

PART B

Project Dragon – Sustainable Aviation
Fuel (SAF) Production Facility

RIBA Stage 3 Fire Strategy Report

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1 Introduction

1.1 General

PartB Group Ltd. has been appointed by LanzaTech UK Limited to advise on the fire safety aspects of RIBA Stage 3 for the Project Dragon - Sustainable Aviation Fuel (SAF) Production Facility project (referenced throughout the fire strategy as Project Dragon).

The Project Dragon installation is a proposed 30 million gallon/year Alcohol-to-Jet (ATJ) plant consisting of two technologies: Ethanol to Ethylene (ETE) and Ethylene to Jet Fuel (ETJ) technology.

This fire strategy reviews the overall site-wide fire strategy, as well as the fire strategies for individual ancillary buildings on site including gatehouses, administration building, process control room, warehouse, workshop and laboratory. The fire strategy for the ancillary accommodation can be found in Annex A.

This report is based in accordance with the fire safety legislation listed in Section 2 below. It does not include for compliance with any other criteria (i.e. additional client requirements, insurance, etc.) unless specifically described in this report.

The fire safety aspects of the design are highlighted, providing a comprehensive fire safety strategy supporting the Building Regulations Part B application for the scheme.

This assessment consists of the following:

- B1 - Means of Warning & Escape
- B2 - Internal Fire Spread (Linings)
- B3 - Internal Fire Spread (Structure)
- B4 - External Fire Spread
- B5 - Access & Facilities for the Fire Service
- That appropriate operational fire safety management arrangements shall be in place

Where the design deviates from the common practice recommendations, fire engineering principles have been applied to bring the design in line with the Functional Requirements of the Building Regulations.

This fire strategy is primarily concerned with life safety. However, inherent property protection will be provided from some of the life safety provisions such as compartmentation.

The RIBA Stage 4 Fire Strategy will respond to any final and/or detailed engineering design at the appropriate time, and LanzaTech will welcome an appropriately worded planning condition.

1.2 Limitations of Report

The fire safety strategy is based on information provided by Inspire Architects, LanzaTech and Technip Energier. Under no circumstances is liability accepted for the accuracy of such information

Information provided by others has been detailed in Table 1

Table 1: Information Provided

Description	Drawing Number	Rev.	Produced By	Date
Proposed Process-Control Building Plans	2143.01-IA-01-ZZ-DR-A-0300	P3	Inspire	30.06.2023
Proposed Process-Control Building Elevations	2143.01-IA-01-ZZ-DR-A-0301	P3	Inspire	30.06.2023
Proposed Laboratory Plan and Elevations	2143.01-IA-02-ZZ-DR-A-0300	P4	Inspire	30.06.2023
Proposed Gatehouse 1 Plans and Elevations	2143.01-IA-03-ZZ-DR-A-0300	P3	Inspire	23.06.2023
Proposed Gatehouse 2 Plans and Elevations	2143.01-IA-04-ZZ-DR-A-0300	P3	Inspire	23.06.2023
Proposed Workshop Plans and Elevations	2143.01-IA-05-ZZ-DR-A-0300	P4	Inspire	30.06.2023
Proposed Warehouse Store Plans and Elevations	2143.01-IA-06-ZZ-DR-A-0300	P4	Inspire	30.06.2023
Proposed Admin Building Plans and Elevations	2143.01-IA-09-ZZ-DR-A-0300	P4	Inspire	30.06.2023
Proposed PDZ Layout and Equipment List	2143.01-IA-ZZ-ST-DR-A-0215	P17	Inspire	27.10.2023
Overall Plot Plan	20294C-050-DW-0051-00001	5	LanzaTech	22.09.2023
Safety Equipment and Escape Route Layout Sheet 1 of 3	202947C-000-DW-1960-00001	3	LanzaTech	26.10.2023
Fire Zone Layout Sheet 1 of 1	202947C-000-DW-1940-00001	1	LanzaTech	17.07.2023
Fire Protection Philosophy	202947C-000-JSD-1900-00005	2	LanzaTech	11.05.2023
Fire Protection Layouts Sheet 1 of 3	202947C-450-DW-1933-00001	0	LanzaTech	25.08.2023
Fire and Gas Detection Layouts Sheet 1 of 3	202947C-050-DW-1950-00001	1	LanzaTech	27.10.2023
DSEAR Assessment	Not yet received			
COMAH Information	Not yet received			
Blast Assessment / Separation Distances	Not yet received			

2 Legislation & Guidance Documents

2.1 Building Regulations

The building will be subject to approval under the Building Regulations 2010 as modified by the Building (Amendment) Regulations 2018.

This will require the design and construction to comply with the Functional Requirements as shown in Section 1.1 of this report.

To demonstrate compliance with Functional Requirements B1 to B5, it is typical to base the design on standard fire safety design documents. Variations to the guidance given in those documents is permitted, provided it can be demonstrated and/or justified to have still met Functional Requirements B1-B5.

In addition, under changes introduced in the Building (Amendment) Regulations 2018, for buildings classified as 'relevant buildings', Regulation 7(2) (and other modified Regulations) applies additional criteria on the combustibility of materials within the external walls.

The definition of a 'relevant building' is a building with a storey that is 18 metres or more above ground level (excluding roof-top plant areas and storeys consisting solely of plant rooms), containing one or more dwellings, an institution, or a room for residential purposes (excluding rooms in hostels, hotels or boarding houses).

This building does not meet the criteria above. As such, additional requirements for 'relevant buildings' under Regulation 7(2) would not be needed.

2.2 COMAH 2015 - Control of Major Accident Hazards (COMAH) - HSE

Major accidents may give rise to serious injury to people or serious damage to the environment, both close to and further away from the site of the accident.

Due to major incidents occurring, and the recognition of the differing standards of controls over industrial activities within the European Union has led the European Commission proposing a directive on the control of major industrial accident hazards.

The original Seveso directive adopted within COMAH comprised a three-part strategy that is still relevant:

- Identification of the sites
- Control measures to prevent major accidents
- Mitigation measures to limit the effects of any accidents which do occur

Measures introduced as mitigation to control risks associated with fire and prevent major fire related incidents occurring will be documented within this fire strategy report as informed by others. This may form part of the documentations collated to assist with COMAH requirements for the associated site tier classification. LanzaTech have confirmed that Project Dragon is classified as 'upper tier'.

As the development is yet to be constructed, when operational, it will become subject to COMAH, the 'responsible person' for the site must send a notification within a reasonable time prior to start of construction. This would normally be three to four months.

A plan setting out a timescale for the stages of the project, such as conceptual design, finalisation of design, construction, procurement, commissioning, etc. should be provided to the HSE.

Figure 1 summaries the responsibilities of the design team / operations team where a site is new, and for first time operations that are relevant prior to key milestones for design, construction and operation for an upper tier classification.

New to COMAH – new construction or first time operation						
Proposed construction/first time operation of new lower-tier establishment	3(1) Date construction/operation of establishment starts	6(1) & 6(2) Pre-construction/operation notifications to be sent within reasonable time before start of construction/operation	7(3)(a)(i) MAPP to be prepared a reasonable time before construction or operation	n/a	n/a	17(5)(a)(i) Information to be provided to competent authority
New establishment						
Proposed construction/first time operation of new upper-tier establishment	3(1) Date construction/operation of establishment starts	6(1) & 6(2) Pre-construction/operation notifications to be sent within reasonable time before start of construction/operation	7(3)(a)(i) MAPP to be prepared a reasonable time before construction or operation as a specific document within safety report	9(2)(a)(i) Pre-construction report to be sent within a reasonable time before start of construction 9(2)(a)(ii) Pre-operation report to be sent within a reasonable time before start of operation	12(2)(a) Plan to be prepared within a reasonable time before operation starts	17(5)(a)(i) Information to be provided to competent authority 18(1) & (6) PIZ information to be sent every 5 years or after 18(5) review
New establishment						

Figure 1: New to COMAH – New Construction or First-Time Operation (Source: COMAH Regulations 2015, HSE.gov)

2.3 DSEAR 2002

Dangerous substances can put peoples' safety at risk from fire, explosions and corrosion of metal. Dangerous substances include the following:

- A substance or preparation which is classified as being explosive, oxidising, extremely flammable, highly flammable or flammable in accordance with the approved classification and labelling guidance
- A substance or preparation which, because of its physio-chemical or chemical properties and/or the way it is used or present at the workplace, creates a risk
- Any dust, whether in the form of solid particle of fibrous material which can form an explosive mixture with air or an explosive atmosphere

The Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR 2002) puts duties on employer to control the risks to safety from fire, explosions and corrosion of metal. DSEAR 2002 requires employers to do the following:

- Identify dangerous substances within workplace and the associated risks
- Implement control measures to remove or, where not possible to remove, control risks
- Implement control measures to reduce effects of an incident involving dangerous substances
- Prepare plans and procedures to effectively deal with accidents, incidents and emergencies involving dangerous substances
- Inform and, where appropriate, train employees to control and or deal with risk from dangerous substances
- Identify and classify areas of the workplace where explosive atmospheres may occur and avoid ignition sources in these areas.

LanzaTech will need to provide PartB with a DSEAR assessment, to include within the Stage 4 Fire Strategy, to ensure management systems are in place which consider the impact of dangerous substances on the Project Dragon site.

2.4 Design Guidance

2.4.1 Fire Strategy for Site

A combination of British Standards (BS) and National Fire Protection Association (NFPA) codes have been deemed acceptable for design of Project Dragon as noted in *Fire Protection Philosophy*, produced by Technip. The following standards have been used to review the site-wide fire strategy for Project Dragon:

- NFPA 10:2022 'Standard for Portable Fire Extinguishers'
- NFPA 11:2021 'Standard for Low -, Medium- and High-Expansion Foam'
- NFPA 13:2022 'Standard for the Installation of Sprinkler Systems'
- NFPA 14:2019 'Standard for the Installation of Standpipe and Hose Systems'
- NFPA 15:2022 'Standard for Water Spray Fixed Systems for Fire Protection'
- NFPA 20:2022 'Standard for the Installation of Stationary Pumps for Fire Protection'
- NFPA 22:2023 'Standard for Water Tanks for Private Fire Protection'
- NFPA 24:2022 'Standard for the Installation of Private Fire Service Mains and Their Appurtenances'

- NFPA 25:2023 'Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems'
- NFPA 30:2021 'Flammable and Combustible Liquids Code'
- NFPA 69:2019 'Standard on Explosion Prevention Systems'
- NFPA 70:2023 'National Electrical Code'
- NFPA 72:2022 'National Fire Alarm and Signalling Code'
- NFPA 80A:2022 'Recommended Practice for Protection of Buildings from Exterior Fire Exposures'
- NFPA 85:2023 'Boiler and Combustion Systems Hazards Code'
- NFPA 214:2021 'Standard on Water-Cooling Towers'
- NFPA 385:2022 'Standard for Tank Vehicles for Flammable and Combustible Liquids'
- NFPA 495:2023 'Explosive Materials Code'
- NFPA 5000:2021 'Building Construction and Safety Code'
- British Standards BS 5306-8:2012 'Fire Extinguishing Installations and Equipment on Premises Part 8: Selection and positions of portable fire extinguishers – Code of Practice'
- British Standards 5839-1:2017 'Fire Detection and Fire alarm Systems for Buildings Part 1: Code of Practice for the design, installation, commissioning and maintenance of systems in non-domestic premises'
- British Standards 5839-2:1986 'Fire Detection and Fire alarm Systems for Buildings Part 2: Specifications for Manual Call Points'
- British Standards BS 9990:2015 'Non-automatic fire-fighting systems in buildings – Code of practice'
- British Standards BS 9999:2017 'Fire Safety in the Design, Management and use of Buildings – Code of Practice'
- British Standards BS EN 3 'Portable Fire Extinguishers'
- British Standards BS EN 54-11:2001 'Fire Detection and Fire Alarm Systems Part 11: Manual Call Points'
- British Standards BS EN 1869:2019 'Fire Blankets'
- AIChE:2003 'Fire Protection in Chemical, Petrochemical, and Hydrocarbon Processing Facilities'

2.4.2 Fire Strategy for Ancillary Buildings

Annex A, i.e. fire strategy for ancillary buildings, has centred the design of the building around Approved Document B Volume 2: Buildings other than dwellings, 2006 edition including 2010, 2013, 2016 and 2020 amendments – for use in Wales (ADB 2020). Additional guidance documents have been referenced throughout Annex A where appropriate.

