 1 surface spread of flame and which has a fire propagation index (I) of not more than 12 and a sub-index (i_1) of not more than 6.*

The fire propagation index is established by reference to the method specified in BS 476-6.

European classifications are described in BS EN 13501-1:2007+A1.

[A] Recommendations are given in Clause **33** for linings of concealed voids.

[B] The national classifications do not automatically equate with the equivalent classifications in the European column, therefore products cannot typically assume a European class, unless they have been tested accordingly.

[C] When a classification includes "s3, d2" this means that there is no limit set for smoke production and/or flaming droplets/particles.

[D] Large rooms such as open plan offices, shops display areas and factories need not be regarded as circulation spaces even though there are circulation routes in them.

Table 9 - Classification of Linings

8.1.2 Requirements – Structure

Ref. BR2010
B3,-

1. The building shall be designed and constructed so that, in the event of fire, its stability will be maintained for a reasonable period.
2. A wall common to two or more buildings shall be designed and constructed so that it adequately resists the spread of fire between those buildings.
3. Where reasonably necessary to inhibit the spread of fire within the building, measures shall be taken to an extent appropriate to the size and intended use of the building, comprising either or both of the following:
    a. Sub-division of the building with fire resisting construction;
    b. Installation of suitable automatic fire suppression systems
4. The building shall be designed and constructed so that the unseen spread of fire and smoke within concealed spaces in its structure and fabric is inhibited

8.1.2.1 Structure – BS 9999

There are separate requirements for the structural fire performance of the Power Plant in accordance with BS9999, table 25:

- Welfare (and Administration) Building (ground floor level and 1st floor) - height of top occupied storey 8.6 m, unsprinklered: 60 minutes fire resistance for elements of structure
- Workshop building (single storey): No requirement according to BS 9999 30.2.3
- Boiler Building and Turbine Building (single storey): No requirement according to BS 9999 30.2.3
- Fuel storage building (single storey): No requirement according to BS9999: 30.2.3

Note: Equipment located on roofs is considered maintenance free during normal operation of the plant. Access to maintenance free equipment is provided but does not form part of escape routes and will not be fire rated.

8.1.2.2 Structure – Insurers requirement

The boiler building, the turbine building, and the fuel storage buildings are single storey buildings and in general not required to be fire rated as risks inside buildings has been identified and addressed. Identified risks have been installed with fire suppression systems.

Specific for Fuel Storage Building Fuel unloading crane rails and roof building structure to be protected by water spray system.

Steel columns exposed vertical steel structures protected by an automatic water-based system.

Steel columns located at front of the fuel pits to be protected against structural damage caused by heat (2hr rating).

8.1.3 Compartmentation – BS 9999 requirements, Table 28

There is no limit on the compartment size for the Welfare Building as the highest occupied storey is less than 30 m above ground.

The remainder of the Power Plant:
Single storey buildings within Risk Profile A1, A2 and A3 are not restricted in regard to maximum floor area (no limit).

8.2 External fire spread

Functional Requirement

1) The external walls of the building shall adequately resist the spread of fire over the walls and from one building to another, having regard to the height, use and position of the building.
2) The roof of the building shall adequately resist the spread of fire over the roof and from one building to another, having regard to the use and position of the building.

8.2.1 Construction of external walls

BS 9999 fig. 47 recommends that the external cladding of the building to be provided with Class 1 (national class) or Class C-s3, d2 or better (European class) or better up to a height of 18m above ground for buildings with a height of 18m or more. Above this height, BS9999 fig. 47 recommends that the external cladding of the building to be provided with Class 0 (National) / B-s3,d2 (European) or better.

8.2.2 Space separation – Building Regulation requirement

A requirement of the Building Regulations is that the external wall of a building shall adequately resist the spread of fire from one building to another. This is achieved by ensuring that the building under consideration has sufficient spatial separation from adjacent buildings.

For the purposes of life safety, the separation between buildings on the same site and subject to the same management regime can usually be ignored (BS 9999 35.1.2). It is therefore not proposed to analyse the potential for fire spread between the buildings on site for the purposes of the Building Regulations.

For business continuity and consequential loss, limitation in the event of a fire, each major element of the plant is provided with fire separation/isolation. Refer to Section 8.9 of this report for further details.

Boundary separation distances and permissible % unprotected openings in facades.

A fire within a building must not cause the ignition of another adjacent building, especially if that building is outside of the site boundary.

Approved Document B and BR187 both provide methods of calculating the permissible percentage of unprotected area for a façade, given the distance to a boundary line. That boundary line is usually taken as the site boundary where there are no existing adjacent buildings. The simple calculation methodology in BR187 can be in this instance and the site boundary becomes the relevant boundary.

Where there are existing adjacent buildings, the boundary is not necessarily the site boundary, and it will be necessary to calculate the consequences of a fire involving both the existing building and the proposed building separately. BR187 provides a methodology to calculate the thermal radiation (heat flux) received by an object or building when exposed to a fire condition in an adjacent building.

Current guidance proposes that an acceptably low level of risk of fire spread exists where the target building (existing or proposed) is subject to not more than 12.6kW/m2, based on the assumption that a building on fire will radiate heat from the affected compartment façade at an intensity of 84kW/m2 for a reduced fire load (e.g., office, residential, assembly buildings) or 168kW/m2 for a standard fuel load (e.g. retail, commercial, industrial buildings). Where a proposed building is too close to an adjacent existing building, the separation may be mitigated by a number or combination of factors:

- Passive fire protection to the building façade
- Active fire suppression within the building

The provision of passive fire protection to a building façade effectively a) reduces the surface area from which a fire may radiate heat from the building and b) provides a level of protection to the building façade from heat radiated from a fire in the adjacent building.

The provision of active fire suppression within a building is considered to reduce the effective thermal radiation from a building by 50% (resulting in a minimum separation distance reduction of 50%).

The two methods employed are described in further detail in the following section, with the site-specific analyses included thereafter.

Method 1:

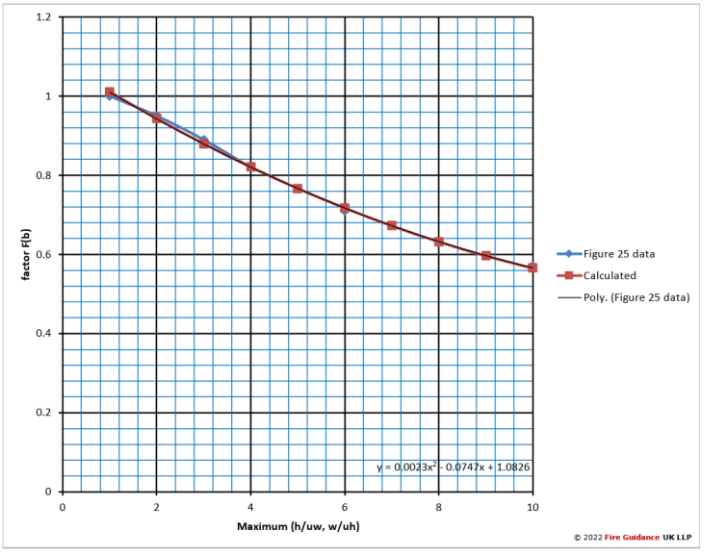
Using graphs from BR187 it is possible to determine the maximum permitted unprotected area for a set relevant boundary distance given the emitter façade dimensions and assumed fire load; in this instance the fire load is taken as the BR187 'standard fire load'.

References: **BR187 Section 2.2.4**

Standard fire load
Unprotected area calculation

$$u = 100\frac{(d/f)^2}{wh}\%$$

f(b) factor from 2nd order poly fit of data from Figure 25:



or, where:

$$\frac{h}{d} or \frac{w}{d} \geq 10$$

The maximum unprotected area is the greater of:

$$0.3\left(\frac{d}{w}\right)$$

and

$$0.3\left(\frac{d}{h}\right)$$

or, where:

$$\frac{h}{d} or \frac{w}{d} \leq 1$$

The maximum unprotected area ia 100%.

By applying a polynomial function to match the curves it is relatively simple to include the entire calculation into a Microsoft Excel worksheet.
Note: This method has only been used where the site boundary is a relevant boundary

Method 2:
Using equation A3 from BR187 it is possible to determine the thermal radiation received by an object at a given distance from the fire source, given the fire source dimensions and thermal radiation emitted from the source.
To determine the thermal radiation received it is first necessary to calculate the view factor from the emitter to the receiver, assuming both bodies are parallel, the following applies:

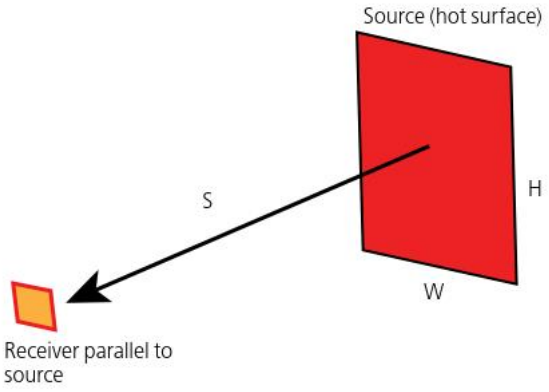


Figure 8 - Radiation view factor

And the view factor may be calculated from the following equation:

$$\phi=\frac{2}{\pi}\left(\frac{X}{\sqrt{1+X^2}}\tan^{-1}\left(\frac{Y}{\sqrt{1+X^2}}\right)+\frac{Y}{\sqrt{1+Y^2}}\tan^{-1}\left(\frac{X}{\sqrt{1+Y^2}}\right)\right)$$

Where:

$$X=\frac{W}{2s} \quad \text{and} \quad Y=\frac{H}{2s}$$

As with the previous method, it is relatively simple to include the entire calculation into a Microsoft Excel worksheet.

Note: This method has been used to determine thermal radiation exposure where Method 1 is not appropriate.

Each method will be used as appropriate when analysing the potential for fire spread across the site boundaries.

There are numerous buildings on the Newport EfW site that have elevations facing the site boundaries, some of which face directly adjacent existing buildings.

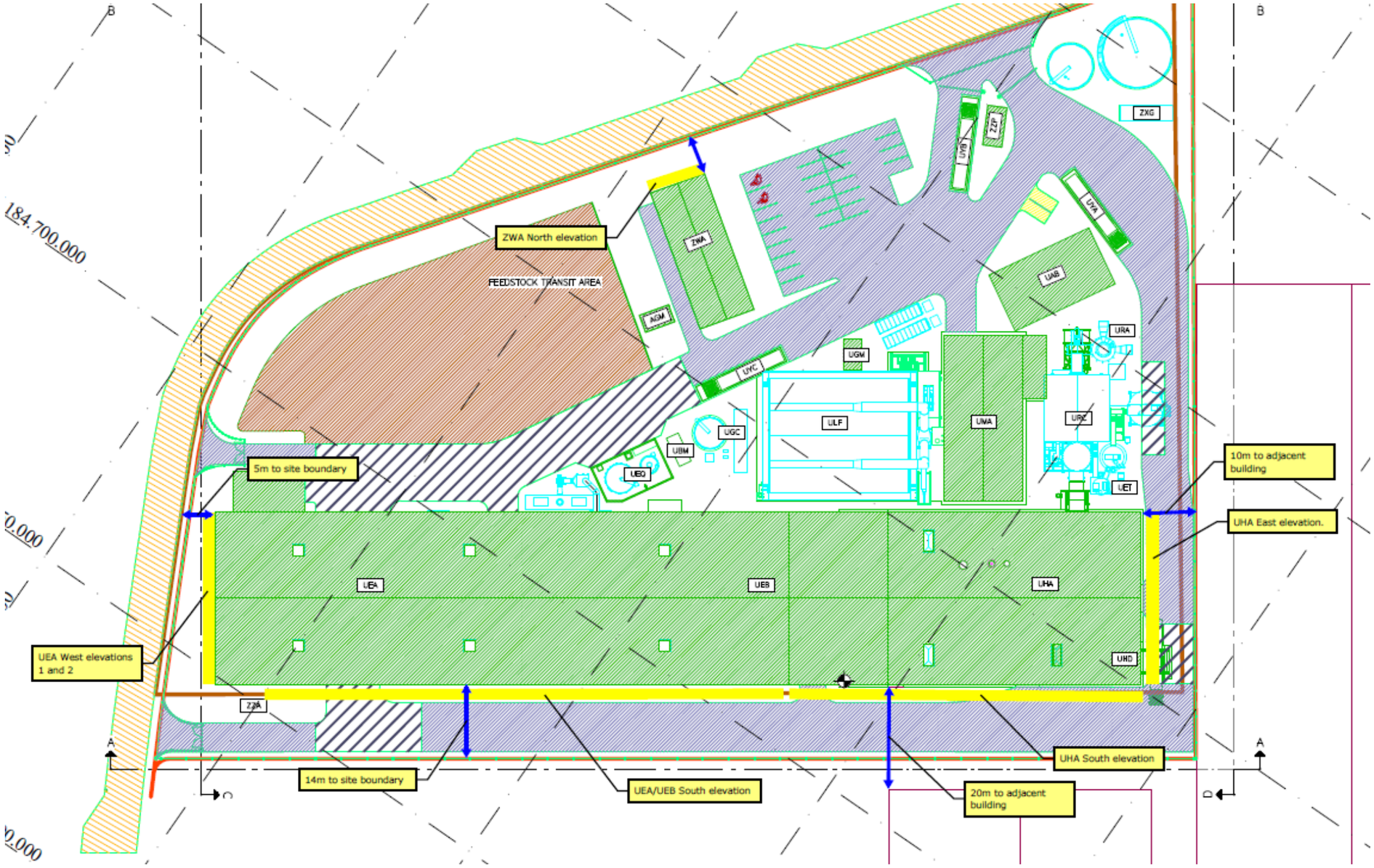


Figure 9 - Boundary Considerations

UHA (Boiler Building East elevation:

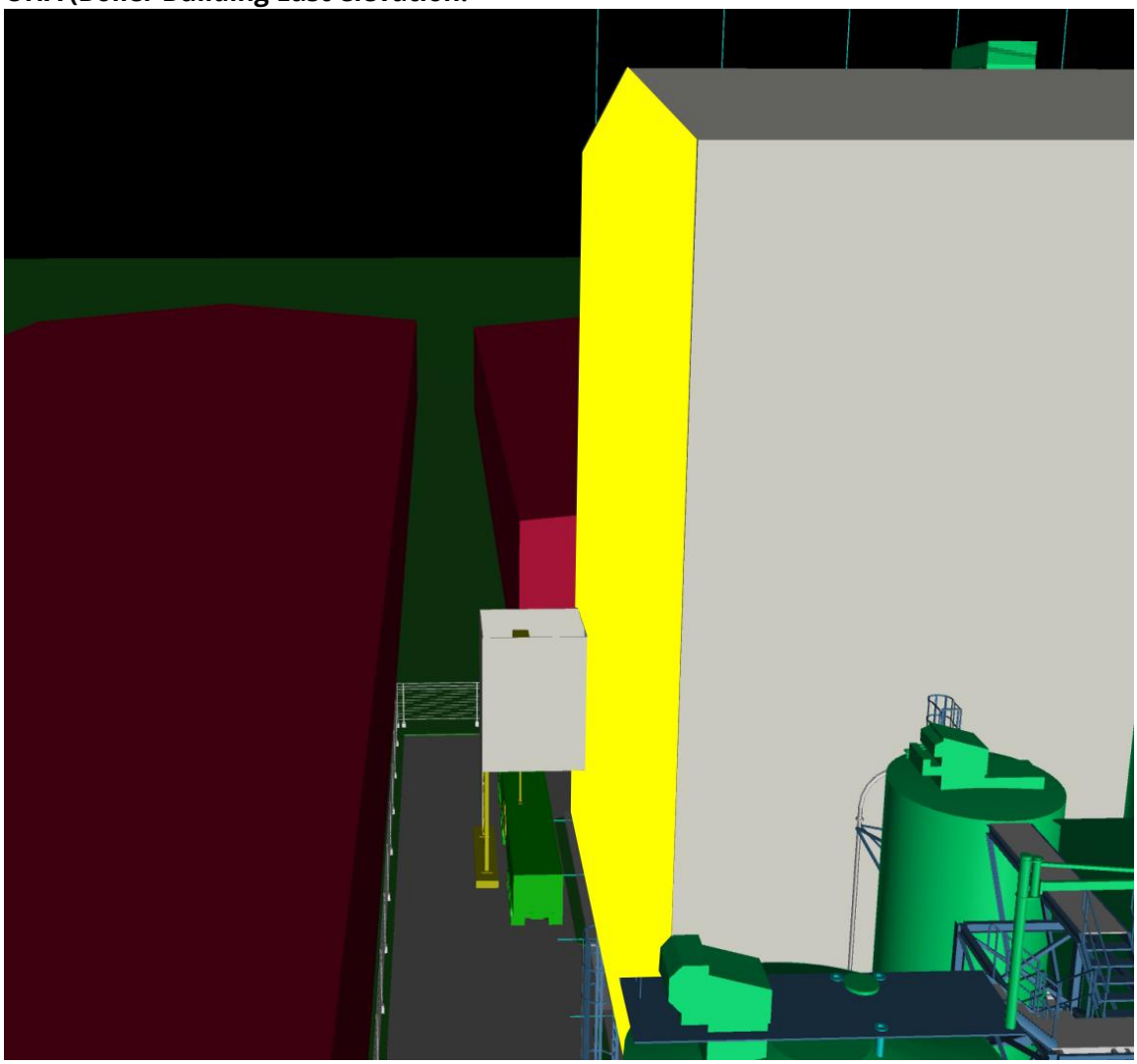


Figure 10 - Boiler Building (UHA) East Elevation

There is an existing building in close proximity to the site boundary adjacent to this elevation therefore the UHA building must not pose a fire spread risk to the existing building. In this instance the site boundary cannot be used as the relevant boundary for fire spread and separation analysis; an assessment of the thermal radiation between the buildings must be undertaken (Method 2).

In the first instance, from the UHA building to the existing building:

- Height of UHA elevation = 35m
- Width of UHA elevation = 32m

- Active fire suppression – Yes
- Distance to adjacent building = 10m

Assuming parallel emitter and receiver planes			
		Centre	
Eflux		168	kW/m^2
Fire suppression		Yes	*Yes/No*
Modified Eflux		84	kW/m^2
height		35	*m*
length		32	*m*
dist		10	*m*
X		**1.600000**	
Y		**1.750000**	
VF		**0.774571**	
VF tot		**0.774571**	
Rflux		**65.063953**	kW/m^2

Calculation 1 - Boiler Building (UHA) East Elevation - No Protection

Clearly the adjacent building would receive thermal radiation in excess of the 12.6kW/m2 recommended maximum.

Providing passive fire protection to the lower 32m of the façade effectively reduces the height of the radiating portion of the façade to 3m which reduces the incident heat flux on the adjacent building to an acceptable level:

Assuming parallel emitter and receiver planes			
		Centre	
Eflux		168	kW/m^2
Fire suppression		Yes	*Yes/No*
Modified Eflux		84	kW/m^2
height		3	*m*
length		32	*m*
dist		10	*m*
X		**1.600000**	
Y		**0.150000**	
VF		**0.137943**	
VF tot		**0.137943**	
Rflux		**11.587219**	kW/m^2

Calculation 2 - Boiler Building (UHA) East Elevation - With Protection

It is noted that there is an aperture within this façade for the removal of slag/ash from the building. Withing the building, the slag/ash room is enclosed within a 120-minute compartment therefore the aperture may be ignored for the purposes of external fire spread assessment.

Secondly, from the existing building to the UHA building:
As the UHA elevation is to be provided with 120-minute fire protection to a height of 32m, there will be no significant impact from a fire in the existing adjacent building, whose height is approximately 12m.

UHA (Boiler Building) South elevation:

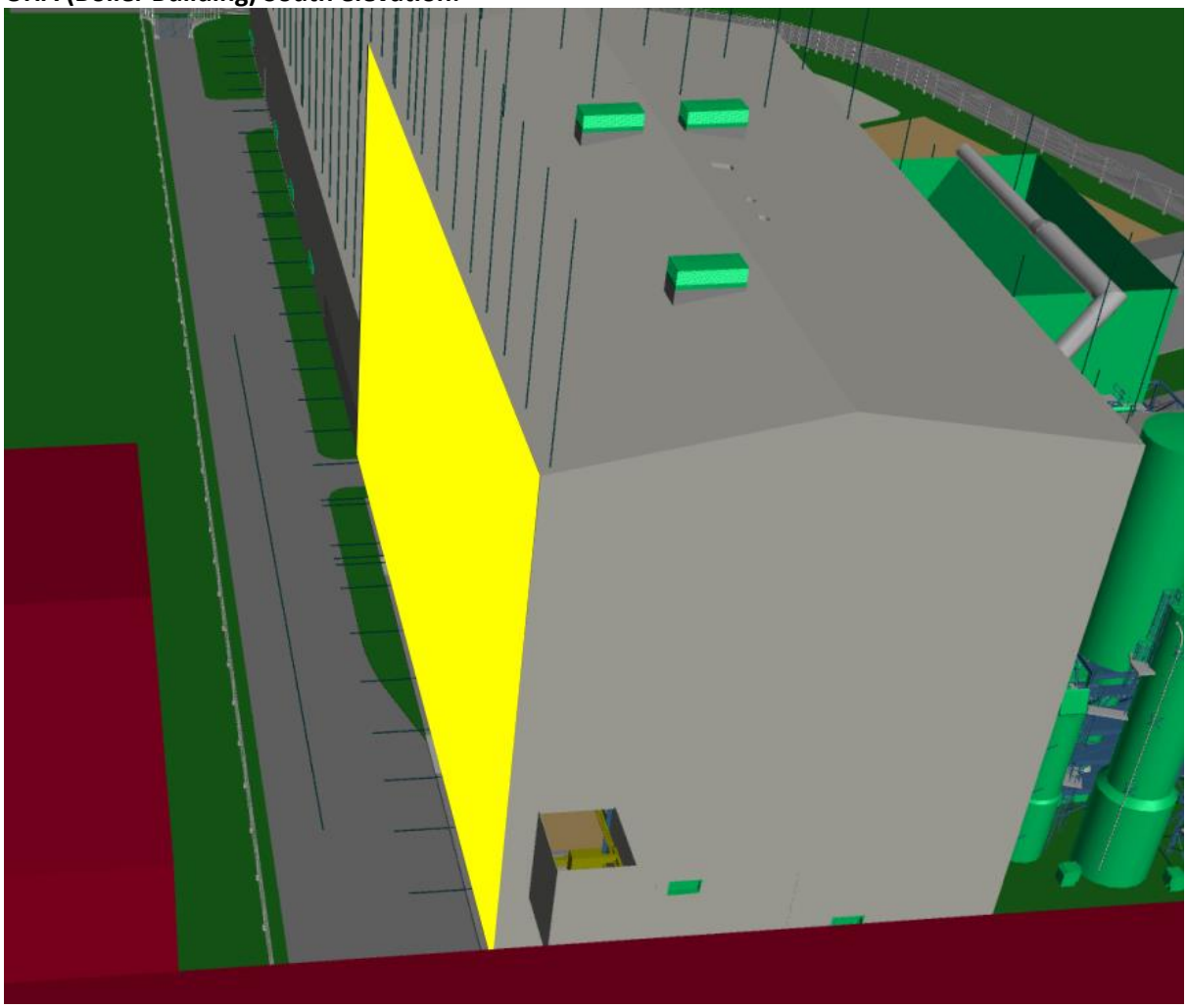


Figure 11 - Boiler Building (UHA) South Elevation

There is an existing building in close proximity to the site boundary adjacent to this elevation therefore the UHA building must not pose a fire spread risk to the existing building. In this instance the site boundary cannot be used as the relevant boundary for fire spread and separation analysis; an assessment of the thermal radiation between the buildings must be undertaken (Method 2).

In the first instance, from the UHA building to the existing building:

- Height of UHA elevation = 35m
- Width of UHA elevation = 59m
- Active fire suppression – Yes
- Distance to adjacent building = 20m

Assuming parallel emitter and receiver planes			
		Centre	
Eflux		168	*kW/m²*
Fire suppression		Yes	*Yes/No*
Modified Eflux		84	*kW/m²*
height		35	*m*
length		59	*m*
dist		20	*m*
X		1.475000	
Y		0.875000	
VF		0.591608	
VF tot		0.591608	
Rflux		49.695034	*kW/m²*

Calculation 3 - Boiler Building (UHA) South Elevation - No Protection

Clearly the adjacent building would receive thermal radiation in excess of the 12.6kW/m^2 recommended maximum.

Providing passive fire protection to the lower 28.5m of the façade effectively reduces the height of the radiating portion of the façade to 6.5m which reduces the incident heat flux on the adjacent building to an acceptable level:

Assuming parallel emitter and receiver planes			
		Centre	
Eflux		168	*kW/m²*
Fire suppression		Yes	*Yes/No*
Modified Eflux		84	*kW/m²*
height		6.5	*m*
length		59	*m*
dist		20	*m*
X		1.475000	
Y		0.162500	
VF		0.146858	
VF tot		0.146858	
Rflux		12.336070	*kW/m²*

Calculation 4 - Boiler Building (UHA) South Elevation - With Protection

Secondly, from the existing building to the UHA building:
As the UHA elevation is to be provided with 120-minute fire protection to a height of 28.5m, there will be no significant impact from a fire in the existing adjacent building, whose height is approximately 12m

UEA/UEB (Fuel Unloading and Bunker Building) South elevation:

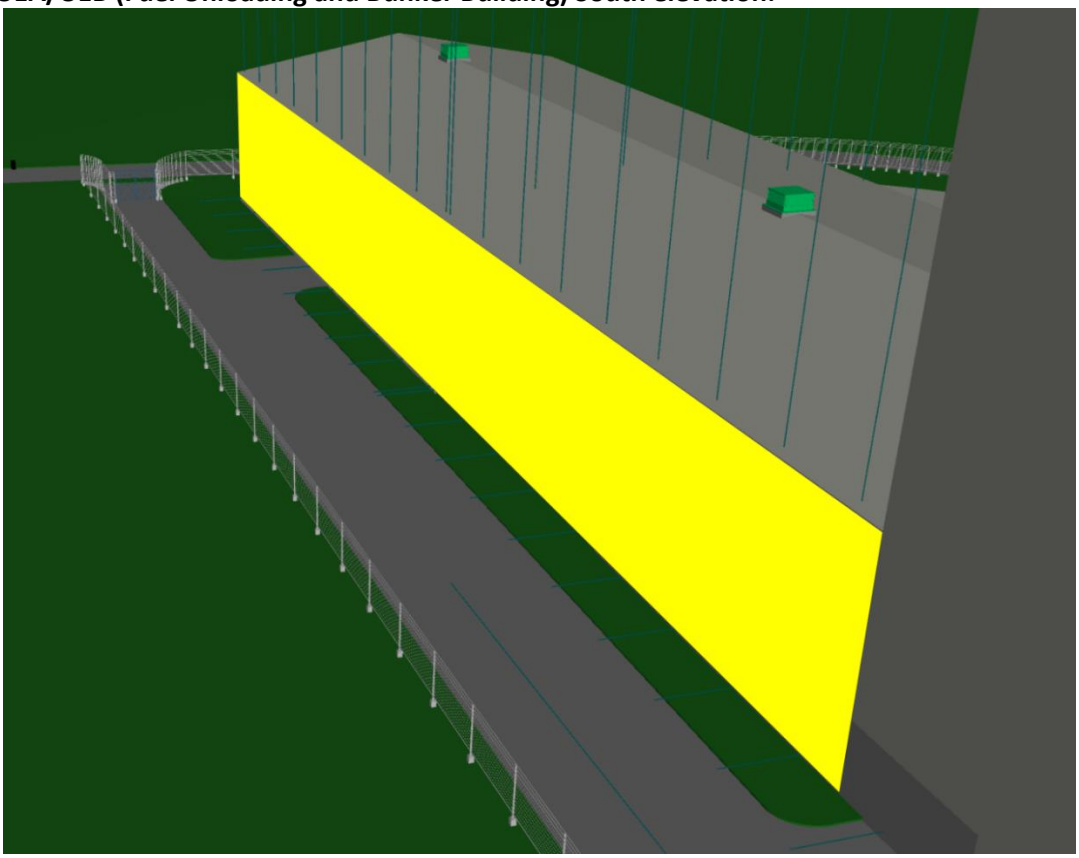


Figure 12 - Fuel Handling and Bunker Building (UEA, UEB) South Elevation

There are no existing buildings adjacent the UEA/UEB South elevation therefore the site boundary may be taken as the relevant boundary and Method 1 used.

- Height of UEA/UEB elevation = 12m
- Width of UEA/UEB 2elevation = 109m
- Active fire suppression – Yes
- Distance to site boundary = 14m

PERMISSIBLE UNPROTECTED OPENINGS (Standard fire load)		
Area:		
Height of elevation	12	h (m)
Width of elevlation	109	w (m)
Distance to relevant boundary	14	d (m)
Sprinklers	Yes	
Modified boundary distance	28	
w/d=	3.892857	
f(a)	0.826659	
Permissible unprotected area	**87.71**	%

Calculation 5 - Fuel Handling and Bunker Building (UEA, UEB) South Elevation - No Protection

Add passive fire protection to lower 2m of the elevation:
Modified height of elevation = 10m (12 – 2):

PERMISSIBLE UNPROTECTED OPENINGS (Standard fire load)		
Area:		
Height of elevation	10	h (m)
Width of elevlation	109	w (m)
Distance to relevant boundary	14	d (m)
Sprinklers	Yes	
Modified boundary distance	28	
w/d=	3.892857	
f(a)	0.826659	
Permissible unprotected area	**100.00**	%

Calculation 6 - Fuel Handling and Bunker Building (UEA, UEB) South Elevation - With Protection

With the lower 2m of the UEA/UEC South elevation provided with 120-minute fire protection there is no restriction on the amount of unprotected opening in the remainder of the façade.