In circumstances where the building design diverges from the guidance in ADB 2020, this has been highlighted and justified in this report.

This report describes the primary fire safety issues relating to the building. In any areas not mentioned in this report, the design should comply with the guidance of the relevant guidance documents stated above.

2.5 Regulatory Reform (Fire Safety) Order 2005

Once completed, the building will be subject to the Fire Safety Order. Following building completion and occupation, the Regulatory Reform (Fire Safety) Order 2005 is the controlling fire safety legislation.

Under the Regulatory Reform Order (RRO) it is necessary - amongst other things - for the 'responsible person' to undertake a fire safety risk assessment. The building's management will be responsible to ensure the building's fire safety provisions are appropriately managed, maintained and tested over the building's lifetime.

The RRO also requires the 'responsible person' for the building to ensure a fire risk assessment has been carried out by a competent person.

This report (or subsequent updated versions of this report) could be used to assist that fire risk assessment.

2.6 Construction (Design & Management) Regulations 2015

Projects undertaken in the UK must comply with the requirements of the Construction, Design and Management Regulations (CDM).

This report outlines the fire safety strategy for complying with the functional and performance requirements of the Building Regulations Part B (Fire Safety). Where any conclusions or recommendations specify particular materials, products, or forms of construction, these will have been assessed in accordance with the CDM Regulation 9 (Duties for Designers).

In the event these involve significant residual risks or health and safety critical assumptions, this information will be made available to the principal designer. Where the architect or other consultants use the standards put forward in this report to specify works, they are understood to be competent in alerting the client, principal designer, contractor, and building occupiers of CDM issues.

2.7 Regulation 38

The person carrying out the work shall give fire safety information to the 'responsible person' either:

- not later than the date of completion of the work
- or on the date of occupation of the building or extension (whichever is the earlier)

3 Site Overview

Project Dragon is a proposed SAF production facility located in Crown Wharf, Port Talbot Docks. Figure 14 below documents the site plan. Due to the size of the site, four additional figures are included to outline the individual pieces of equipment as shown in Figure 14.

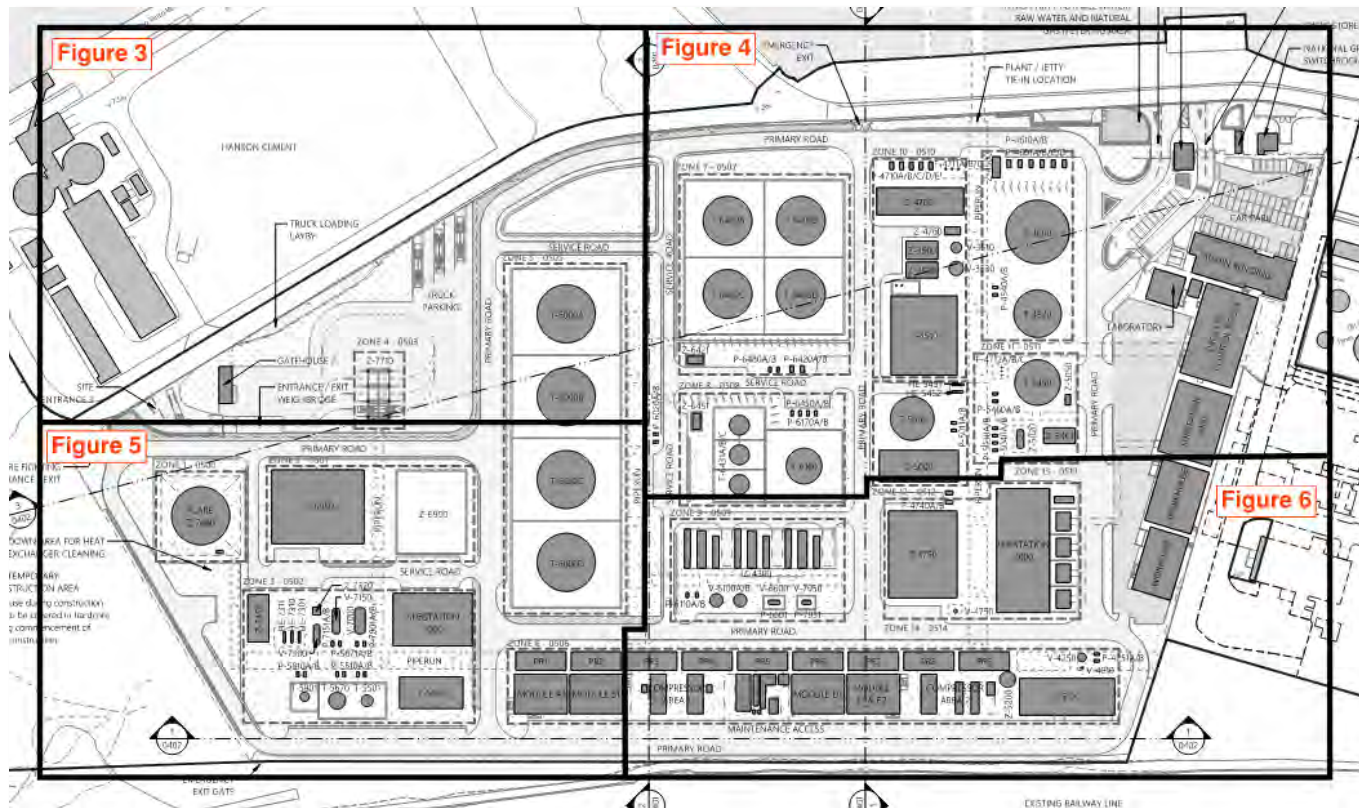


Figure 2: Project Dragon Site Plan with Equipment (Source: LanzaTech Drawing)

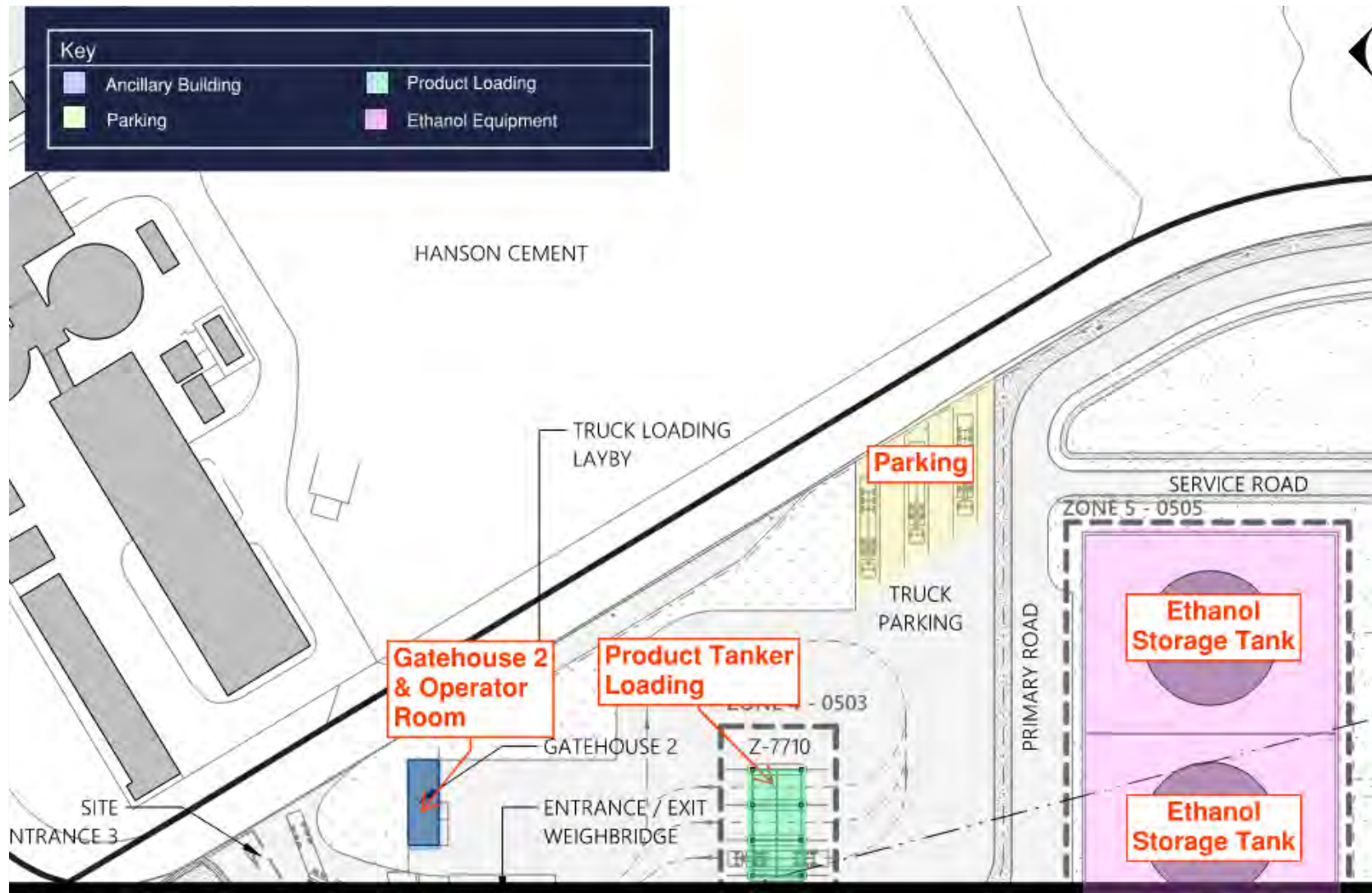


Figure 3: Project Dragon Site Plan with Equipment (Source: LanzaTech Drawing)