UEA/UEB (Fuel Unloading and Bunker Building) South elevation (supplemental):

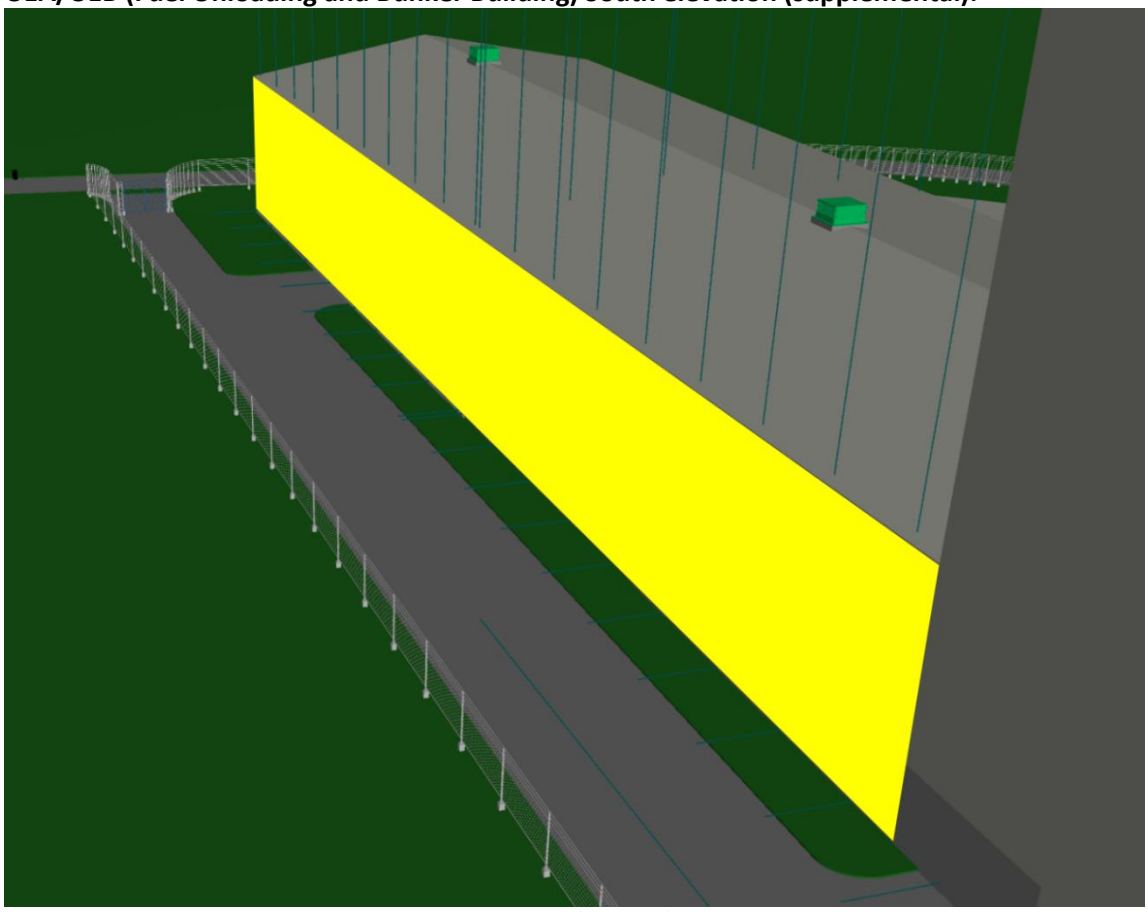


Figure 13 - Fuel Handling and Bunker Building (UEA, UEB) South Elevation

There is a proposed, 17m tall x 50m wide building proposed outside of the site boundary. The spatial separation of the proposed building from the boundary is not determined or fixed therefore the South elevation of UEA/UEB must also be assessed in terms of potential thermal radiation to the site boundary (rather than assuming mirrored separation distances. Method 2 has been used.

- Height of UEA/UEB elevation = 12m
- Width of UEA/UEB 2elevation = 109m
- Active fire suppression – Yes
- Distance to site boundary = 14m

Assuming parallel emitter and receiver planes			
	Centre		
Eflux	168	kW/m^2	
Fire suppression	Yes	*Yes/No*	
Modified Eflux	84	kW/m^2	
height	12	*m*	
length	109	*m*	
dist	14	*m*	
X	3.892857		
Y	0.428571		
VF	0.391077		
VF tot	0.391077		
Rflux	32.850467	kW/m^2	

Calculation 7 - Fuel Handling and Bunker Building (UEA, UEB) South Elevation - No Protection

Clearly the adjacent building would receive thermal radiation in excess of the 12.6kW/m^2 recommended maximum.

Providing passive fire protection to the lower 8m of the façade effectively reduces the height of the radiating portion of the façade to 4m which reduces the incident heat flux on the adjacent building to an acceptable level:

Assuming parallel emitter and receiver planes			
	Centre		
Eflux	168	kW/m^2	
Fire suppression	Yes	*Yes/No*	
Modified Eflux	84	kW/m^2	
height	4	*m*	
length	109	*m*	
dist	14	*m*	
X	3.892857		
Y	0.142857		
VF	0.140470		
VF tot	0.140470		
Rflux	11.799488	kW/m^2	

Calculation 8 - Fuel Handling and Bunker Building (UEA, UEB) South Elevation - With Protection

UEA (Fuel Handling Building) West elevation 1:

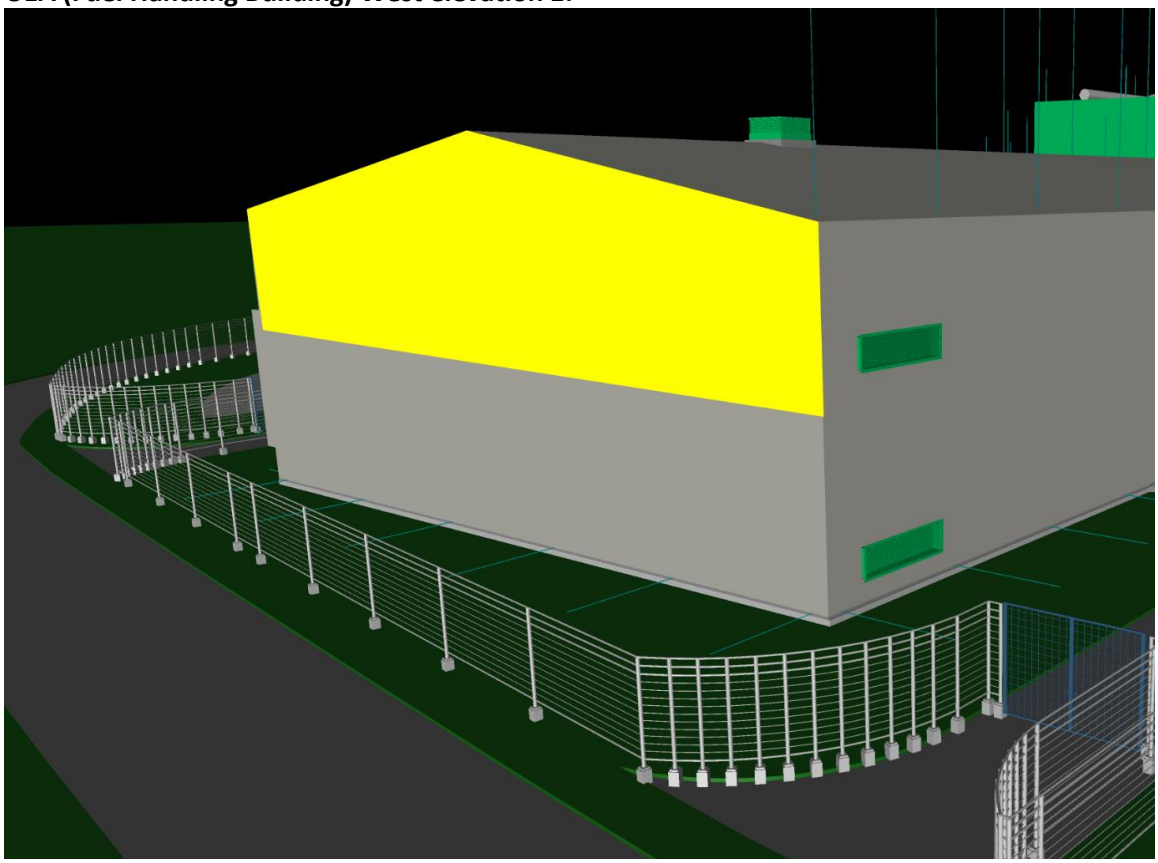


Figure 14 - Fuel Handling and Bunker Building (UEA, UEB) West Elevation 1

There are no existing buildings adjacent the UEA West elevation therefore the site boundary may be taken as the relevant boundary and Method 1 used.

There is internal compartmentation at the mid height level due to the electrical annexe location therefore the effective emitter height (6m) is half of the overall height of the building (12m).

- Height of UEA West elevation 1 = 6m
- Width of UEA West elevation 1 = 32m
- Active fire suppression – Yes
- Distance to site boundary = 5m
- (Whilst the site boundary ranges from 5m to 10m at this location, the worst case of 5m has been used in the assessment).

PERMISSIBLE UNPROTECTED OPENINGS (Standard fire load)		
Area:		
Height of elevation	6	h (m)
Width of elevlation	32	w (m)
Distance to relevant boundary	5	d (m)
Sprinklers	Yes	
Modified boundary distance	10	
w/d=	3.2	
f(a)	0.867112	
Permissible unprotected area	**69.27**	%

Calculation 9 - Fuel Handling Building (UEA) West Elevation 1 - No Protection

Add passive fire protection to lower 2m of the elevation:
Modified height of elevation = 4m (6 – 2):

PERMISSIBLE UNPROTECTED OPENINGS (Standard fire load)		
Area:		
Height of elevation	4	h (m)
Width of elevlation	32	w (m)
Distance to relevant boundary	5	d (m)
Sprinklers	Yes	
Modified boundary distance	10	
w/d=	3.2	
f(a)	0.867112	
Permissible unprotected area	**100.00**	%

Calculation 10 - Fuel Handling Building (UEA) West Elevation 1 - With Protection

Providing a horizontal 2m 'strip' of fire protection to the UEA West elevation 1 façade results in there being no restriction on unprotected openings in the remainder of this façade (the 2m horizontal strip may be located anywhere within the façade).

UEA (Fuel Handling Building) West elevation 2:

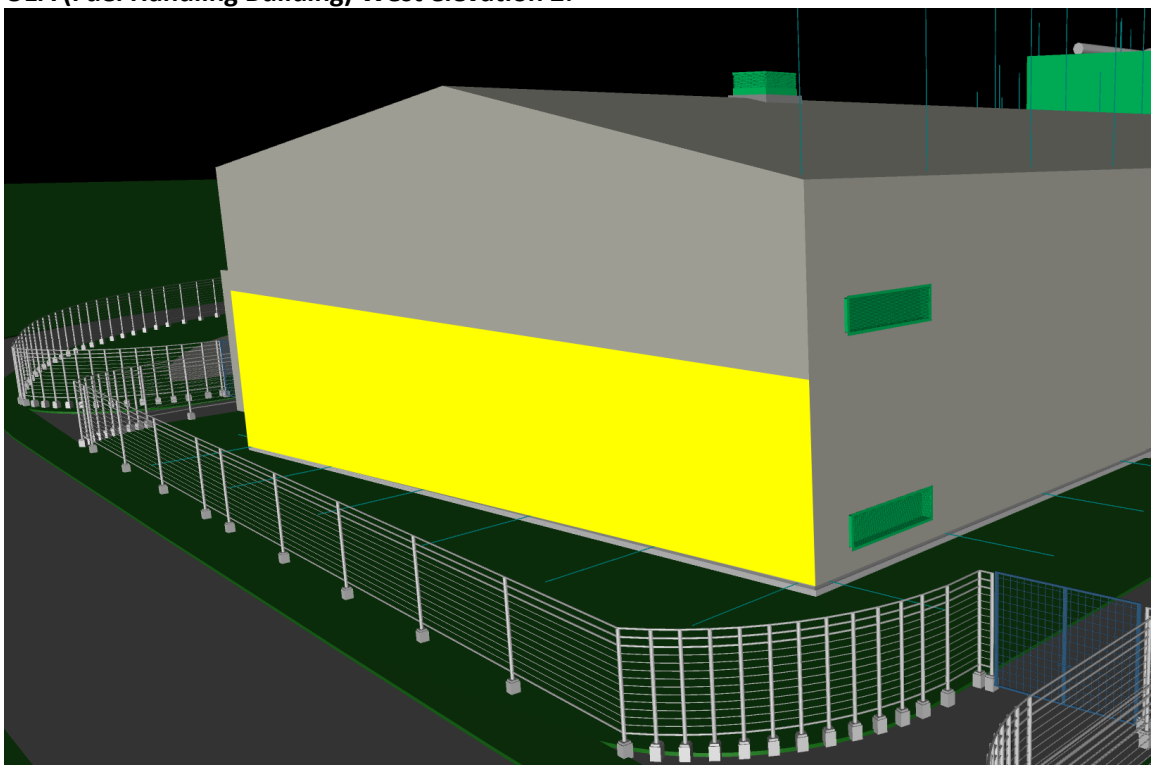


Figure 15 - Fuel Handling Building (UEA) West Elevation 2

There are no existing buildings adjacent the UEA West elevation therefore the site boundary may be taken as the relevant boundary and Method 1 used.

There is internal compartmentation at the mid height level due to the electrical annexe location therefore the effective emitter height (6m) is half of the overall height of the building (12m).

- Height of UEA West elevation 2 = 6m
- Width of UEA West elevation 2 = 32m
- Active fire suppression – Yes
- Distance to site boundary = 5m
- Whilst the site boundary ranges from 5m to 10m at this location, the worst case of 5m has been used in the assessment).

PERMISSIBLE UNPROTECTED OPENINGS (Standard fire load)		
Area:		
Height of elevation	6	h (m)
Width of elevlation	32	w (m)
Distance to relevant boundary	5	d (m)
Sprinklers	Yes	
Modified boundary distance	10	
w/d=	3.2	
f(a)	0.867112	
Permissible unprotected area	**69.27**	%

Calculation 11 - Fuel Handling Building (UEA) West Elevation 2 - No Protection

Add passive fire protection to lower 2m of the elevation:
Modified height of elevation = 4m (6 – 2):

PERMISSIBLE UNPROTECTED OPENINGS (Standard fire load)		
Area:		
Height of elevation	4	h (m)
Width of elevlation	32	w (m)
Distance to relevant boundary	5	d (m)
Sprinklers	Yes	
Modified boundary distance	10	
w/d=	3.2	
f(a)	0.867112	
Permissible unprotected area	**100.00**	%

Calculation 12 - Fuel Handling Building (UEA) West Elevation 2 - With Protection

Providing a horizontal 2m 'strip' of fire protection to the UEA West elevation 2 façade results in there being no restriction on unprotected openings in the remainder of this façade (the 2m horizontal strip may be located anywhere within the façade).

ZWA (Welfare building) North elevation:

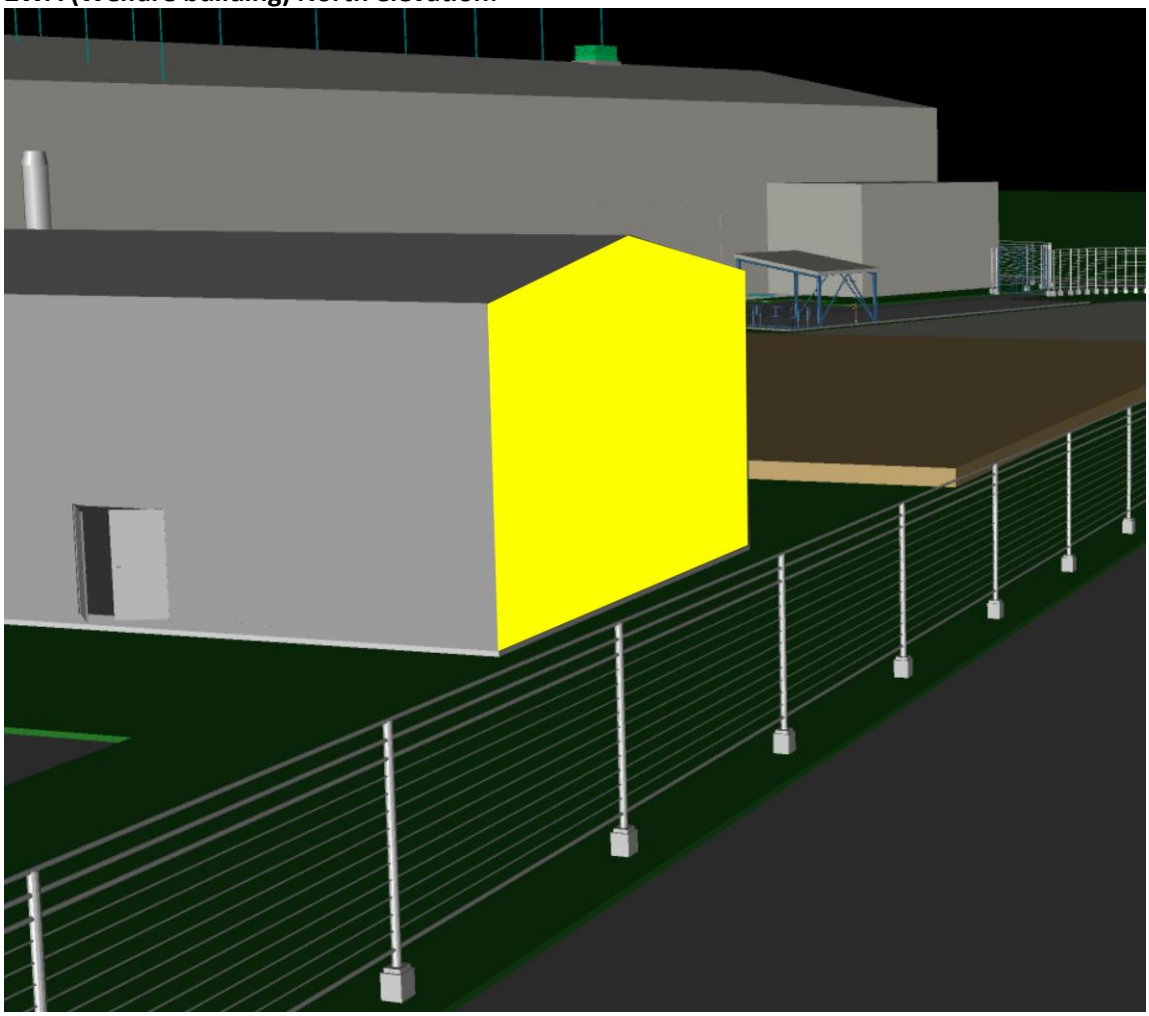


Figure 16 - Welfare Building (ZWA) North Elevation

There are no existing buildings adjacent the ZWA North elevation therefore the site boundary may be taken as the relevant boundary and Method 1 used.