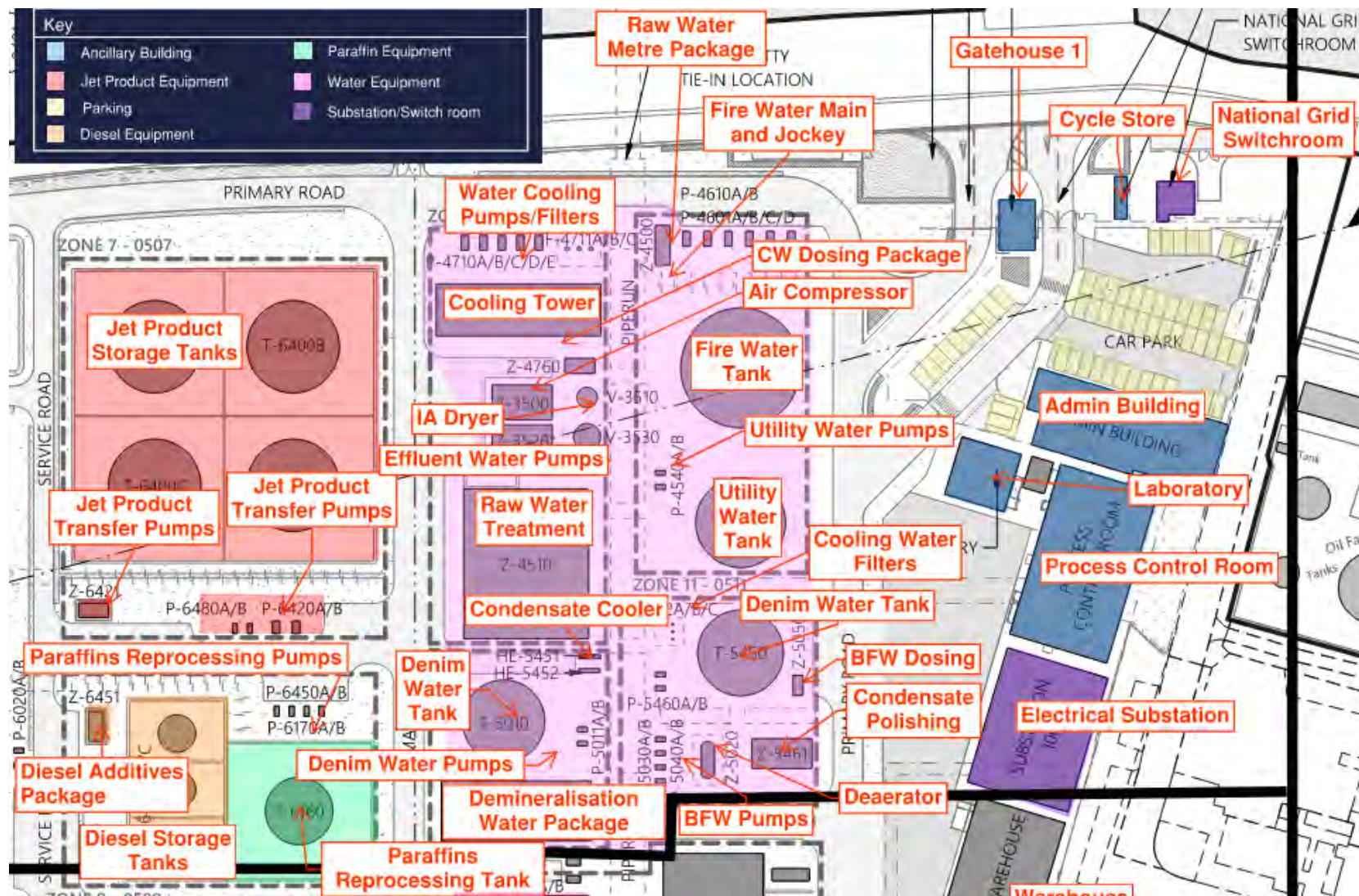


Figure 4: Project Dragon Site Plan with Equipment (Source: LanzaTech Drawing)

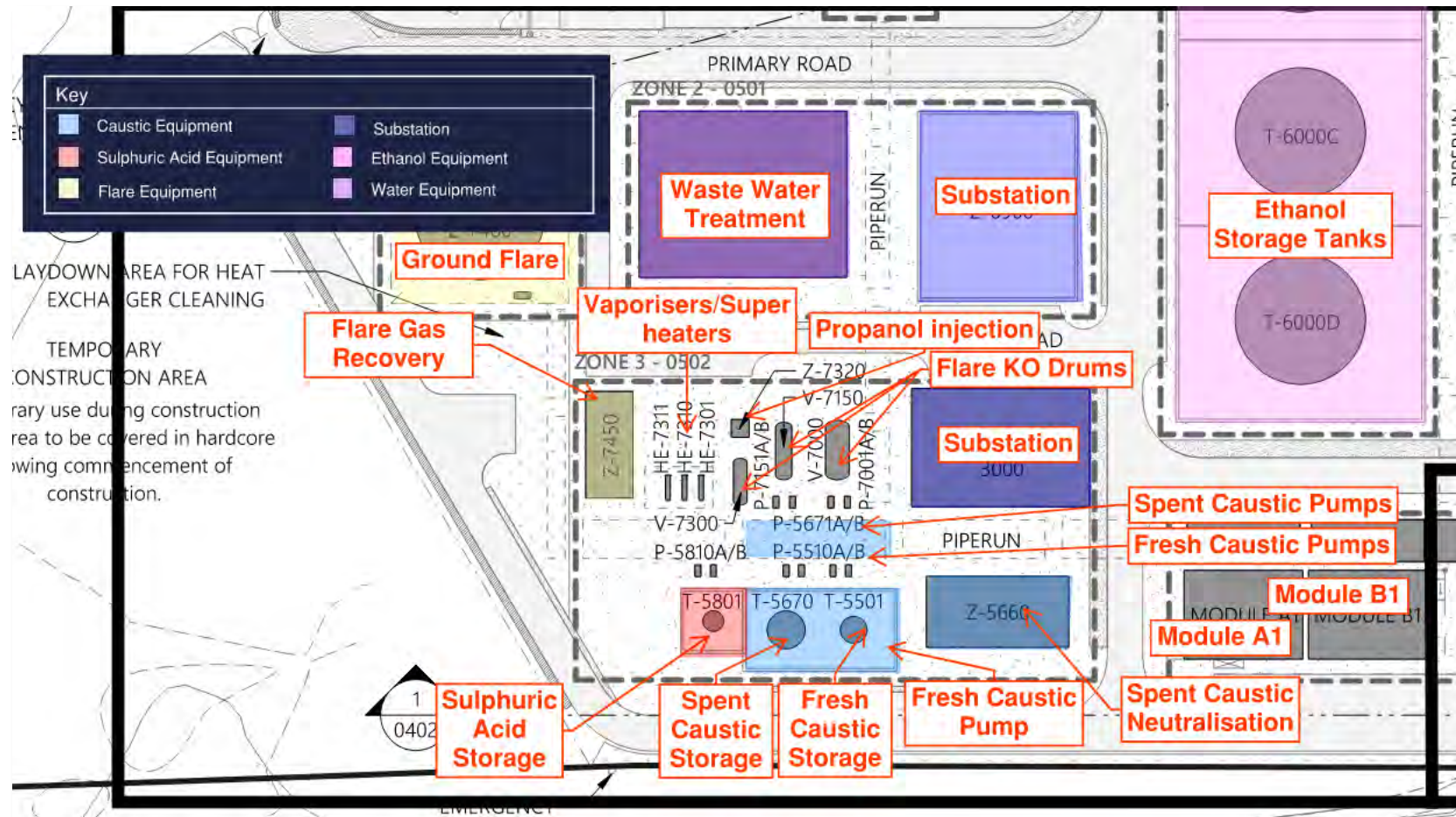


Figure 5: Project Dragon Site Plan with Equipment (Source: LanzaTech Drawing)

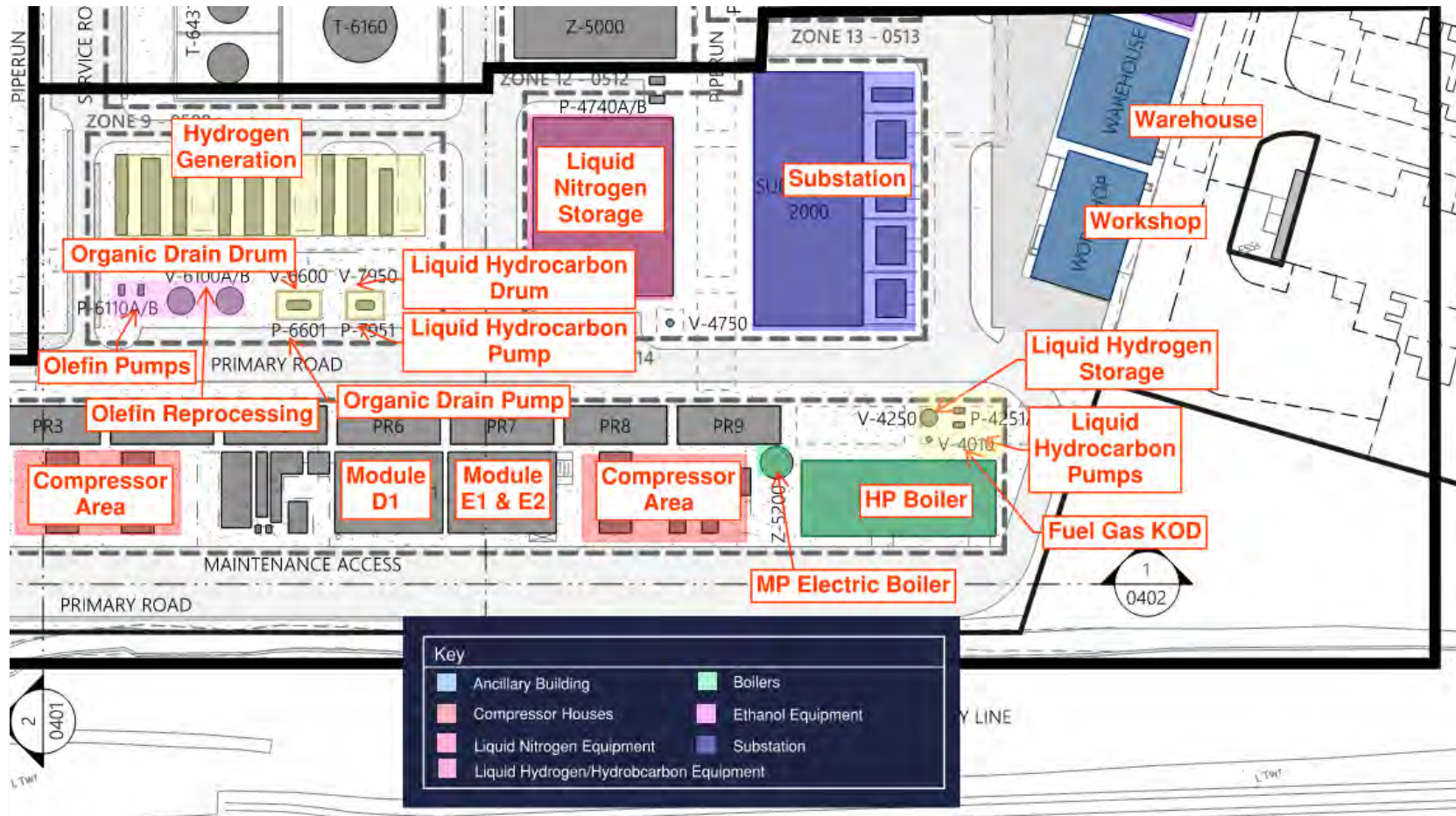


Figure 6: Project Dragon Site Plan with Equipment (Source: LanzaTech Drawing)

3.1 Flammable Liquids

The following flammable liquids are located on the Project Dragon Site. A full list of liquids on site can be found in Appendix B – Full List of Liquids on Site, provided by LanzaTech.