There is internal compartmentation at the mid height level due to the electrical annexe location therefore the effective emitter height (6m) is half of the overall height of the building (12m).

- Height of ZWA North elevation = 6m
- Width of ZWA North elevation = 10m
- Active fire suppression – No
- Distance to site boundary = 8m

PERMISSIBLE UNPROTECTED OPENINGS (Standard fire load)		
Area:		
Height of elevation	6	h (m)
Width of elevlation	10	w (m)
Distance to relevant boundary	8	d (m)
Sprinklers	No	
Modified boundary distance	8	
w/d=	1.25	
f(a)	0.992819	
Permissible unprotected area	**100.00**	%

Calculation 13 - Welfare Building (ZWA) North Elevation - No Protection

There is no requirement to provide additional fire protection to the ZWA building North elevation in terms of potential for fire spread over the site boundary.

Feedstock transit area:

EA guidance recommends that feedstock piles, located close to the site boundary be either:

- Provided with a 120-minute fire wall between the feedstock pile and the boundary, or
- Provided with a 6m clearance between the feedstock pile and the boundary.

Using 6m as the distance to the relevant boundary (assuming no fire wall between feedstock pile and the site boundary) it is possible to assess the potential for fire spread across the boundary to existing or future buildings:

It is necessary to modify the Eflux value from the previous assessments in this instance due to the fire load presented by the fuel. From WISH data, a burn temperature of 950°C can be used to determine the thermal radiation emitted from the fire:

Calculate the thermal radiation emitted from a hot mass:			
$q_{rad} = \varepsilon \sigma T^4$			
Emissivity	ε	1	*(0 to 1)*
Temperature	t	950	*C*
Absolute Temperature	T	**1223.15**	*K*
Stephan Boltzmann Constar	σ	5.6703E-08	$W/m^2 K^4$
Thermal Radiation Emitted	q_{rad}	**126918.496**	W/m^2
		126.918496	kW/m^2

Calculation 14 - Feedstock Thermal Emission

From the above, the Eflux value to be used for this assessment should be 127kW/m^2 due to the fire load presented by the fuel.

- Width of emitter (feedstock pile) = 9.7m (from sketch plan)
- Height of emitter (feedstock pile) = 4m (assumed 2 bale high stack of 2.5m plus assumed flame height of 1.5m)
- Target distance = 12m (2 x boundary distance)
- Effective thermal radiation emission = 127kW/m^2

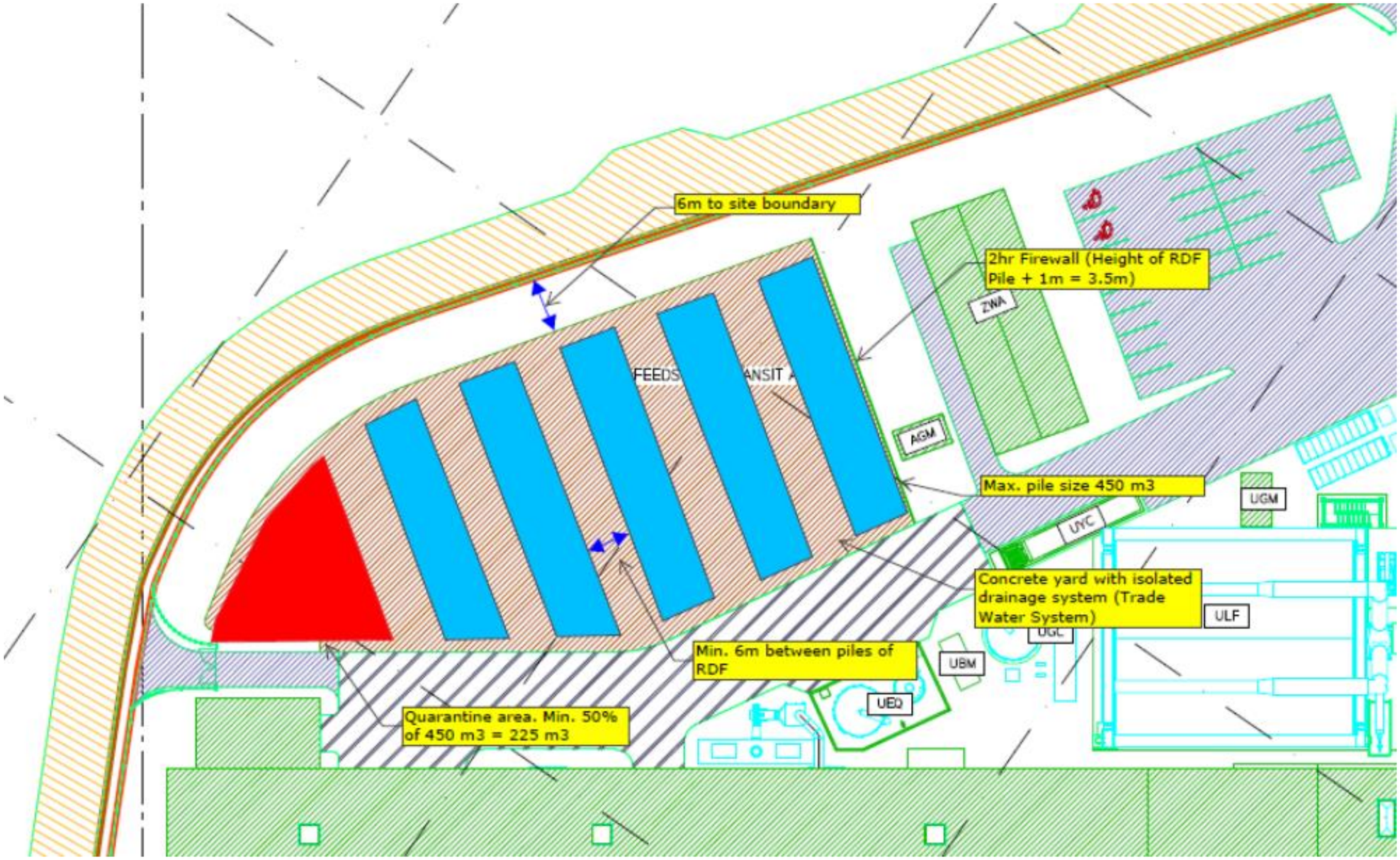


Figure 17 - External Feedstock Storage

Assuming parallel emitter and receiver planes				
		Centre		
Eflux		127	*kW/m²*	
Fire suppression		No	*Yes/No*	
Modified Eflux		127	*kW/m²*	
height		4	*m*	
length		9.7	*m*	
dist		12	*m*	
X		0.404167		
Y		0.166667		
VF		0.076276		
VF tot		0.076276		
Rflux		9.687067	*kW/m²*	

Calculation 15 - External Feedstock Storage Pile Thermal Radiation

With the orientation of the feedstock piles as proposed, with 6m separation in between the feedstock piles, the incident thermal radiation to a target 12m distant is sufficiently low as to not be of significance to any future building structures.

Note: feedstock storage may be subject to change during detailed design – the above assessment will be updated to reflect any changes proposed or implemented.

8.3 Separation and compartmentation – Insurer's Requirement

8.3.1 Buildings, Plant and Equipment

Fire areas should be separated from each other by 2-hour fire barriers, 15 m spatial separation or other approved means.

Fire separation of the various elements will be provided by a combination of one or more of the following measures:

- Blockwork or concrete construction.
- Fire rated cladding.
- Spatial separation.
- Active fire suppression.
- Fire rated cladding.

Ventilation ducts passing from one fire separated area to another will be provided with automatic fire dampers. Operation of dampers may either be from the fire detection system or inert gas panel. All dampers in the ventilation system are failsafe closed.

Fire areas to be defined as e.g.:

- Indoor biomass receiving / tipping floor and storage area.
- Indoor processed and unprocessed biomass storage (e.g., storage other than in the Bunker or the biomass receiving / tipping floor).
- External processed and unprocessed biomass storage.
- Processing area.
- Slag store areas.
- Dust collection equipment from any equipment.
- Cable spreading rooms and cable tunnels.
- Control Room, Computer Room, or combined Control / Computer Room.
- CEMS room.
- Rooms with major concentrations of electrical equipment, such as switchgear room and relay room.
- Battery rooms.
- Maintenance shop.
- Fire pumps.
- Warehouses.
- Emergency diesel generator.
- Office/Welfare buildings.
- Turbine-generator.

Note 1:
Buildings spaced less than 15 m will be fire rated. One of two opposite buildings spaced less than 15 m, shall be fire rated for two hours in regard to a fire from inside and outside or both buildings shall be fire rated for 2 hours in regard to a fire from outside.

Note 2:
For buildings where the exposing building is of lesser height than the exposed building and where the roof of the exposing building has no fire resistance, the height of the protection above the roof should be 7.5m (ref. NFPA 80A; 4.4.8.2).

Note 3:
Where an internal compartment fire wall terminates at a façade, the flanking elements of that façade are required to provide a fire resistance of either 60-minutes or 2 hours less than that of the compartment fore wall, whichever is the greater. In the case of the Newport EfW buildings, the requirement is for 60-minutes as the fire compartment walls are 120-minutes.

The extent of the flanking fire protection is based on the height of the compartmentation and the construction interface (i.e., the structural arrangement) of the fire compartment wall.

Reference is made to Figures 5.16.2.1(a) and 5.16.2.1(b) from NFPA 221 (2021):

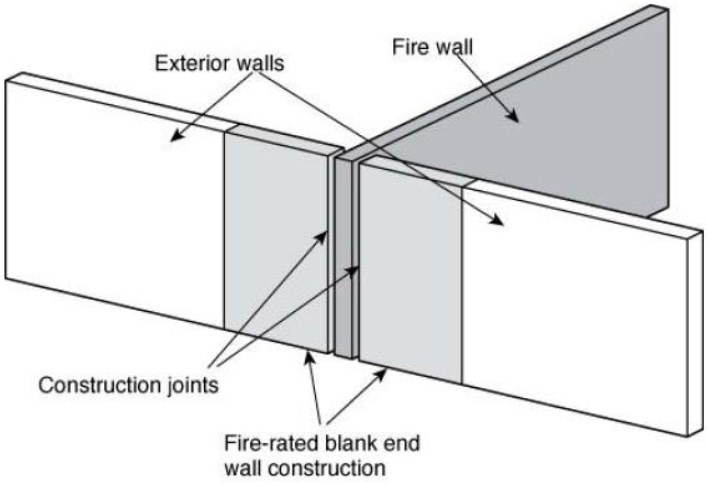


Figure 5.16.2.1(a) End Wall Exposure Protection — End Walls Tied to Structural Framing.

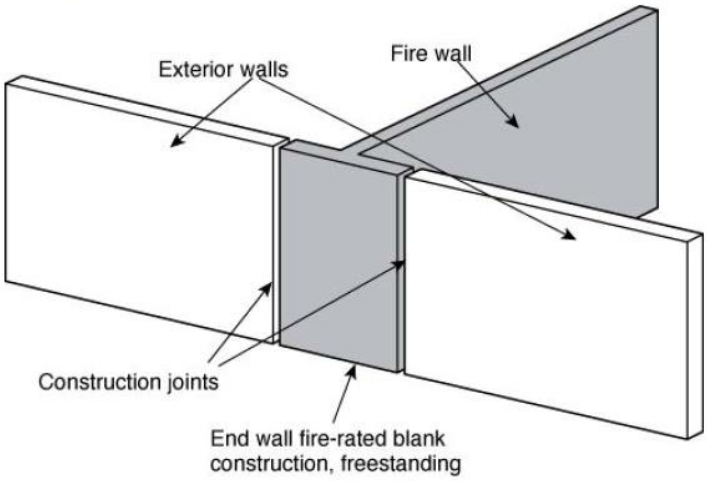


Figure 5.16.2.1(b) End Wall Exposure Protection — End Walls Not Tied to Structural Framing.

Figure 18 - Fire Wall Ends (From NFPA 221)

Flanking protection dimensions can be obtained from Table 5.16.2.1 (Wall protection) of NFPA 221 (2021):

Height of exposing area		Length of end wall protection	
m	ft	m	ft
<=12.2	<=40	1.830	6
12.5 – 21	41-70	3.050	10
>=21.6	>=71	4.265	14

Table 10 - Flanking Wall Protection Extents

8.4 Other measures

8.4.1 Cavity barriers

Where appropriate, suitable provisions will be made to prevent the unseen spread of fire and smoke through cavities or concealed spaces by use of cavity barriers. Cavity barriers will be designed and located to achieve the performance required for Building Regulations compliance e.g., by following the guidance contained in BS9999.

It should be noted that cavity barriers are not required within walls of 'traditional construction' i.e., two leaves of masonry minimum 75mm thickness separated by an internal cavity. In this instance, where cavity closers are required, they do not have to be provided with the same performance as a cavity barrier.

Concealed spaces within floor voids and ceiling voids as well as cable shafts will be installed with fire detection.

8.4.2 Fire doors

A Fire-resistant door in a compartment wall has the same fire resistance as the wall, e.g., the door in a 60-minute compartment wall has to be rated FD60S.

8.4.3 Corridors

Corridors exceeding 12m in length that provide access to more than one exit will be subdivided by cross corridor fire doors. The doors should be positioned approximately mid-way along the corridor and should be rated FD 20S (BS 9999 16.3.11.3; table 30). This does not mean that corridors are required to be broken down into 12 m segments.

8.4.4 Crane operator room viewing window

To achieve 2-hour fire resistance to the crane operator room viewing window will have a glazing system designed to provide at least 60 minutes integrity. The fire-resistant glazing will further be protected by a water drenching curtain system mounted on the Fuel/Bunker side of the glazing (see section 15.5.3 of this report)

8.5 Ductwork

Fire protection of ventilation ductwork is needed as an integral part of the building's compartmentation strategy to ensure not to compromise the integrity of the means of escape. As such, the recommendations contained BS 9999 Section 32.5.2 will be adopted.

- Where air handling ducts pass through fire-separating elements such as compartment walls or the enclosures to protected escape routes, then the integrity of those elements should be maintained, using one or a combination of the following four methods:

  - Method 1: thermally actuated fire dampers.
  - Method 2: fire-resisting enclosures.
  - Method 3: protection using fire-resisting ductwork.
  - Method 4: automatically actuated fire and smoke dampers triggered by automatic fire detection and alarm system.

Selection or combining the methods 1 to 4 will be evaluated based on the specific application in which they are to be used.

8.6 Fire stopping

All joints between fire separating elements will be adequately fire stopped and all openings for services passing through fire separating elements will be:

- As few in number as possible to serve the building.
- As small as possible to provide the service transit.
- Suitably fire stopped (allowing for thermal movement in the case of pipes and ducts).