- Ethanol
- Propane
- Propanol
- Natural Gas
- Diesel
- Fuel Gas (Various)
- Liquid Fuel
- Conductivity improver

Flammable liquids can be classified as Class I, Class II or Class III. The definitions for each Class are given below:

- A Class I liquid is defined as a liquid having a closed-cup flashpoint below 37.8°C.
- A Class II liquid is defined as a liquid having a closed-cup flashpoint between 37.8°C and 60°C.
- A Class III liquid is defined as a liquid having a closed-cup flashpoint above 60°C.

3.1.1 Class I Liquids

Class I liquids are further split into the following subclasses:

- Class IA liquids have a closed-cup flashpoint below 22.8°C and a boiling point below 37.8°C.
- Class IB liquids have a closed-cup flashpoint below 22.8°C and a boiling point at or above 37.8°C.
- Class IC liquids have a closed-cup flashpoint at or above 22.8°C but below 37.8°C.

In accordance with NFPA 30 *Flammable and Combustible Liquids Code*, areas where there is a potential for a Class I liquid to spill should be monitored appropriately. Monitoring methods may include one of the following:

- Personnel observation/patrols
- Process-monitoring equipment which can indicate if a spill/leak has occurred
- Gas detectors to continuously monitor areas where facilities are unattended

The following liquids on site are considered to be Class I:

- Ethanol has a closed-cup flash point of 16.6°C and boiling point of 78.37°C = Class IB Liquid
- Propane has a closed-cup flashpoint of -104.5°C and boiling point of -42°C = Class IA Liquid
- Propanol has a closed-cup flashpoint of 15°C and boiling point of 92°C = Class IB Liquid

Therefore, all areas of ethanol, propane and propanol processing will require a form of monitoring as mentioned above. LanzaTech will need to ensure this monitoring is taken into consideration.

4 B1 - Means of Warning & Escape

This section deals with the following requirement from Part B1 of Schedule 1 of the Building Regulations 2010.

Functional Requirement

Means Of Warning and Escape

- B1. 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

4.1 Means of Warning

Fire detection and alarm systems are designed to alert occupants at an early stage of a fire, thus giving them the ability to evacuate the area of fire in relatively safe conditions, prior to escape routes becoming untenable due to the products of a fire (smoke, heat, flames, toxic gases, etc.)

For the Project Dragon site, automatic fire detection and alarm systems will not be appropriate for some of the areas of external equipment as smoke/heat from a potential fire is not guaranteed to activate the system in open air. The open-air equipment on site will therefore be protected via manual call points as a general rule. Figure 7 below documents the locations of the detectors and manual call points proposed on the Project Dragon Site. The following types of detectors have been specified:

- Flame Detector 3-H2 (point type), to detect hydrogen fires/explosions
- Flammable Gas Detector (point type), which will indicate a leak of flammable material
- Hydrogen Gas Detector (point type)
- Manual Alarm Call Point
- Oxygen Depletion Detector
- Flammable Gas Detector (line of sight type)

There is a single flame detector 3-H2 and nine hydrogen gas detectors located at the hydrogen generator. The oxygen depletion detectors are located within the liquid nitrogen storage, which will indicate if there is a liquid nitrogen leak. Manual call points are distributed around the site, and the flammable gas detectors are located where flammable gases could potentially leak.

The specialist detectors will be designed and installed in accordance with specialist design, adhering to BS EN 45544-4:2016.

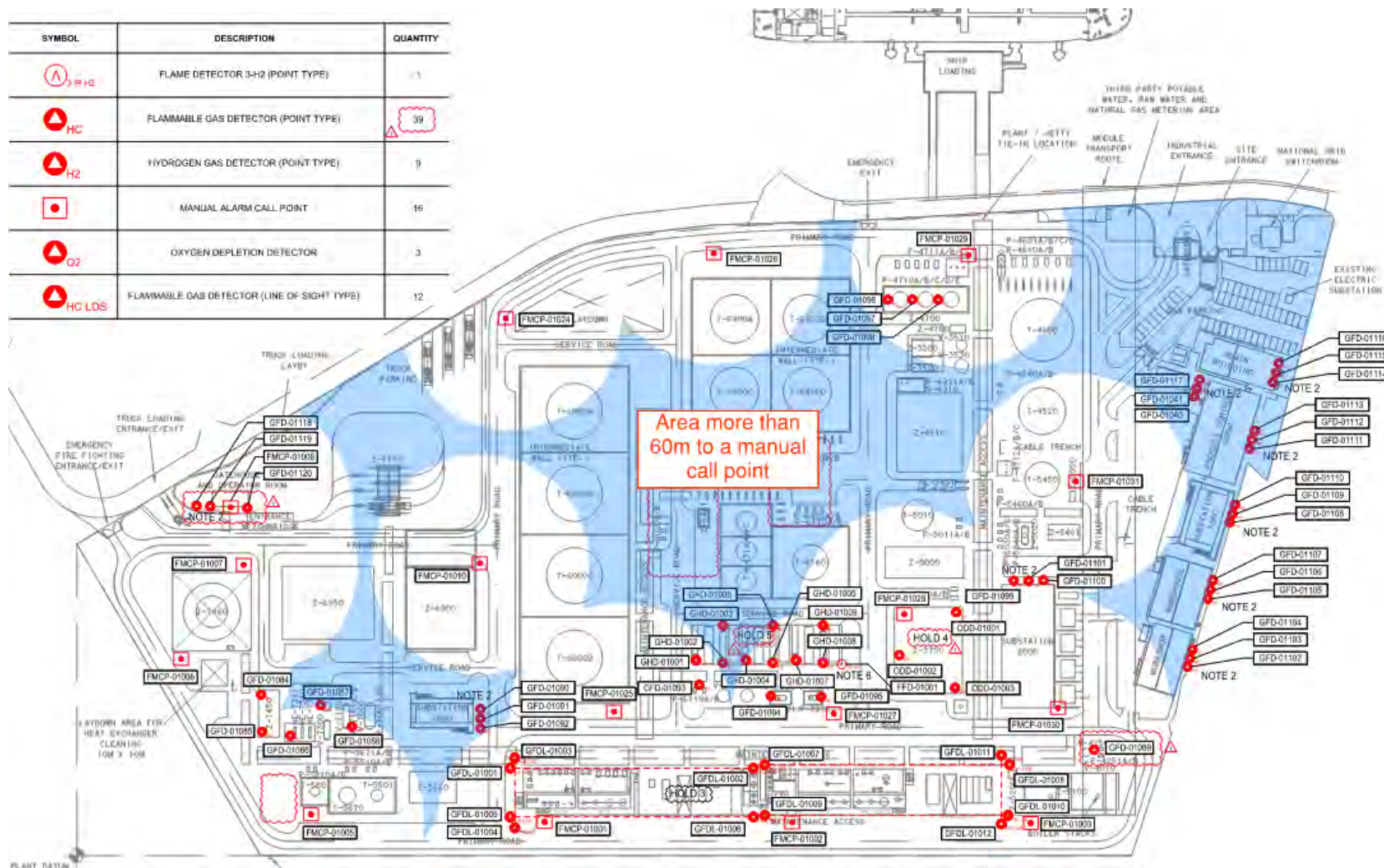


Figure 7: Project Dragon Fire and Gas Detection Layout (Source: LanzaTech Drawing)

Figure 7 above documents the proposed locations of detectors and manual call points based on the Technip engineering layout. There are minor elements of the layout which differ against the latest site wide plan for planning i.e. Proposed PDZ Layout and Equipment List Revision P17. PartB have reviewed Figure 7 against the latest drawing revision for planning and consider that Figure 7 is acceptable as a drawing indicating the principles of the proposed locations of detectors and manual call points. Once updated engineering plans are received, PartB will ensure the same principles have been carried over.

4.1.1 Manual Call Points

Manual call points should comply with BS 5839-2:1983 or Type A of BS EN 54-11:2001 and should be designed and installed to BS5839-1:2017.

Manual call points should be located such that the travel distance from any point in the building to a manual call point is no more than 60 metres for the outdoor areas. For indoor/enclosed areas of the site, the following provisions will be made for the manual call point locations in accordance with *Fire Protection Philosophy* (note this does not include the ancillary accommodation, which is covered in Annex A - Means of Warning):

- At each point of exit from modules/buildings (on outside)
- At either end of staircases within closed modules, where the travel distance is a maximum of 30 metres
- At externally opening maintenance/equipment room doors (on outside)
- At working platforms where escape ladders are provided as the only route away from the working platform level

There are some areas (highlighted in Figure 7 above) where the manual call points are situated in such a configuration that it is more than 60 metres to a manual call point. PartB propose either:

- Additional manual call points are installed in these areas to reduce the travel distance between manual call points to 60 metres or below, or
- A risk assessment is carried out by LanzaTech to determine if additional manual call points are required in these areas based on the equipment requirements.

This information is required for the RIBA Stage 4 Fire Strategy.

4.1.2 Emergency Signalling

Telecoms and emergency signs will be developed at the EPC Stage and included within the fire strategy once locations have been determined. This will include the location of flashing beacons and speakers to alert occupants on site, along with escape signage and escape route marking.

4.1.3 Emergency Shutdown Systems

LanzaTech should confirm if any systems shutdown upon activation of alarm both within an alarm zone (Figure 10 in Fire Alarm Zones) and across adjacent fire alarm zones/full site.

4.2 Fire Alarm Zones

Project Dragon has been split into 12 different fire zones as shown in Figure 8 below. The aim of the zoning is to reduce the spread of fire and facilitate the fire detection and alarm system and emergency shutdown systems.

The activation of a manual call point in one of the fire alarm zones (shown in Figure 8) should alert all areas within the fire alarm zone to begin evacuation.

It will need to be confirmed by LanzaTech if the activation of a manual call point or detector initiates an interface to shut down any processes/equipment on site within the fire alarm zone where the manual call point or detector has been activated. In addition, it will need to be confirmed if adjacent fire alarm zones will also be notified. This information will be required for the RIBA Stage 4 Fire Strategy.

Figure 8 below documents the proposed locations of the fire alarm zones based on the Technip engineering layout. There are minor elements of the layout which differ against the latest site wide plan for planning i.e. Proposed PDZ Layout and Equipment List Revision P17. PartB have reviewed Figure 8 against the latest drawing revision for planning and consider that Figure 8 is acceptable as a drawing indicating the principles of the proposed locations of the fire alarm zones. Once updated engineering plans are received, PartB will ensure the same principles have been carried over.

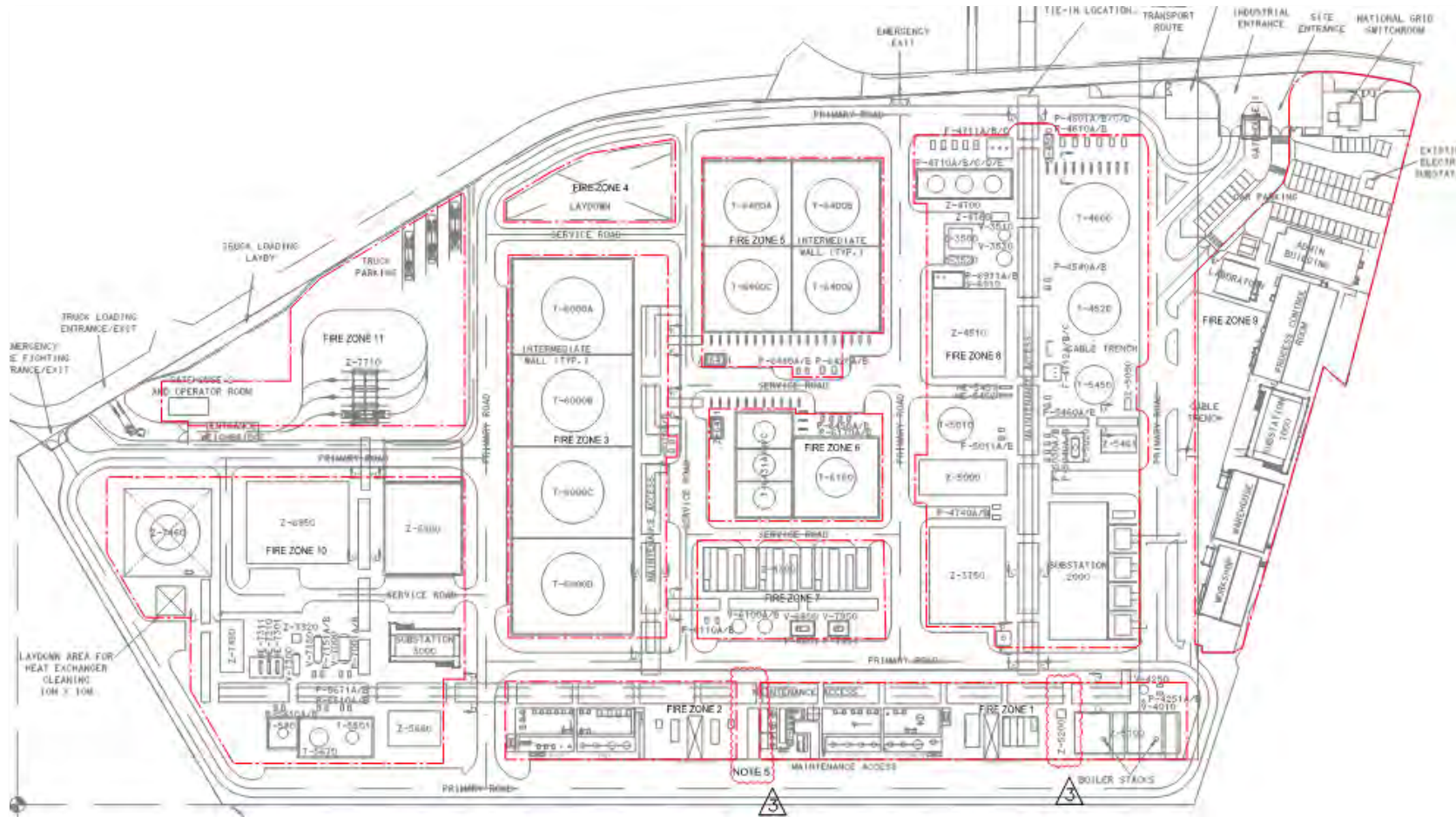


Figure 8: Project Dragon Fire Zones (Source: LanzaTech Drawing)

4.3 Horizontal Means of Escape

4.3.1 Evacuation Strategy

The evacuation strategy for the site will be based on a single-staged 'simultaneous' evacuation strategy per fire alarm zone, whereby the activation of a manual call point within a fire alarm zone will alert all occupants within the zone to evacuate.

4.3.2 Travel Distances

Travel distance is the actual distance a person needs to travel from any point within a building to the nearest storey/final exit.

Travel distance limits have been based on guidance within BS 9999:2017 Annex F. The maximum travel distances are given in Table 7 below:

Table 2: Maximum Permitted Travel Distances (Source: BS 9999:2017 Table F.1)

Situation	Details/Risk Profile	Maximum Permitted Travel Distance (metres)	
		One direction (metres)	More than one direction (metres)
Weather Housed Plant	Risk Profile A1	20 ¹	100
	Risk Profile A2	18 ¹	100
	Risk Profile A3	13 ¹	60
	Risk Profile A4	N/A	N/A
External Plant/Weather Protected Plant	Normal Fire Hazard Outdoor Zone	60 ²	200 ³
	Higher Hazard Outdoor Zone (frequently visited)	13	100 ³
	Higher Hazard Outdoor Zone (not frequently visited)	25	200 ³

Notes:

1. Maximum when minimal fire protection measures are provided
2. Plus additional 50 metres at ground level where direction of travel is unrestricted
3. 100 metres from top of a storage tank or silo, provided the person is not required to cross the top of more than one other tank to reach a route leading to ground level

Equipment considered to be higher hazard areas include storage/processing spaces for fuel or other flammable liquids.

LanzaTech will need to confirm which of the equipment on site will be considered frequently visited, and the heights/escape routes from any indoor modules or storage/processing tanks. This information will be required for the RIBA Stage 4 Fire Strategy.

Once occupants have reached ground level, there are multiple directions of escape and all travel distances to move away from a module/piece of equipment to reach another zone and/or an area considered a safe distance away are considered acceptable. Figure 9 below documents the main routes of escape within the site and the location of the two proposed muster points.

Figure 9 below documents the proposed locations of the primary escape routes and muster points based on the Technip engineering layout. There are minor elements of the layout which differ against the latest site wide plan for planning i.e. Proposed PDZ Layout and Equipment List Revision P17. PartB have reviewed Figure 9 against the latest drawing revision for planning and consider that Figure 9 is acceptable as a drawing indicating the principles of the proposed locations of the primary escape routes and muster points. Once updated engineering plans are received, PartB will ensure the same principles have been carried over.

PartB will review means of escape from each storage unit, escape from gantries etc. once the detailed information has been provided within RIBA Stage 4.

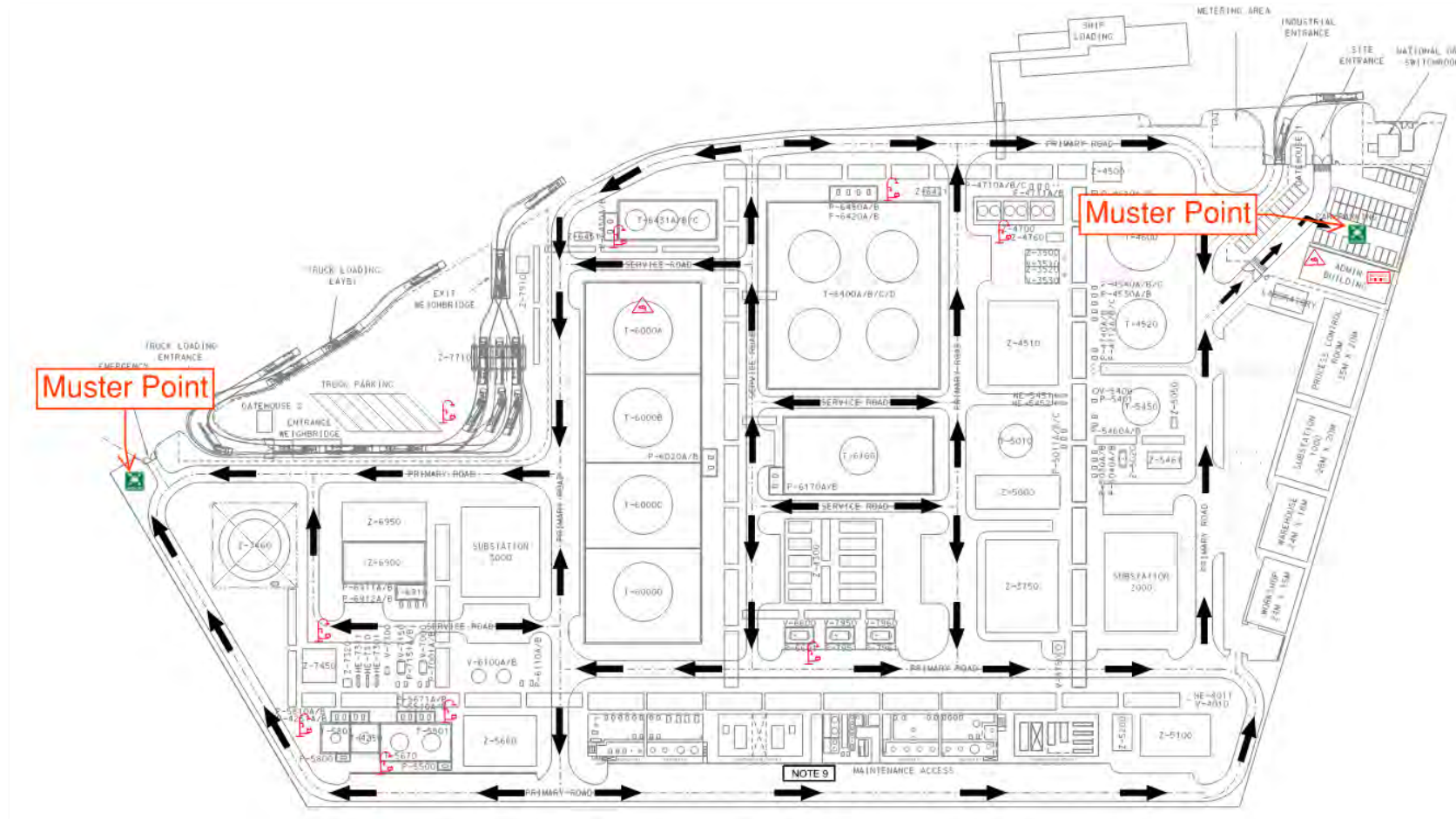


Figure 9: Project Dragon Primary Escape Routes (Source: LanzaTech Drawing)

4.3.3 Number of Occupants

The number of occupants located around the outdoor equipment at the Project Dragon site or in a fire zone at any time is considered to be minimal. Exact numbers should be confirmed with LanzaTech as part of the detailed design at RIBA Stage 4.

4.3.4 Number of Escape Routes

Once occupants have reached ground level, there are generally multiple directions of escape, either into an adjacent fire zone (see Figure 9) or away from the location of a fire. There are locations on site with a single direction of escape (see the dead-end roads in Figure 11). However, the travel distances are such that a secondary means of escape is not required in these areas.

The Project Dragon site therefore has a suitable number of exits and escape routes available once the ground floor has been reached.

4.4 Disabled Access

The Equality Act became law in October 2010. It replaced previous legislation (Disability Discrimination Act 1995) and provides employers and employees information on what they need.

Fire safety procedures will, where appropriate, make provision for occupants who might need assistance to make their way to a place of ultimate safety in a fire. If there is a need to make specific arrangements, then it is assumed that consultation with the individual(s) or representative organisations should take place at the earliest opportunity.

Occupants with visual, hearing or learning difficulties will be expected to use the route of escape through which they entered the building. It is the responsibility of the building management team to ensure resource is available to accommodate individual disabilities where appropriate, for example personal vibration devices.

It is assumed the occupants working with/on the outdoor equipment on the Project Dragon site are capable of using the required escape routes without assistance, e.g. using escape ladders to evacuate the roof of a storage tank.

The fire strategy report for each building located on site will consider disabled egress independently.

5 B3 - Internal Fire Spread (Structure)

This section deals with the following requirement from Part B3 of Schedule 1 of the Building Regulations 2010.

Functional Requirement

Internal fire spread (Structure)

- 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.
For the purposes of this sub-paragraph a house in a terrace and a semi-detached house are each to be treated as a separate building.
- (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.

5.1 General

It is paramount the load-bearing elements of structure and important construction elements of the building/equipment remain for defined periods during a fire event. This means they must withstand the effects of fire without loss of stability.