8.7 Transformer cell

The step-up transformer (UAB) is spatially separated from all adjacent buildings and plant by a distance of not less than 1.5m. The transformer insulating/cooling oil is a type K Less Flammable Insulant with a capacity of 12,800L and the transformer is provided with “enhanced protection” in accordance with EC 61936-1.

The above provisions meet the requirements of Chubb Guidance (Table 5.1.15 – 1.5m) and exceed the requirements of EC 61936-1 (Table 3 – 0.9m vertically and 1.5m horizontally) therefore fire/blast wall enclosure and/or fixed fire suppression is not required.

8.8 Flue gas treatment

The filter bags installed in the filter are designed for high temperature operation and therefore do not require additional passive fire protection, however refer to Section 15.15 of this report for any active fire suppression requirements.

8.9 Fire separation (segregation) and compartmentation drawings

The fire segregation drawings for each main area are listed in section 18 and included in the attachment to this report ref. 1017.M0.J01.002 (to be added)

The following colour code indicates the fire resistance indicated on the drawings.

	120 minutes

Note: The 120-minute fire resistance is achieved either by concrete, block wall or cladding (cladding walls 120-minute fire resistance from a fire outside towards inside).

9 Access and facilities for the Fire Service

9.1 Functional requirement

1) The building shall be designed and constructed so as to provide reasonable facilities to assist fire-fighters in the protection of life.
2) Reasonable provision shall be made within the site of the building to enable fire appliances to gain access to the building.

9.2 Vehicle access

The typical design guidance for vehicle access routes is given below table (ref. BS9999 Table 20), although the route dimensions formally need to be confirmed with the Local Fire Authority.

Table 20 **Example of measurements for a typical vehicle access route**

Appliance type	Min. width of road between kerbs	Min. width of gateways	Min. turning circle between kerbs	Min. turning circle between walls	Min. clearance height	Min. carrying capacity
	m	m	m	m	m	t
Pump	3.7	3.1	16.8	19.2	3.7	12.5
High-reach [A)]	3.7	3.1	26.0	29.0	4.0	17.0

[A)] Because the weight of high-reach appliances is distributed over a number of axles, their infrequent use of a carriageway or route designed to 12.5 t is not likely to cause damage. It would therefore be reasonable to design the road base to 12.5 t, although structures such as bridges should have the full 17 t capacity.

Table 11 - Typical Fire Service Vehicle Data

A swept path analysis has been carried out for typical fire and rescue service vehicles on site and listed in section 18.

9.3 Access to buildings for firefighting personnel

The process areas do not have internal storeys that are normally occupied that would require firefighting stairs. Specific risks in the process areas are provided with dedicated fire extinguishing/control systems as described in Section 15 to this report.

With the exception for the Welfare Building the service areas that are normally occupied during operational times are all situated at ground floor level.

9.4 Firefighting in fuel unloading bunker and fuel storage bunker

Access into the fuel reception/unloading building (UEA) and fuel bunkers (UEB) is via the site vehicular roadway which provides access to entry point on the northern façade.

The areas are installed with fire water monitors (2 pc. covering each combined bunker) which can be operated from the main control room or during normal working hours be operated from the crane cabin.

10 Fire main and location of hydrants

The guidance contained in Appendix 5 of the National Guidance Document on The Provision of Water for Fire Fighting 2007) provides ideal requirements in terms of water flow availability for firefighting purposes based on the area of the site concerned. This however is based on the assumption that no additional firefighting measure have been provided. The provision of automatic fire suppression systems is based on NFPA 850 requirements as detailed in Section 15 therefore the hydrant demand will be based around a hose reel demand of 1890 litres per minute.

The Power Plant is to be provided with a looped fire hydrant ring main for use by the attending fire Service. Hydrants will be provided as indicated on the following diagram based on the provisions of NFPA 850 (2020) Clause 7.4.1

The hydrants will be in accordance with BS 750:2012 to ensure compatibility with the equipment carried by the Local Fire and Rescue Service.

Hose cabinets located in the vicinity of each hydrant will be supplied with one spray nozzle (jet and fog) and a total of 30m hose.

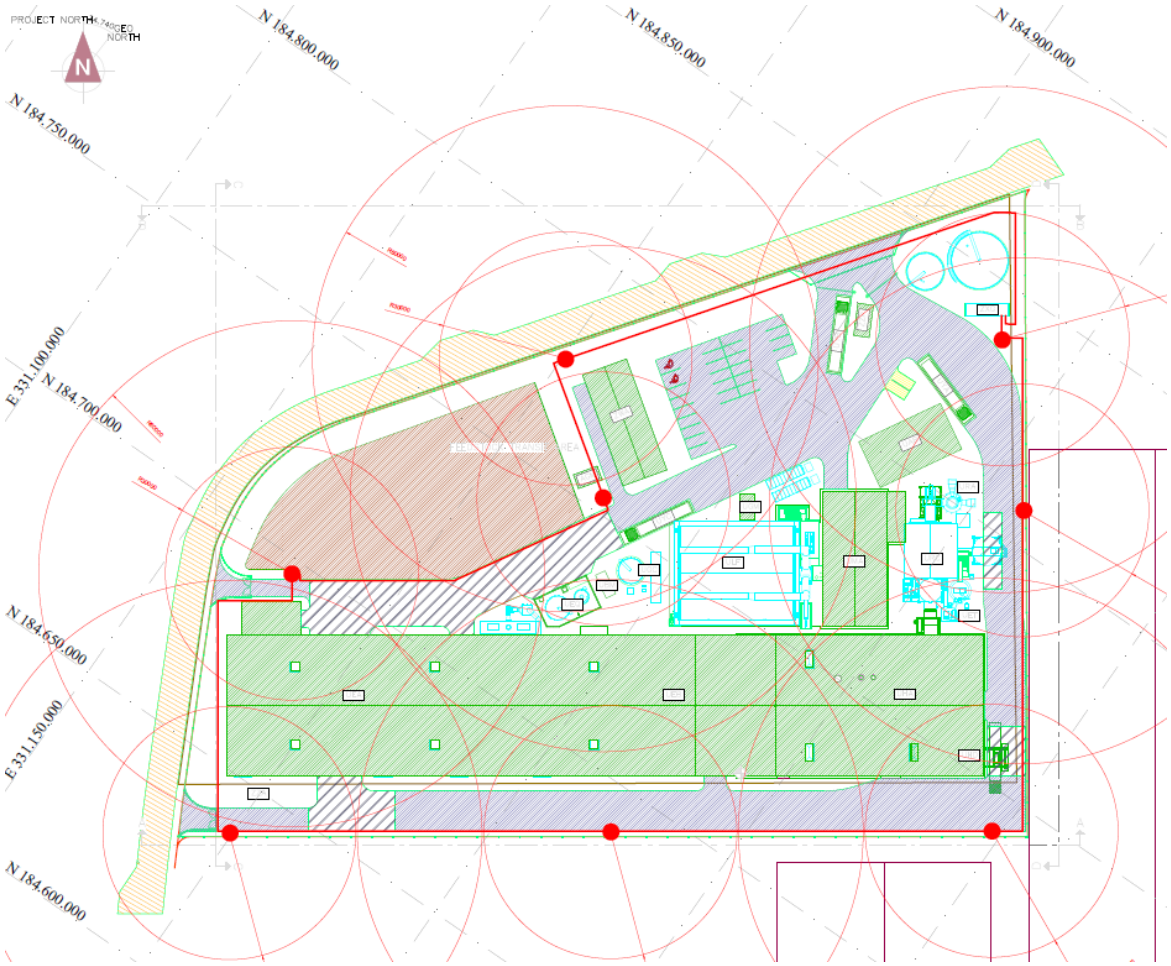


Figure 19 - Site Fire Main and Hydrant Layout

11 Portable fire extinguishers

Portable fire extinguishers will be provided throughout the entire facility, selected according to perceived risk.

Electrical rooms and the boiler building will be equipped with CO_2 extinguishers*. STG room will be equipped with both dry powder and CO_2 extinguishers.

* The boiler building will additional be installed with dry powder extinguishers where oil for the aux. burners is present.

The portable fire extinguisher layout drawings for each main area are listed in section 18.

12 Fire water run-off

In the event of a fire, water polluted by fire detritus and firefighting foam etc. will be retained on site by means of isolation valve (Penstock) and if required, thereafter pumped out and transported for appropriate disposal, reused in the process, or released in accordance with regulatory requirements.

CIRIA C736 gives guidance as to the control of pollution from firefighting events. This requires that

- firefighting water
- any rainfall retained from a 24-hour preceding the event
- rainfall during the period of the fire and
- rainfall for 8 days after the event (all based on a 1 in 10-year storm event)

...must be retained on the site.

Fire water retention capacity is maintained for the full plant area including volume included in the drainage system, the discharge attenuation tanks, the sedimentation basin, the trade water treatment tanks and main RDF bunkers.

Fire water retention is, as far as practible, designed separate for clean rainwater and other sources like firefighting and trade water etc. Initial volume planned for rainwater (clean) is 1750 m3 and some 5000 m3 will be available for overflow from rainwater, firefighting water, foul and trade (polluted).

In the event of a fire on site, a penstock linked to the building management system, will shut off water discharge to the Newport docks. Once the attenuation system is full, a pump station will begin to pump surface water to the waste unloading bunker (overflow). Any water drained to the attenuation system during a fire event shall initially be treated as polluted. The water is tested and removed for treatment if polluted or finally discharged to the Newport docks.

Any area inside buildings (except the fuel storage) is drained via the sedimentation basin and the trade water treatment tanks during a fire event. Overflow is pumped to the waste unloading bunker. In the fuel storage, the unloading area (reception) drains directly to the waste unloading bunker. Any water drained or pumped to the waste unloading bunker during a fire event shall be treated as polluted and removed for treatment as described above.
The site will therefore be able to accommodate the fire water retention requirements via retention of surface water and fire water and trade in the event of a fire, with no risk of pollution or flooding.

13 Smoke and heat venting system

13.1 Boiler building

The boiler building is installed with 3 pc. roof ventilation units which also serve as smoke extraction fans (rated for operation for 2 hours at 300 °C (F300)). In the event of a fire or after a fire, should smoke ventilation be required, the ventilation units can be started from the DCS. Fresh makeup air is provided either by the installed inlet louvres and/or by opening the gates at ground floor manually. The 3 pc. ventilation units are spaced as indicated below:

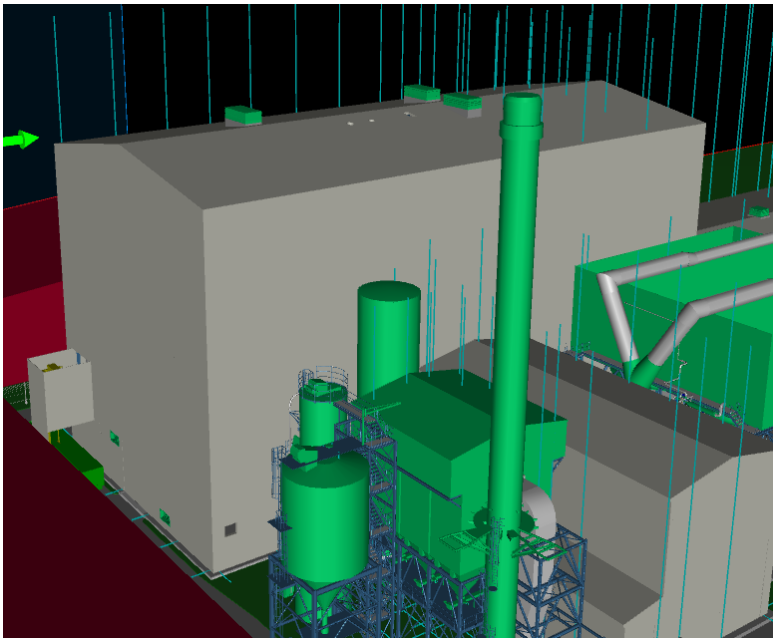


Figure 20 - Boiler Building (UHA) Smoke and Heat Ventilation

Capacity:		
Ventilation unit 1:	~50,000	m3/h
Ventilation unit 2:	~100.000	m3/h
Ventilation unit 3:	~100.000	m3/h
Total flow through the building provided by having all ventilation units in operation:	~250.000	m3/h
Total flow through the building provided by having ventilation unit 1 and ventilation unit 2, 3, or 4 in operation:	~150,000	m3/h
Boiler building volume:	~68,000	m3

The roof ventilation units are designed as fail-safe open. In the event of loss of power supply to the units, these will be forced open and the gates at ground floor shall be opened manually to provide the required draft/replacement air through the building.

13.2 Steam turbine building

The building is installed with 3 pc. supply fan units located at the external walls of the building and 2 pc. passive outlet units at the roof. Each of the three supply fan units is sized to 31,000 m3/hour provided by two fans each sized to 50% of the total flow. Each of the two roof outlet units is sized to 61,000 m3/h.

Total flow into the building provided by having all three intake units in operation:	~93,000	m3/h
Total flow into the building provided by having one intake unit in operation:	~31,000	m3/h
Steam turbine building volume:	~8.650	m3

The gates at ground floor shall be opened manually to provide the required draft/replacement air through the building.

13.3 Feedstock building

The feedstock building is installed with 5 pc. smoke ventilation units (rated for operation for 2 hours at 300 °C (F300)). Each of the four smoke ventilation units is sized to 30,000 m3/hour

Total smoke extraction by having all four units in operation:	~150,000	m3/h
Feedstock building volume*:	~25,000	m3

*Not including occupied space for the boiler building and the fuel treatment structure and not including the tipping hall volume.

The tipping hall gate shall be opened manually to provide the required draft/replacement air through the building.

13.4 Control room

Fresh air is continuously supplied into the Control room (pressurized). In the event of fire all dampers leading to and from the rooms will be closed.

14 References

The following regulations and reference documents have been used in the preparation of this report:

- Guidance Document, Waste Processing Plant – Fire Systems, Issue 2.0, dated 19 May 2017(*1: see section 3.1)
- Guidance Document, Energy from Waste – Fire Systems, Issue 3.0, dated 19 May 2017(*1: see section 3.1)
- S.I. 2010 No. 2214 - The Building Regulations 2010
- S.I. 2005 No. 1541 - The Regulatory Reform (Fire Safety) Order 2005
- The Building Regulations 2010, Approved Document B Volume 2 - Fire Safety; (2006 edition incorporating 2007, 2010 and 2013 amendments)
- National Guidance Document on The Provision of Water for Fire Fighting (January 2007, 3rd edition)
- BS 9999: 2017; Code of Practice for Fire Safety in the Design, Management and Use of Buildings
- BS5839-1:2017; Fire detection and alarm systems for buildings Part 1 – Code of practice for system design, installation, commissioning and maintenance
- BS8300: 2018; Design of buildings and their approaches to meet the needs of disabled people. Code of Practice
- NFPA850: 2020; Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations
- NFPA13: 2022; Standard for the Installation of Sprinkler Systems
- NFPA14: 2019; Standard for the Installation of Standpipe and Hose Systems
- NFPA15: 2022; Standard for Water Spray Fixed systems for Fire Protection
- NFPA16: 2019; Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems
- NFPA20: 2022; Standard for the Installation of Stationary Pumps for Fire Fighting
- NFPA30: 2021; Flammable and Combustible Liquids Code
- NFPA101: 2018; Life Safety Code
- Research Establishment Report BRE187 (2014 – External fire spread: Building separation and boundary distances)
- CIBSE Guide E; Fire engineering
- WASTE 28 Reducing fire risk at waste management sites issue 2 – April 2017
- HSE Storage of flammable liquids in tanks (HSG176)

15 Fire safety provisions (Statutory requirement and Insurer's requirement)

The following describes each of the additionally fire safety measures to be incorporated in the design of the power plant for life safety and property protection (the figures mentioned for the water-based fire suppression systems would not necessarily be accurate however, they should provide sufficient information for the design and sizing of the fire water requirement i.e. fire water storage tank and fire pump capacity).

Fire suppression systems will be designed in accordance with the recommendations of NFPA except for the inert gas systems which will be designed in accordance with BS EN15004.

Note: Any water filled pipe, valve, deluge valve etc. serving fire suppression systems and dry risers with risk of being exposed to low temperature (frost) shall be properly heat traced.

15.1 Compartmentation – Fire segregation

Refer to section 8.9 of this report.

15.1.1 Steel Structure

Steel structure supporting 2-way fire rated compartment walls will be fire protected for a 2hr rating by passive fire protection system. Protection either by intumescent paint or by wrapping.

15.1.2 Fire rated walls

Fire walls with 2-way fire rating will in general be constructed using horizontally laid Rockwool cored composite panels (Eurobond Rainspan or similar) spanning between structural columns without horizontal sheeting rails.

Alternatively, pre-cast wall panels will be used where there is a risk for any mechanical load or wear on surfaces or need for continuous cleaning.

Fire walls with 1-way fire rating will in general be constructed using a twin skin, site assembled insulated profiled metal cladding built-up system with medium dense core rockwool (Tata Trinsul or similar) on traditional cold-rolled sheeting rails.

15.1.3 Fire rated roofs

Roofs with 1-way fire rating will in general be constructed using twin skin site assembled insulated profiled metal cladding built-up system with medium dense core rockwool (Tata Trinsul or similar) on traditional cold-rolled purlins.

15.2 Hydraulic systems

Listed Fire resistant hydraulic fluids will be used for hydraulic systems except where otherwise accepted by the codes.

15.3 Fixed fire protection – Sprinkler and Monitors

For life safety and in order to minimise losses to plant and production, certain areas and risks in a Power Plant of this type are recommended to be provided with fixed fire protection systems (manual or automatic in operation as appropriate).

15.4 External RDF storage

The external RDF storage is managed as stockpiles of baled fuel of not more than 450m3 with each stockpile separated from the adjacent pile by not less than 6m as per EA guidance.

EA guidance requires a water supply capable of providing 2,000L per minute, per 300m3 of fuel in the largest stockpile, for a period of 3 hours.

Fire water demand ((450/300) x 2000 x 180) ~540m3 total

15.5 Waste Fuel Handling (UEA/UEB)

15.5.1 Tipping Hall

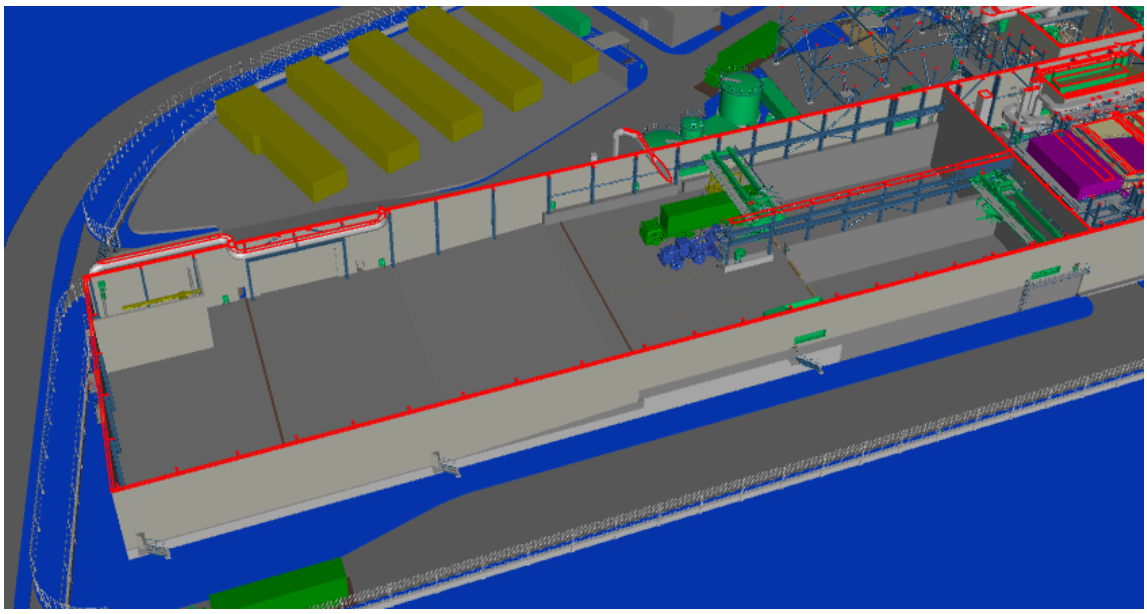


Figure 21 - Waste Fuel Handling (UEA/UEB)

The tipping hall will be provided with an automatic water sprinkler system. The system will be designed to provide complete coverage of the floor area. The system will be designed for a minimum of 10.2 mm/min over the most remote 279 m^2 of floor area.

Fire water demand (minimum requirement according to NFPA 850) ~171 m^3/h

15.5.2 Unloading and Fuel Storage Bunker

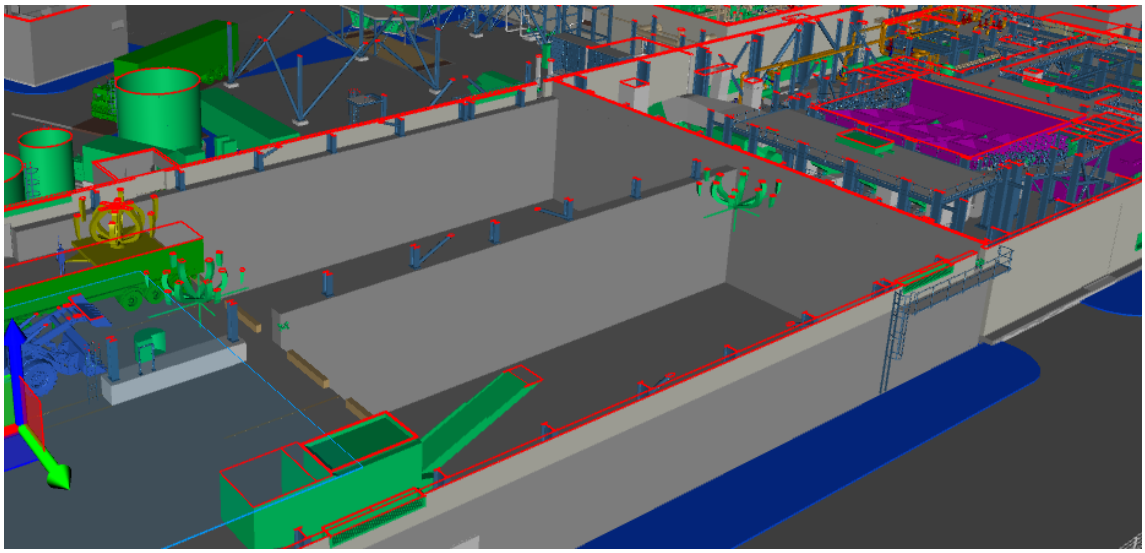


Figure 22 - Unloading Bunker (UEB)

The fuel bunker with centre separation wall will be installed with three monitors, so that each of the two sections is covered by two monitors. Each monitor with a capacity of minimum 946 l/min at 6.89 bar. The monitors will be located to allow for coverage of one section at a time with two monitors operating simultaneously.

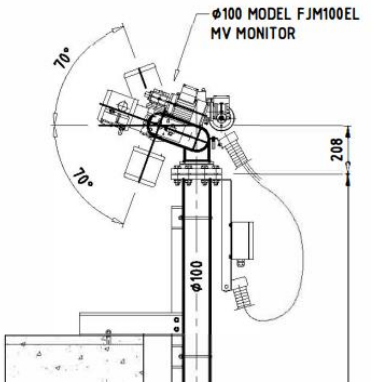


Figure 23 – Monitor, typical installation

Upon detection of fire and automatic start of the monitors, the monitor nozzles will automatic start oscillating. Manual override will be provided, and the monitors will be capable of remote operation from the crane operator room and the central control room.

Fire water demand ~114 m^3/h.

15.5.3 Crane operator room viewing window

Additional to the fire rated glazing for 60 minutes for the viewing windows towards the bunker/hopper area, a water drenching curtain system will be mounted on the bunker side of the glazing designed for a density of 10.2 mm/min over the window area. The water drenching system will be automatically activated via the bunker fire detection system linked to a deluge valve. In addition, a manual initiation system will be installed inside the crane operator rooms and the central control Room.

Fire water demand (2 No operating) ~11.6 m^3/h

15.5.4 Steel Structure

All steel columns in the fuel storage bunker area will be fire protected for a 2hr rating by passive fire protection system. Protection either by intumescent paint or by wrapping.

15.6 Waste Fuel Storage Area – UEB

15.6.1 Boiler Feed Area

The tipping hall will be provided with an automatic deluge protection. The system will be designed as two zones each covering 75% of the floor area. The centred area will at any time be sprayed in the event of release of either system. The systems will be designed for a minimum of 10.2 mm/min over the most remote 279 m2 of floor area. In the event of fire, the installed fire detection system covering the specific area will release the specific deluge valve (note: only one out of two area can be release at one time).

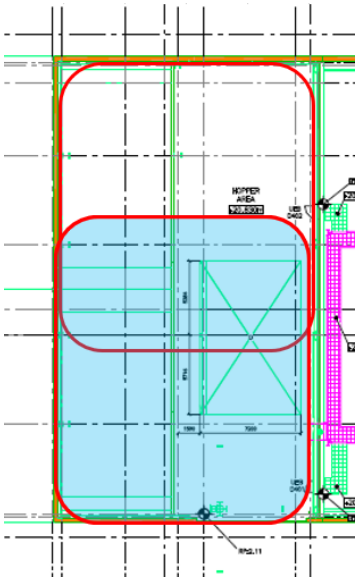


Figure 24 – Deluge zones

Fire water consumption (minimum requirement according to NFPA 850)	~171 m3/h
Actual fire water consumption per zone (before detailed design):	~275 m3/h

15.6.2 Boiler Feed Hopper

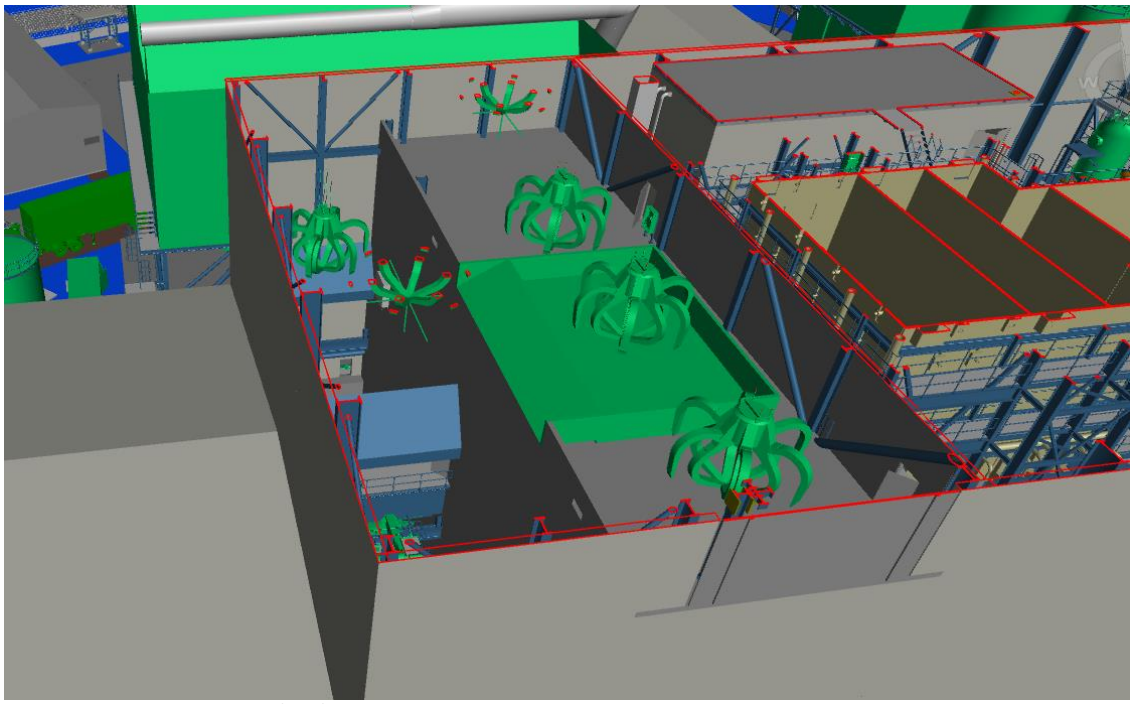


Figure 25 - Boiler Feed Hopper (UEB)

The feed hopper for the boiler will have automatic deluge protection designed for a minimum of 8.1 mm/min over the entire Hopper, with the protection area per deluge head not to exceed 12.0 m^2. Manual activation of the Hopper deluge system will be possible from the Control Room.

Fire water demand (11m x 7m hopper) ~37.5 m^3/h

The boiler feed hopper also has two integral water spray systems, one at high level, just below the chute gate, and the other at low level however these are process related and not for direct fire suppression.

15.7 Step-up transformer (UAB)

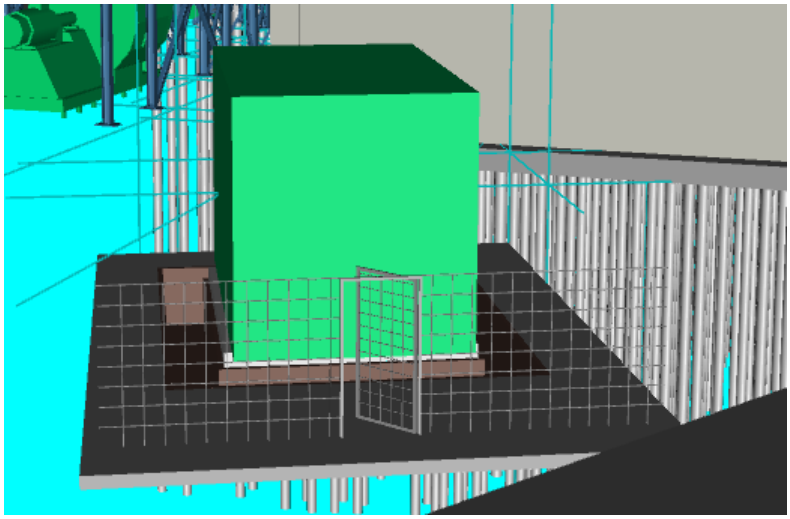


Figure 26 - Step Up Transformer (UAB)

The external step-up transformer (UAB) is filled with a type K Less Flammable Liquid insulant and has a capacity <38,000L (actual specification is 12,800L). Accordingly, Chubb guidance recommends that a minimum separation distance of 1.5m (Table 5.12.5) be maintained between all parts of the transformer and any adjacent buildings.

With a spatial separation of 1.5m the step-up transformer is not required to be enclosed by firewalls, nor provided with an automatic fire suppression system.

15.8 Diesel and Urea storage tanks (UEQ)

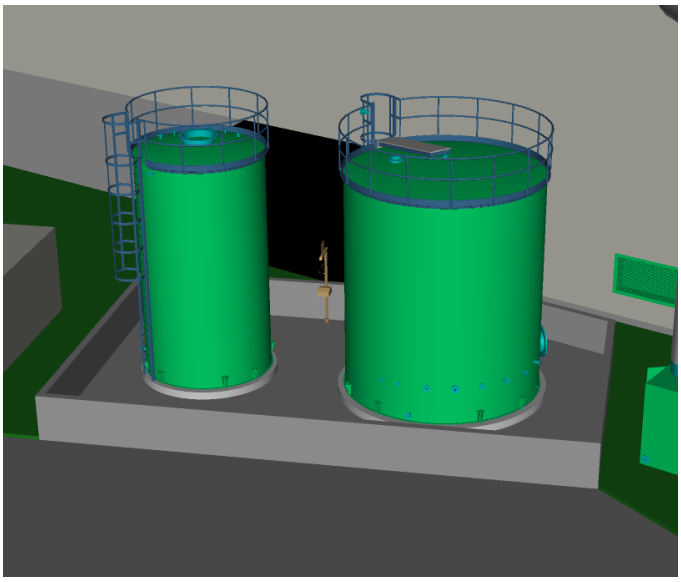


Figure 27 - Diesel and Urea Storage Tanks

The diesel and Urea storage tanks are located externally but near the Fuel Handling Building (UEA/UEB) and as such the affected façade of the building will be provided with fire protection. In this instance the fire protection offered is in the form of a local hydrant to enable wetting of the UEA/UEB façade in the event of a fire in the proximity.
This provision follows the guidance of NFPA30 Table 22.4.1.1(a) and requires a minimum spatial separation of the tanks from the building of:

- 1/3 the tank diameter for vertical tanks with a weak roof to shall seam, or
- The value from Table 22.4.1.1(b) for a vertical tank fitted with a pressure relief vent limiting the pressure to a gauge pressure of 17kPa.