For Project Dragon, the majority of the equipment on site will have specialist requirements for structural fire resistance periods depending on their size and use. Protection to the water supplies will be required to provide

LanzaTech will need to confirm any specialised requirements for the structural fire resistance of all equipment for the RIBA Stage 4 Fire Strategy.

5.1.1 Blast Assessment

On completion of the blast assessment, the fire resistance periods of the walls documented from the output results will dictate the level of protection. Structural protection may be require an uplift to individual buildings located near a blast zone for protection against secondary fire situations.

5.1.2 Water Storage Tanks

In accordance with *Fire Protection Philosophy*, the storage tanks for firewater will guarantee 4 hours' continuous operation. Therefore, the water storage tanks, and associated structures/equipment, should have 240 minutes' fire resistance integrity and insulation to ensure the storage tank is available throughout the required duration.

5.1.3 Flammable and Combustible Liquids

In accordance with NFPA 30 *Flammable and Combustible Liquids*, the storage requirements of liquids of Class II or higher (i.e. having a closed-cup flashpoint of more than 37.8°C) should follow the requirements of a Class I liquid where they are being heated at or above their flashpoint. The following flammable liquids on site are classified as being Class II:

- Diesel (flashpoint between 52°C and 93°C)
- Jet product (flashpoint of approximately 38°C)

The above will need to meet the storage requirements of a Class I liquid should they be heated beyond their respective flashpoint temperatures.

The flashpoint of the conductivity improver should be confirmed to determine if it will be heated above its flashpoint.

6 B4 & Regulation 7 - External Fire Spread

This section deals with the following requirement from Part B4 of Schedule 1 of the Building Regulations 2010.

Functional Requirement

External fire spread

- B4. (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

6.1 Fire Alarm Zones

Project Dragon has been split into 12 different fire zones, as shown in Figure 8 in Fire Alarm Zones. The aim of the zoning is to reduce the spread of fire and facilitate the fire detection and alarm system and emergency shutdown systems.

Providing there is sufficient separation between the fire zones (see Section 6.3 below), it can be assumed that a fire will not spread between the zones, and the calculations for minimum water supply will be taken as the maximum demand for a single zone (rather than the demand for multiple zones simultaneously).

6.2 Blast Analysis

Due to the combustible nature of some of the chemicals used on site, there are possibilities for explosions to occur on site following an incident of fire. The blast analysis will determine if areas of the equipment/ancillary buildings will require additional protective measures and will be undertaken by a specialist consultancy. PartB are currently awaiting the outcome of the blast analysis and will update the fire strategy once the information has been received.

6.3 Separation Distances

6.3.1 Between Fire Alarm Zones

In accordance with AIChE '*Fire Protection in Chemical, Petrochemical, and Hydrocarbon Processing Facilities*', the distance between fire zones should be a minimum of 15 metres. Figure 10 below documents the distances between the fire zones, the majority of which do not meet the standard 15-metre requirement. However, most of the equipment is not located on the edge of the zone, so the actual distances between equipment are larger than what is shown in Figure 10. LanzaTech and PartB will undertake an in-depth analysis of the separation distances for the RIBA Stage 4 Fire Strategy.

Figure 10 below documents the proposed locations of the fire alarm zones based on the Technip engineering layout. There are minor elements of the layout which differ against the latest site wide plan for planning i.e. Proposed PDZ Layout and Equipment List Revision P17. PartB have reviewed Figure 10 against the latest drawing revision for planning and consider that Figure 10 is acceptable as a drawing indicating the principles of the proposed locations of the fire alarm zones. Once updated engineering plans are received, PartB will ensure the same principles have been carried over.

6.3.2 Between Flammable Storage Areas

The storage of flammable and combustible liquids at Project Dragon will follow the requirements of NFPA 30 '*Flammable and Combustible Liquids Code*'. Table 3 below summarises the restrictions on outdoor storage given in NFPA 30.

Table 3: Storage Limitations for Outdoor Storage (Source: NFPA 30 Table 15.3)

Liquid Class	Containers		Minimum Separation Distance (metres)		
	Max quantity per pile (litres)	Max storage height (metres)	To buildings	To property line	Between tanks
IA	4,163	3	1.5	15.3	3
IB	8,327	3.6	1.5	15.3	3
IC	16,655	3.6	1.5	15.3	3
II	33,311	3.6	1.5	7.7	1.5
III	83,279	5.4	1.5	3	1.5

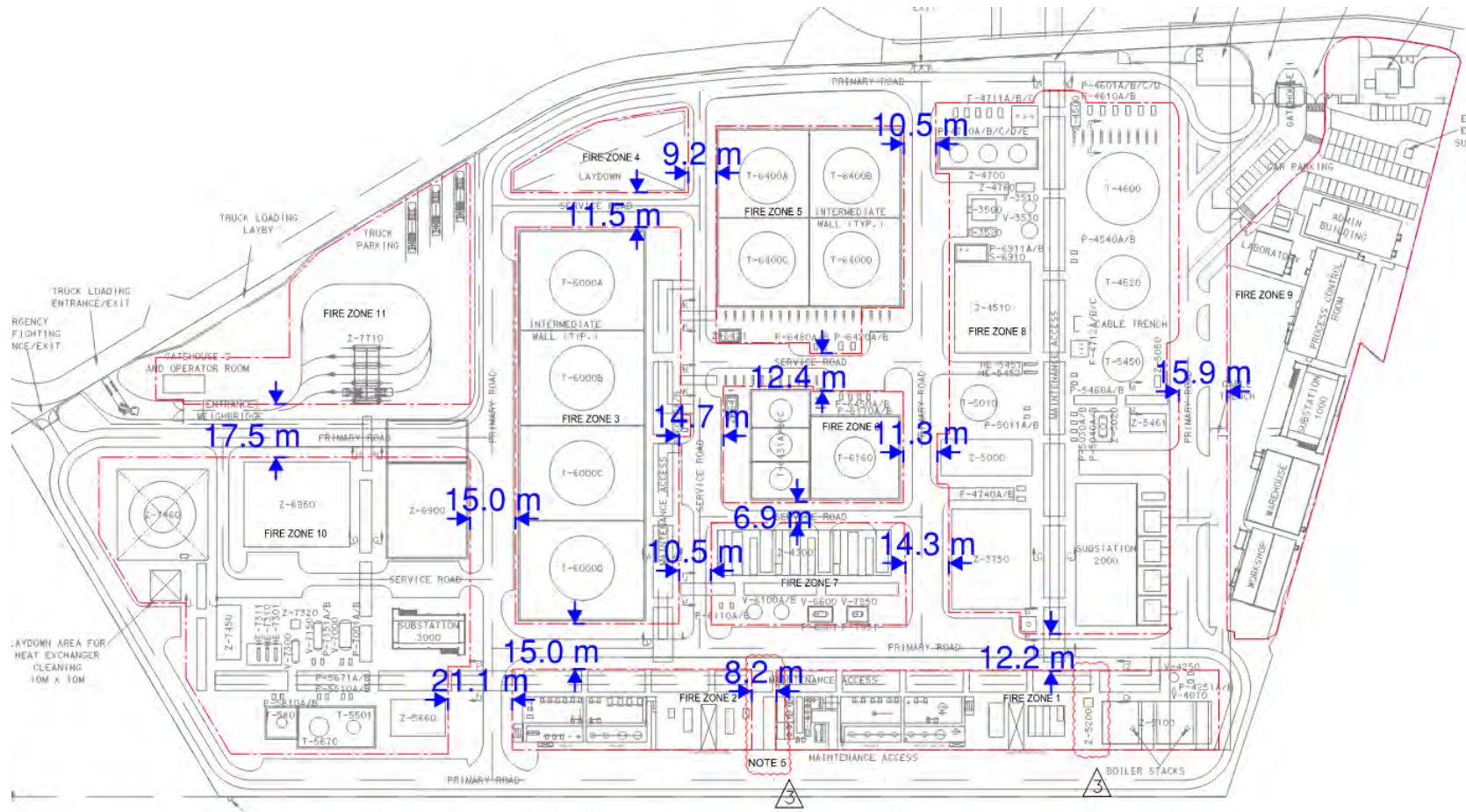


Figure 10: Separation Distances between Fire Alarm Zones (Source: LanzaTech Drawing)

7 B5 - Access & Facilities for the Fire Service

This section deals with the following requirement from Part B5 of Schedule 1 of the Building Regulations 2010.

Functional Requirement

Access and Facilities for the Fire Service

B5. (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.

7.1 Firefighting Access

The vehicle access roadways for the site should achieve the following in accordance with Table 20 in BS 9999:2017.

Table 4: Vehicle Access Requirements (Source: Table 20, BS 9999:2017)

Appliance Type	Width of road between kerbs (metres)	Width of gateways (metres)	Turning circle between kerbs (metres)	Turning circle between walls (metres)	Clearance height (metres)	Carry capacity (tonnes)
Pump	3.7	3.1	16.8	19.2	3.7	12.5
High Reach	3.7	3.1	26	29	4	17

Figure 11 below documents the roads located through the site. All roads meet the requirements in Table 18 for width between curbs for both Pump and High Reach, i.e. 3.7 metres wide. There are six locations where there is a dead-end road, as shown in Figure 11. Fire appliances are permitted to reverse up to 20 metres as a maximum, therefore the appliance is permitted to travel up to 20 metres down these roads (i.e. not the full distance where the dead-end is more than 20 metres). There is no requirement for turning circles within the site.

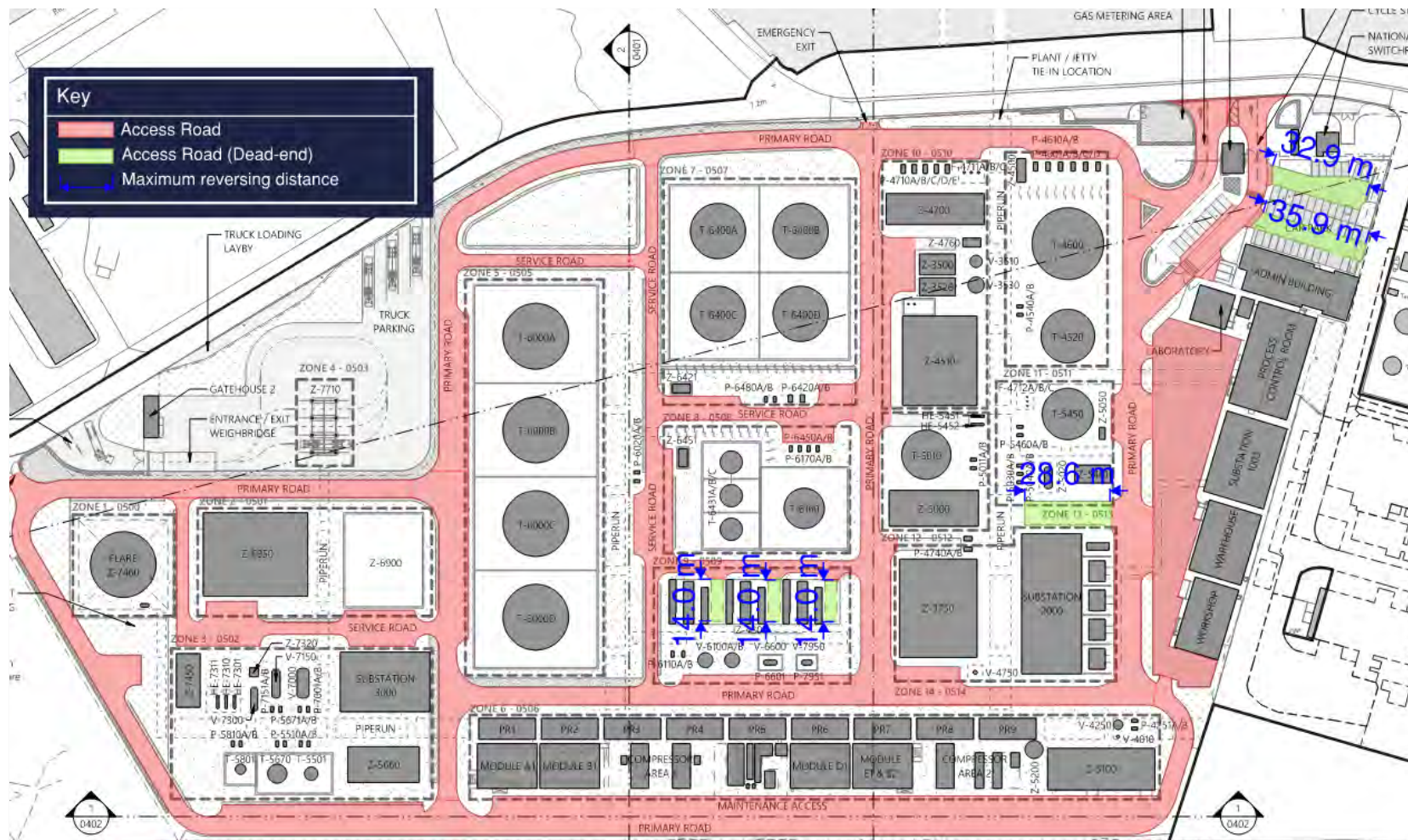


Figure 11: Project Dragon Fire Service Access (Source: LanzaTech Drawing)

7.2 Water Supplies

Project Dragon contains a variety of fire and explosion hazards which require a variety of firewater systems to reduce fire growth and spread in the event of a fire.

In accordance with *Fire Protection Philosophy*, the system of firewater will provide adequate water supply for firefighting, vessel and structural cooling in the event of a fire.

Figure 12 below documents the fire water protection layout for Project Dragon, including details on the following:

- Hydrants
- Underground Firewater Line
- Above Ground Firewater Line
- Foam Connections

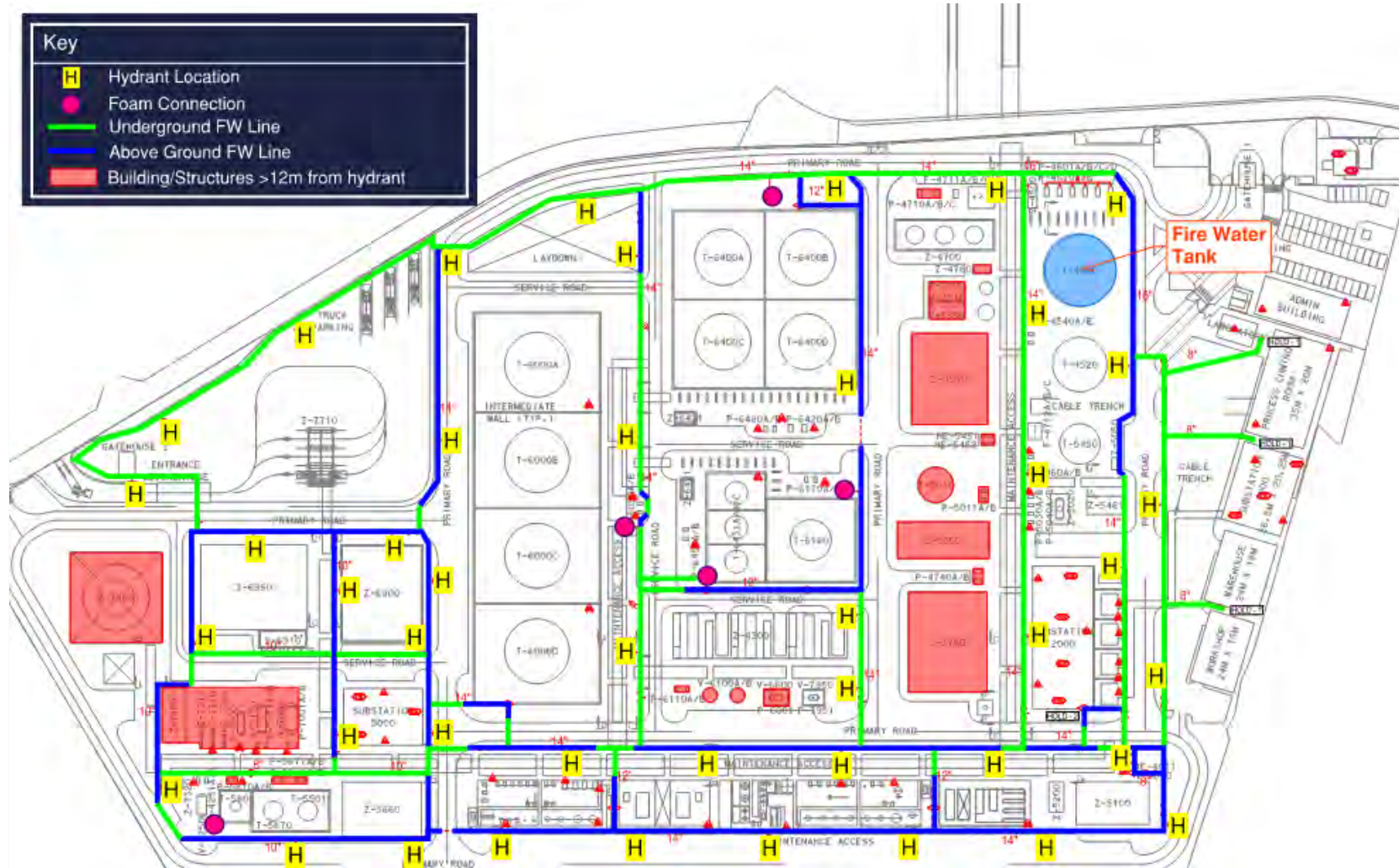


Figure 12: Project Dragon Fire Protection Layout (Source: LanzaTech Drawing)

Figure 12 above documents the fire protection layout based on the Technip engineering layout. There are minor elements of the layout which differ against the latest site wide plan for planning i.e. Proposed PDZ Layout and Equipment List Revision P17. PartB have reviewed Figure 12 against the latest drawing revision for planning and consider that Figure 12 is acceptable as a drawing indicating the principles of the fire protection layout. Once updated engineering plans are received, PartB will ensure the same principles have been carried over.

7.2.1 Fire Water Storage

The water tank for use of the fire service can be seen in Figure 12 above. The water tank should meet the requirements set out in NFPA 22 '*Standard for Water Tanks for Private Fire Protection*'.

In accordance with *Fire Protection Philosophy*, the storage tanks for firewater will guarantee 4 hours' continuous operation at the maximum firewater demand for maximum single incident expected on the site. This has been calculated by LanzaTech as being 7,000m³.

The tank will feed the pump station, which comprises of a main fire water jockey pump (electrically powered) and a spare fire water jockey pump (diesel powered).

7.2.2 Hydrants

Hydrants should meet the requirements set out in NFPA 24 '*Standard for the Installation of Private Fire Service Mains and Their Appurtenances*'.

In accordance with NFPA 24, Hydrants should be located within 12 metres of the building or structures to be protected. Hydrants should be positioned immediately adjacent to roadways of hard-standing facilities for ease of use for the fire service. The installation of the hydrant system should be in line with NFPA 24. There are a total of 44 proposed hydrant locations, which can be seen in Figure 12 above.

Figure 12 documents the structures/buildings not within 12 metres of a hydrant. In accordance with Annex A B5 - Access & Facilities for the Fire Service, there is no requirement for the ancillary buildings to be within 12 metres of a hydrant. The other buildings/structures further than 12 metres from a hydrant are given in Table 5 below. These should either be within 12 metres of a hydrant or LanzaTech should confirm no hydrant protection is required for these areas. This information is required for the RIBA Stage 4 Fire Strategy.

Table 5: Buildings/Structures Further than 12 Metres from a Hydrant (Source: LanzaTech Drawing)

Equipment No.	Description	Equipment No.	Description
HE-5451	SUSPECT CONDENSATE COOLER 1	V-3510	PLANT AIR RECEIVER
HE-5452	SUSPECT CONDENSATE COOLER 2	V-3530	IA RECEIVER
HE-7301	COLD FLARE VAPORISER	V-6100	OLEFINS REPROCESSING VESSEL
HE-7310	COLD FLARE CUPERHEATER	V-6600	ORAGNIC (ETHANOL RICH) DRAIN DRUM
HE-7311	PROPANOL VAPORISER	V-7000	HP FLARE KO DRUM
P-4710	COOLING WATER PUMPS	V-7150	LP FLARE KO DRUM
P-4740	COOLING WATER BOOSTER PUMPS	V-7300	COLD FLARE KO DRUM
P-5011	DENIM WATER PUMPS	V-7950	LIQUID HYDROCARBON RECOVERY DRUM
P-5510	FREAH CAUSTIC DISTRIBUTION PUMP	Z-3500	AIR COMPRESSOR PACKAGE
P-5671	NEUTRALISED CAUSTIC TRANSFER PUMP	Z-3520	IA DRYER PACKAGE
P-5810	SULPURIC ACID DSITRIBUTION PUMP	Z-3750	LIQUID NITROGREN SOTRAGE AND VAPROISERS PACKAGE
P-6110	REPROCESSED OLEFINS PUMP	Z-4510	RAW WATER TREATMENT PACKAGE
P-6601	ORGANIC DRAIN LIFTING PUMP	Z-4760	CW DOSING PACKAGE
P-7001	HP FLARE KO DRUM PUMP	Z-5000	DEMINERALISATION WATER PACKAGE
P-7151	LP FLARE KO DRUM PUMP	Z-7450	FLARE GAS RECOVERY PACKAGE
P-7951	LIQUID HYDROCARBON RECOVERY PUMP	Z-7460	GROUND FLARE PACKAGE
T-5010	DENIM WATER STORAGE TANK		

7.2.3 Dry Risers

In accordance with *Fire Protection Philosophy*, any structure with three or more working levels will be provided with a dry riser. LanzaTech will need to confirm if any of the structures on site are three of more levels high. This information is required for the RIBA Stage 4 Fire Strategy.

All dry risers will need to meet the requirements of BS 9990:2015.

7.3 Fire Protection Systems

7.3.1 Exposure Protection Systems

An exposure protection system is used to absorb heat through use of foam or water directly onto structures to reduce the surface temperature. In accordance with *Fire Protection Philosophy*, an automatic deluge system will be installed to provide protection via water spray. The deluge system should be designed, installed and maintained in accordance with NFPA 15 '*Standard for Water Spray Fixed Systems for Fire Protection*'.

A firefighting foam network shall also be installed in areas where spillages of flammable liquids can occur. The foam network should be designed, installed and maintained in accordance with NFPA 11 '*Standard for Low-, Medium- and High-Expansion Foam*'.

7.3.2 Foam Systems

In accordance with *Fire Protection Philosophy*, a low expansion foam system will be provided for firefighting tank fires and in areas where spillages of flammable liquids can occur. The foam concentrate will be an alcohol resistant non-fluorinated foam. The foam storage should be designed, installed and maintained in accordance with NFPA 11 '*Standard for Low-, Medium- and High-Expansion Foam*'.