Minimum Distance (m)		
Tank Capacity (L)	**From Property Line that Is or Can Be Built Upon, Including the Opposite Side of a Public Way**	**From Nearest Side of Any Important Building on the Same Property**
1,045 or less	1.5	1.5
1,046 to 2,850	3	1.5
2,851 to 45,600	4.5	1.5
45,601 to 114,000	6	1.5
114,001 to 190,000	9	3
190,001 to 380,000	15	4.5
380,001 to 1,900,000	24	7.5
1,900,001 to 3,800,000	30	10.5
3,800,001 to 7,600,000	40.5	13.5
7,600,001 to 11,400,000	49.5	16.5
11,400,001 or more	52.5	18

Table 12 - SI version of Table 22.4.1.1(b) from NFPA30

15.9 Emergency diesel generator (UBM)

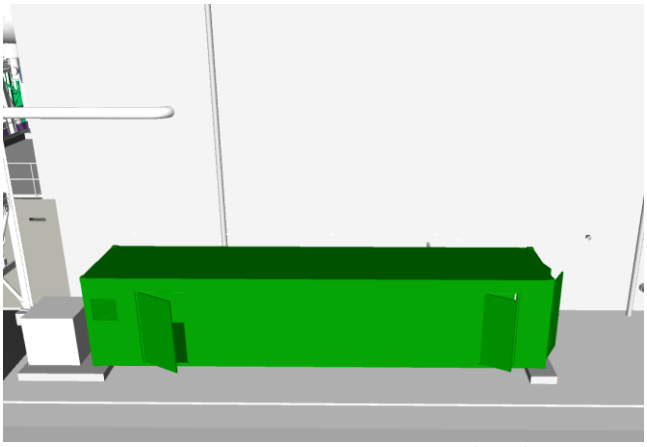


Figure 28 - Emergency Diesel Generator (UBM)

The emergency diesel generator is installed outdoor in a weatherproof and non-combustible enclosure and is a standard package unit. The unit will be equipped with smoke detectors for early warning and an internal sprinkler system. The sprinkler system will be release by means of heat detectors (glass bulbs, set point 30°C above ambient temperature.

Fire water demand (assuming a nominal 32m^2 coverage) ~20 m^3/h.
The above figure is subject to change as detailed design progresses.

15.10 Containerized fire pump unit (USG)

The containerised fire pump unit will be designed according to NFPA20. This includes fire protection of the interior of the containerized unit with automatic sprinklers to all areas including the fuel tank.

Fire water demand (assuming a nominal 32m^2 coverage) ~20 m^3/h.
The above figure is subject to change as detailed design progresses.

15.11 Steam turbine generator (UMA)

15.11.1 The area above the turbine table

Turbine bearings, generator bearings, gearbox, the purifier- and the lube oil unit, and main steam valve, will be protected by an automatic low-pressure pre-action closed head sprinkler system.

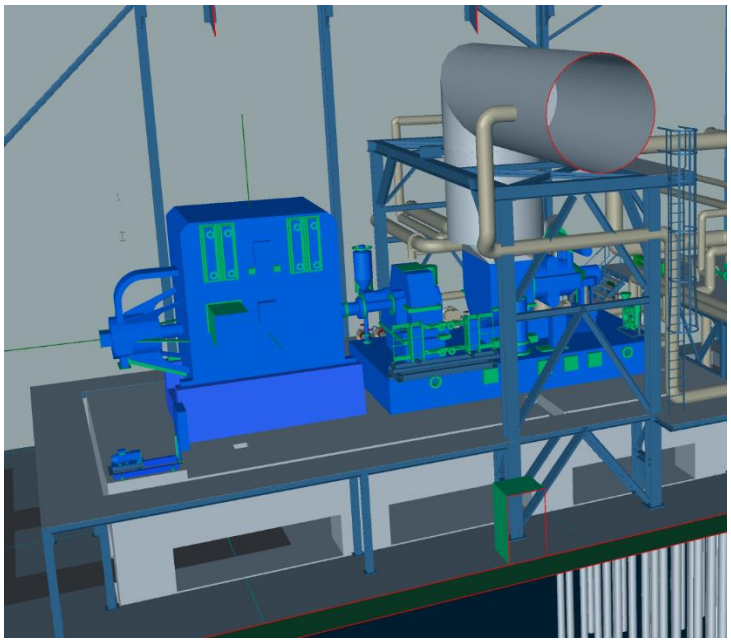


Figure 29 - Turbine Table

The fire protection system for the gearbox, the purifier- and the lube oil unit, and main steam valve, will be designed for a density of 12.2 mm/min in accordance with NFPA850 (2020); 10.3.1.

The fire protection system for the turbine generator bearings will be designed for a density 10.2 mm/min in accordance with NFPA850 (2020); 10.3.3.1.

Until detailed design of the systems is complete an assumed maximum area of coverage of 112m2 has been adopted.

Fire water demand ~82.0m3/h.

15.11.2 The area beneath the turbine table

The fire protection system will be designed for a density of minimum 6.5 mm/min in accordance with NFPA16 (2019); 7.2.2.1 and a duration of minimum 10 minutes in accordance with NFPA16 (2019); 7.2.3.1

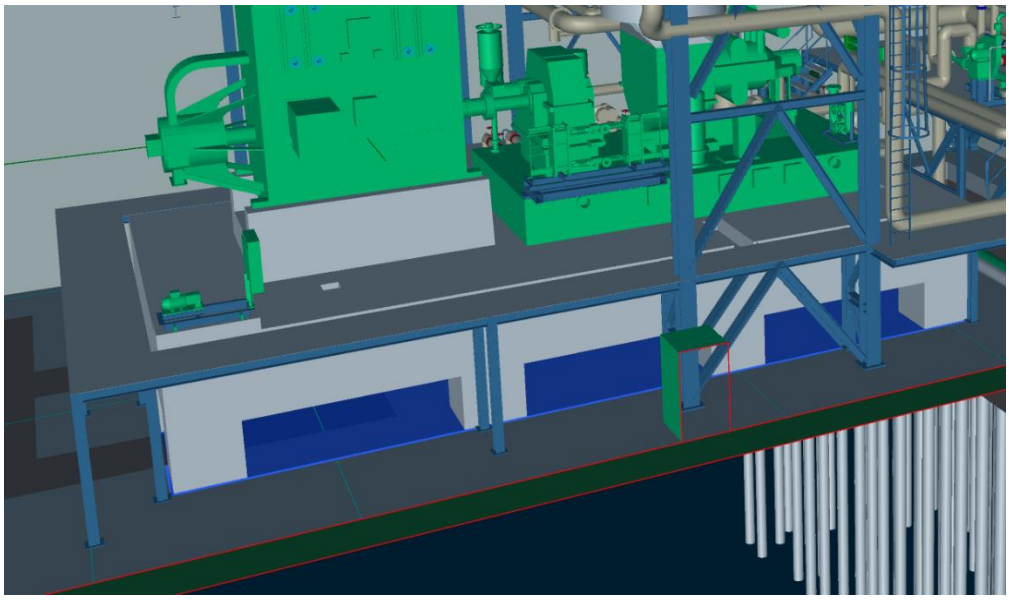


Figure 30 - Area Beneath Turbine Table

The foam system will be for automatic release be by means of heat and flame detectors through a deluge valve as well as manual release.

Unless detailed design dictates otherwise, it is assumed that the whole of the UMA floor area is to be covered by the foam system – area 14.8 x 31.7 = 470m2.

Fire water demand ~30.6m3.

A reservoir is constructed below turbine table to limit the spread of oil from any leakage in lube or hydraulic systems. The reservoir is established by constructing a concrete “bund” around circumference of the turbine table at terrain level covered with steel grating.

15.11.3 Spray guides

To reduce the risk of aerosols from oil originated from a leaking flange assembly in the turbine building, flange assemblies will be installed with spray guides.

15.12 Boiler auxiliary burners (UHA)

15.12.1 General

The auxiliary burners and valve skids serving the boiler shall be protected by a closed head pre-action single interlocked foam water sprinkler system (i.e., one valve set per boiler serving all areas). The fire protection system will be designed for a density of minimum 10.2 mm/min in accordance with NFPA 850 (2020); 12.3.1.1.2 and a duration of minimum 10 minutes in accordance with NFPA16 (2019); 7.2.3.1

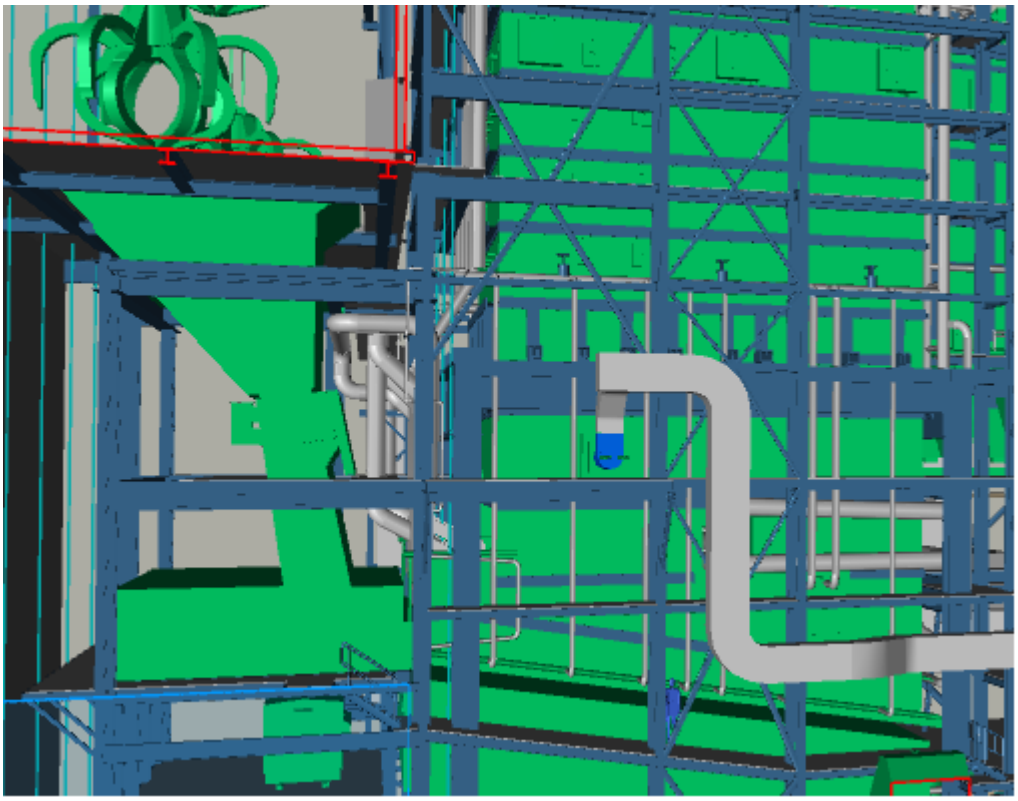


Figure 31 - Auxiliary Boiler Burners - View from South

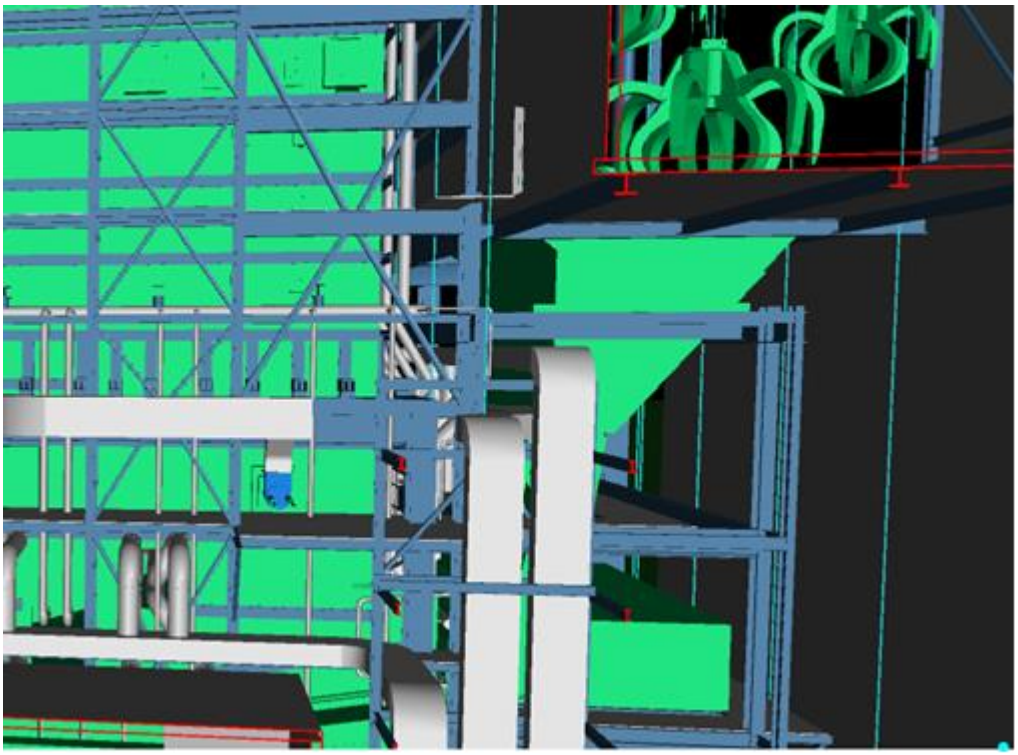


Figure 32 - Auxiliary Boiler Burners - View from North

The foam system design for burners and igniters and adjacent fuel oil piping shall be designed to cover 6.1 m distance from the burners and igniters including structural members and walkways according to NFPA 850.

The foam water sprinkler system shall be designed to a density of 10.2 mm/min over a total area of 465 m^2 (most remote area) for a minimum of 10 minutes according to NFPA 16. The total area to be covered is approximately 2 x 800 m^2.

Fire water demand ~284 m3/h.

The above figures are subject to confirmation of required protected area and subject to change as detailed design progresses.

15.12.2 Spray guides

To reduce the risk of aerosols from oil originated from a leaking flange assembly in the boiler building, flange assemblies will be installed with spray guides.

15.13 Boiler Grate Hydraulic Pack (UHA)

The Boiler Grate is driven by a hydraulic ram pack located at the bottom of the boiler fuel chute. The fuel is pushed by hydraulic rams onto the boiler grate where it moves through the various combustion zones (drying, ignition, main combustion, extinction).

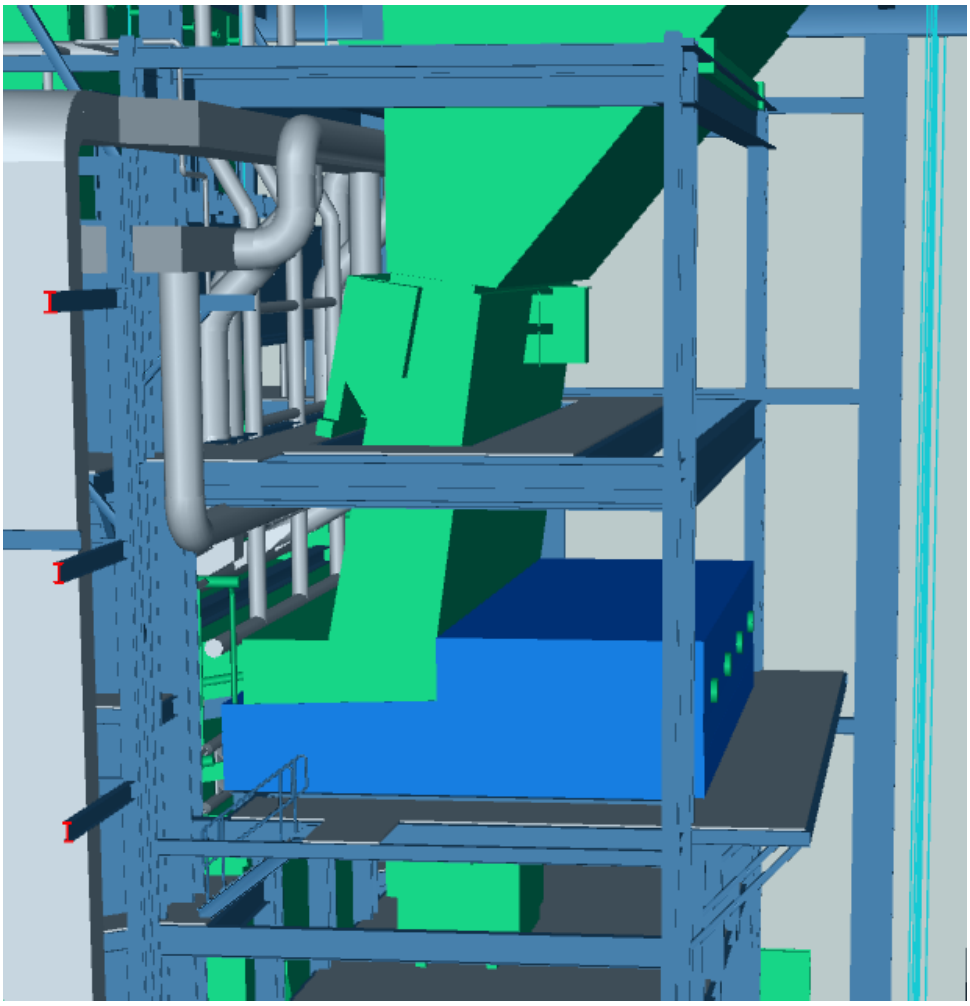


Figure 33 - Boiler Grate Drive

The Boiler Grate Hydraulic Ram system utilises a Fire Resistant Fluid (FRF) – estimated volume 800-1,000 litres and has an associated hydraulic pack (tank, pumps, instrumentation etc.).

As the system uses a FRF (example cited – “Quintolubric 888-68” or equivalent) there is no requirement to provide additional active fire suppression to the system.

15.14 Electrical rooms (various locations)

A total flooding inert gas system will be provided for the following rooms:

- MV room.
- LV room.
- DCS equipment room.
- Battery room.
- SAT room (building).
- Feedstock handling switchboard room.
- ACC / Steam Turbine switchboard room.
- FGT Area switchboard room.
- CEMS.

The above areas are typical descriptions only and the list of protected rooms will be rationalised during detailed design. Where multiple electrical rooms are in close proximity to one another they may be protected by a single extinguishing system, activated on a zonal basis.

The gaseous extinguishing systems will be designed according to EN15004-2009 and based on discharge of Inergen (IG541).

Coverage will include floor voids and ceiling voids where applicable.

Automatic systems must be interlocked such that when the room is occupied, extinguishant discharge cannot occur. The system may operate in fully automatic mode when such rooms are unoccupied.

Detailed design of any gaseous extinguishing systems will be the responsibility of the specialist system supplier.

15.15 FGT Bag filter

An Inergen extinguishing system will be installed for protection of the Bag filter. The system will be designed to flood one compartment out of six. The system will be released based on temperature switches monitoring each compartment.

Detailed design of any gaseous extinguishing systems will be the responsibility of the specialist system supplier.

15.16 Smoke and Heat Venting system

Refer to section 13 of this report.

15.17 Hose reels

Hose reels are provided for manual firefighting in the following areas:

- Boiler building
- Steam turbine building
- Fuel unloading area
- External baled fuel storage area

The hose reels inside the process buildings will be designed so that all areas are within the range of a fire hose.

Size of hoses will be 1" (DN25) semi ridged rubber hoses.

15.18 Dry riser

Dry risers with landing valves located at each level will be installed at the two internal staircases inside the boiler building (UHA).

15.19 Fire Service connection

Two 2-way inlet breeching valves will be available on site allowing for charging the fire main. One will be available at the gate to enter the power plant and one will be available next to the steam turbine building (UMA). The connections will be 2 1/2" and according to BS336.

15.20 Fire water tank

Secondary outlet for fire water supply to Fire Service and filling of tank.
The fire water storage tank will be equipped with a spare connection to allow the attending Fire Service to connect directly to the tank for replenishment water for the fire appliances should it be necessary. Type of coupling to be agreed.

The fire water storage tank will normally be filled and refilled through a fixed connection to the site water supply from the public water supplier. To allow for additional filling the fire water storage tank will equipped with a separate connection installed with a 2-way inlet breeching valve. The connection will be 2 1/2" and according to BS336.

15.21 Sprinkler system for crane grab workshop

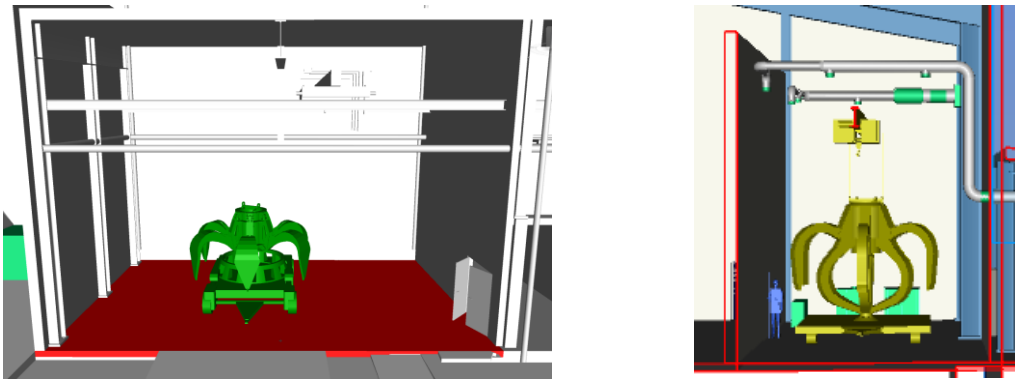


Figure 34 - Crane grab workshop (sprinkler floor area coverage)

The sprinkler system to be installed will be designed as a dry pipe system with a density of 8.1 mm/min.

The system shall be for automatic release through glass bulb with release temperature at 30 °C above ambient temperature.

Fire water demand (134.7 m^2 x 8.1 mm/min) ~ 65.5 m^3/h.
The above figure is subject to change as detail design progresses.

15.22 Powdered Activated Carbon (PAC) Silo

The PAC silo will be fitted with temperature sensors and a manual initiated gaseous fire protection system. To avoid danger to the operator, the manual release point will be located at a safe distance from the PAC silo.

15.23 Odour Control Unit

The Odour Control Unit will internally be provided with automatic sprinkler. The sprinkler system to be installed will be designed as a dry pipe system with a density of 10.2 mm/min.

The system shall be for automatic release through glass bulb with release temperature at 30 °C above ambient temperature.

15.24 Oil Storage room – Workshop

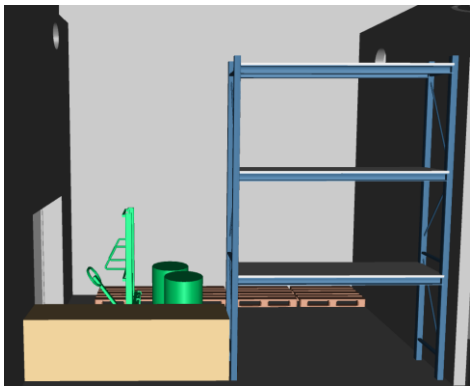


Figure 35 - Oil storage room

The oil storage room (area 3.655mm x 5.555mm) will be provided with automatic sprinkler. The sprinkler system to be installed will be designed as a dry pipe system with a density of 12.2 mm/min.

The system shall be for automatic release through glass bulb with release temperature at 30 °C above ambient temperature.

Fire water demand (20.3 m^2 x 12.2 mm/min) ~ 15 m^3/h.

The above figure is subject to change as detailed design progresses.

15.25 Water supplies for firefighting purposes

The firefighting water supply is to comprise a water storage facility for the fire main, duty and standby fire pumps (100% duty each, either 2 x diesel engine driven or 1 x diesel engine and 1 x electric motor driven), and a jockey pump to maintain quiescent static ring main pressure. The supply design for the Power Plant is based on the requirements of NFPA850:

The water supply for the permanent fire protection installation is be based on providing a 2-hour supply for:

- Either the largest fixed fire suppression system demand or any fixed fire suppression system demands that could reasonably be expected to operate simultaneously during a single event.

And

- The hose stream demand of not less than 1893 L/min (113.6 m^3/h)

The scenario considered as a potential worst case would be a large fire in Fuel Handling (UEA/UEB):

Fire Design basis:
Largest simultaneously operated fixed extinguisher system at power plant:

Deluge system, only one zone (75% of the area)	278	m³/h
Waste feed hopper sprinklers	37	m³/h

Fire water pump:

Fire hose stream + largest fixed extinguisher system (acc. NFPA 850)		
Fire hose capacity (acc. NFPA 850):	113.4	m³/h
Largest fixed extinguisher system (+30% gradient):	410	m³/h
Fire pump min. capacity:	523	m³/h

Fire and service water tank:

Required fire water tank capacity (acc. NFPA):	1100	m³
Service water storage capacity (option):	0	m³
Additional service water storage capacity (option):	0	m³
Total fire and service water tank capacity:	1100	m³

From BS9999; 22.2:

Water mains and hydrants should be capable of delivering a sufficient flow of water to enable effective firefighting to be undertaken. If the water supply takes the form of a static tank or dam, the capacity should be related to the size of the building and the risk involved.

The fire water storage tank combines provision for both automatic water-based fire suppression systems and hydrant/hose reel demand.

16 Impairment procedure

NFPA25 - Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, provides guidelines in regard to how to act in case of impairment. Based on these guidelines the O&M Contractor should prepare and issue procedures, so that these are in place before actually needed. Further, the O&M Contractor and his team should be familiar with these procedures and responsible members should be appointed before an actual event would occur.

The following from NFPA 25 – Definition:

Impairment. A condition where a fire protection system or unit or portion thereof is out of order, and the condition can result in the fire protection system or unit not functioning in a fire event.
Emergency Impairment. A condition where a water-based fire protection system or portion thereof is out of order due to an unplanned occurrence, or the impairment is found while performing inspection testing or maintenance activities.
Preplanned Impairment. A condition where a water-based fire protection system or a portion thereof is out of service due to work planned in advance, such as revisions to the water supply or sprinkler system piping.

As mentioned in NFPA25 section 15.4.2 impaired equipment shall include, but shall not be limited to:

(1) Sprinkler systems
(2) Standpipe systems
(3) Fire hose systems
(4) Underground fire service mains
(5) Fire pumps
(6) Water storage tanks
(7) Water spray fixed systems
(8) Foam-water systems
(9) Water mist systems
(10) Fire service control valves

NFPA 25, section 15.6 Emergency Impairments:

15.6.1 Emergency impairments shall include, but are not limited to, interruption of water supply, frozen or ruptured piping, and equipment failure, and includes impairments found during inspection, testing, or maintenance activities.

15.6.2 The coordinator shall implement the steps outlined in section 15.5

NFPA 25 section 15.5 Preplanned impairment program:

15.5.1 All preplanned impairments shall be authorized by the impairment coordinator.

15.5.2 Before authorization is given, the impairment coordinator shall be responsible for verifying that the following procedures have been implemented:

(1) The extend and expected duration of the impairment have been determined.
(2) The areas or buildings involved have been inspected and the increased risks determined.
(3) Recommendations to mitigate any increased risks have been submitted to management or the property owner or his designated representative.
(4) Where a fire protection system is out of service for more than 10 hours in a 24-hour period, the impairment coordinator (see NFPA25 (2014) section 15.2) shall arrange for one of the following:
    (a) Evacuation of the building or portion of the building affected by the system out of service
    (b) An approved fire watch
    (c) Establishment of a temporary water supply
    (d) Establishment and implementation of an approved program to eliminate potential ignition sources and limit the amount of fuel available to the fire.
(5) The fire department has been notified
(6) The insurance carrier, the alarm company, property owner or designated representative, and other authorities having jurisdiction have been notified.
(7) The supervisors in the areas to be affected have been notified.
(8) A tag impairment system has been implemented.
(9) All necessary tools and materials have been assembled on the impairment site.

NFPA 25 section 15.7 Restoring systems to service:

When all impaired equipment is restored to normal working order, the impairment coordinator shall verify that the following procedures have been implemented:

(1) Any necessary inspections and tests have been conducted to verify that affected systems are operational. The appropriate chapter of NFPA 25 shall be consulted for guidance on the type inspection and test required.
(2) Supervisors have been advised that protection is restored.
(3) The fire department has been advised that protection is restored.
(4) The property owner or designated representative, insurance carrier, alarm company, and other authorities having jurisdiction have been advised that protection is restored.
(5) The impairment tag has been removed

Definitions:
NFPA 25, 15.2 Impairment Coordinator.
15.2.1 The property owner or designated representative shall assign an impairment coordinator to comply with the requirements of this chapter.
15.2.2 In the absence of a specific designee, the property owner or designated representative shall be considered the impairment coordinator.

Note: This section should not be considered as fulfilling all requirements within NFPA25. NFPA 25 should be reviewed in its full length and be implemented in the impairment procedures where applicable.

17 Follow on design

The purpose of this report is to promote and support Building Regulations application and Local Fire and Rescue Service discussions.

The actual design and specification of the systems and fire safety provisions described herein are required to be carried out during the detailed design stage of the project and will form part of the M&E package, otherwise specialist fire alarm and protection design input will be sought.

Any fire safety designs will be required to be submitted to Building Control for areas that are subject to the Building Regulations, i.e. permanently occupied buildings and facilities such as Welfare Building (ZWA) etc. Where not covered by the Building Regulations, the designer is required to ensure that a suitable level of fire safety has been provided to safeguard any persons who may occasion the affected areas – this may be demonstrated by following established published guidance or performance-based design and should be the subject of discussion with the Local Fire and Rescue Service.

Where fire safety provisions have been made purely for the protection of property or business continuity the design should be in accordance with both the Client's requirements and those of the eventual insurer.

Prior to full operation of the plant and occupation of the Welfare Building a documented fire risk assessment is required under the Regulatory Reform (Fire Safety) Order 2005. The fire risk assessment should be carried out by a person or persons conversant with the fire safety provisions and operating procedures for the installation. The Local Fire and Rescue Service will not provide a fire risk assessment but will require its availability for inspection at any reasonable time during the occupation and operation of the installation.

18 Attachments

Refer 1017.M0.J01.002 - Fire safety strategy report, Attachments

Contents

1 3D - Plant Layout
2 Mechanical - Fire Fighting - P&ID
3 Mechanical – Fire Fighting - Process
4 Mechanical - Fire Fighting - Hose Reel Layout
5 Electrical – Site Lighting
6 Civil - Cladding
7 Civil – Drainage – Surface water, foul and trade

The following represents an indication of the related document types that are/will be used to support the Fire Strategy for the development and will be compiled together as a complete package during detailed design and prior to occupation and full operation of the plant.

Drawing Type
Fire Main layout
Escape and egress – All areas
Portable extinguisher locations – All areas
Hose reel layout – All areas
Fire segregation / Fire separation - All areas
Equipment layout of Fire Detection System (all plant areas)
Light & Small Power - All areas
Swept Path Analysis
Firefighting Containment Volume Design
ATEX area locations