In accordance with 1.1, the following flammable liquids are located on site:

- Ethanol
- Propane
- Propanol
- Jet fuel
- Diesel

PartB would suggest that any areas on site where these liquids are located should be protected via the foam system. There are five locations of foam connectors as shown in Figure 12. They are located in the following areas:

- Adjacent to the ethanol storage tanks (T-6000 A/B/C/D)
- Adjacent to the sulphuric acid storage tank, spent caustic storage, fresh caustic storage and associated equipment (T-5801, T-5670, T-5501)
- Adjacent to the diesel storage tanks (T6431 A/B/C)
- Adjacent to the paraffins reprocessing tank (T-6160)
- Adjacent to the jet product storage tanks (T-6400 A/B/C/D)

LanzaTech should confirm all areas with flammable liquids are protected via the foam system. This information is required for the RIBA Stage 4 Fire Strategy.

7.3.3 Design Densities

Design densities for water applications will follow the requirements given in NFPA 15 '*Standard for Water Spray Fixed Systems for Fire Protection*', and NFPA 11 '*Standard for Low-, Medium- and High-Expansion Foam*' for foam applications.

7.4 Portable & Mobile Fire Extinguishers

The provision of portable and mobile fire extinguishers will be in accordance with either NFPA 10 'Standard for Portable Fire Extinguishers' or BS 5306-8:2012.

Table 6 below documents the type of fire with the corresponding suitable fire extinguishers, and the maximum travel distance for an extinguisher to be away from a risk area.

Table 6: Fire Extinguishers (Source: BS 5306-8:2012)

Fire Classification	Fire Description	Applicable Extinguishing Agent Type	Maximum distance to fire extinguisher (metres)
Class A	Fires involving solid materials of organic nature	Water, Foam, Dry Chemical Powder (ABC), wet chemical	30
Class B	Fire involving flammable and combustible liquids	ABC	10
Class C	Fire involving flammable gases	ABC	30
Class D	Fire involving burning metals	Specialist Powder	Case by case basis, advised by competent person
Class F	Fire involving cooking media	Wet chemical	10

Note: There is no recognised classification for electrical fires, as electricity does not burn, but can cause fires in Class A, B, C, D and F materials

In accordance with *Fire Protection Philosophy*, mobile or wheeled extinguishers will be located where the capacity of portable extinguishers is insufficient to combat a fire. Any mobile or wheeled extinguishers will be in accordance with either NFPA 10 'Standard for Portable Fire Extinguishers' or BS 5306-8:2012.

Any fire blankets to be located on site will meet the requirements in BS EN 1869:2019.

7.4.1 Proposed Extinguishers on Site

Figure 13 below documents the locations of fire extinguishers proposed on the Project Dragon site. The following types of extinguishers have been specified:

- 9kg portable CO₂ extinguishers x 12
- 12kg dry chemical powder (DCP) extinguishers x 36
- 50kg DCP extinguishers x 12

The 9kg CO₂ extinguishers have been placed within the four substations on site (three proposed and one existing). They are used for primarily electrical fires (can also be used for Class B fires) and therefore suitable for the substations where electrical fires are a possibility. They are located

in such a way that occupants do not have to travel more than 20 metres within a substation to reach an extinguisher, which PartB deems as acceptable.

The 12kg DCP extinguishers are proposed throughout the site within the following areas:

- Within all substations
- Within the admin building, laboratory and process control ancillary buildings
- Adjacent to sulphuric acid storage tank, spent caustic storage, fresh caustic storage and associated equipment
- Adjacent to the PAU modules
- Adjacent to the condensate storage and associated equipment
- Adjacent to the HP boiler package
- Adjacent to the ethanol and diesel storage tanks
- Adjacent to the jet fuel storage tanks and jet fuel transfer pumps

The 12kg DCP extinguishers can be used for Class B (flammable liquid) and Class C (flammable gas) fires, along with electrical fires. Therefore, they are suitable to be located within the substations and where there are possibilities for a flammable liquid or gas fire, such as the ethanol and diesel storage tanks. They are located in such a way as that occupants do not have to travel more than 20 metres from the above areas to reach an extinguisher, which PartB deems as acceptable.

The 50kg DCP extinguishers are proposed in similar locations to the 12kg extinguishers but primarily around the jet fuel, ethanol and diesel storage tanks, giving a larger amount of extinguishing agent for a potentially larger fire. The 50kg DCP extinguishers have also been located within the two compressor houses on site.

Figure 13 below documents the fire protection layout based on the Technip engineering layout. There are minor elements of the layout which differ against the latest site wide plan for planning i.e. Proposed PDZ Layout and Equipment List Revision P17. PartB have reviewed Figure 13 against the latest drawing revision for planning and consider that Figure 13 is acceptable as a drawing indicating the principles of the fire protection layout. Once updated engineering plans are received, PartB will ensure the same principles have been carried over.



Figure 13: Project Dragon Proposed Extinguisher Layout (Source: LanzaTech Drawing)

Annex A – Ancillary Buildings

1 Building / Site Overview

1.1 General

Project Dragon is a proposed SAF production facility located in Port Talbot, Wales. Figure 14 below documents the site plan, highlighting the ancillary accommodation which this fire strategy report covers.

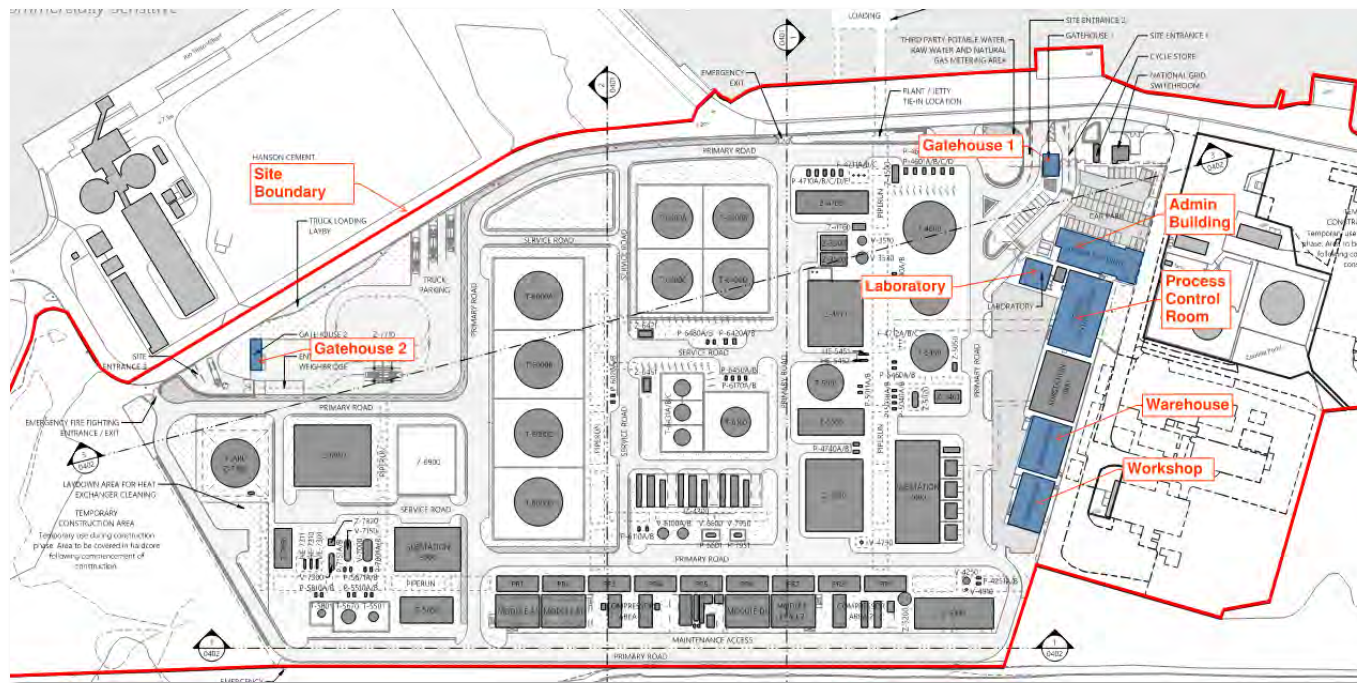


Figure 14: Project Dragon Site Plan with Ancillary Areas (Source: LanzaTech Drawing)

1.2 Internal Layouts

1.2.1 Gatehouse 1

Figure 15 below documents the internal layout of Gatehouse 1. The building contains a desk area for two occupants, a kitchen and a WC. The roof is proposed to be a flat brown roof.

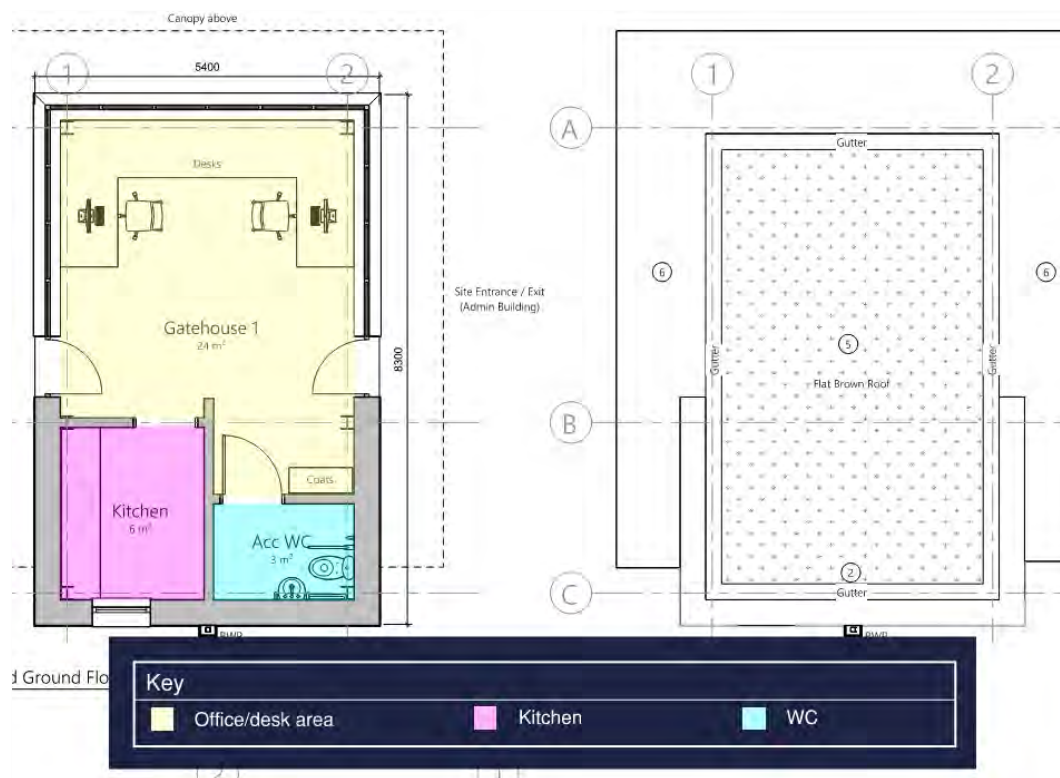


Figure 15: Gatehouse 1 Plan (Source: Inspire Drawing)

1.2.2 Gatehouse 2

Figure 16 below documents the internal layout of Gatehouse 2. The building contains a desk area for one occupant, a kitchen and a WC. The roof is a flat, single-ply roof.

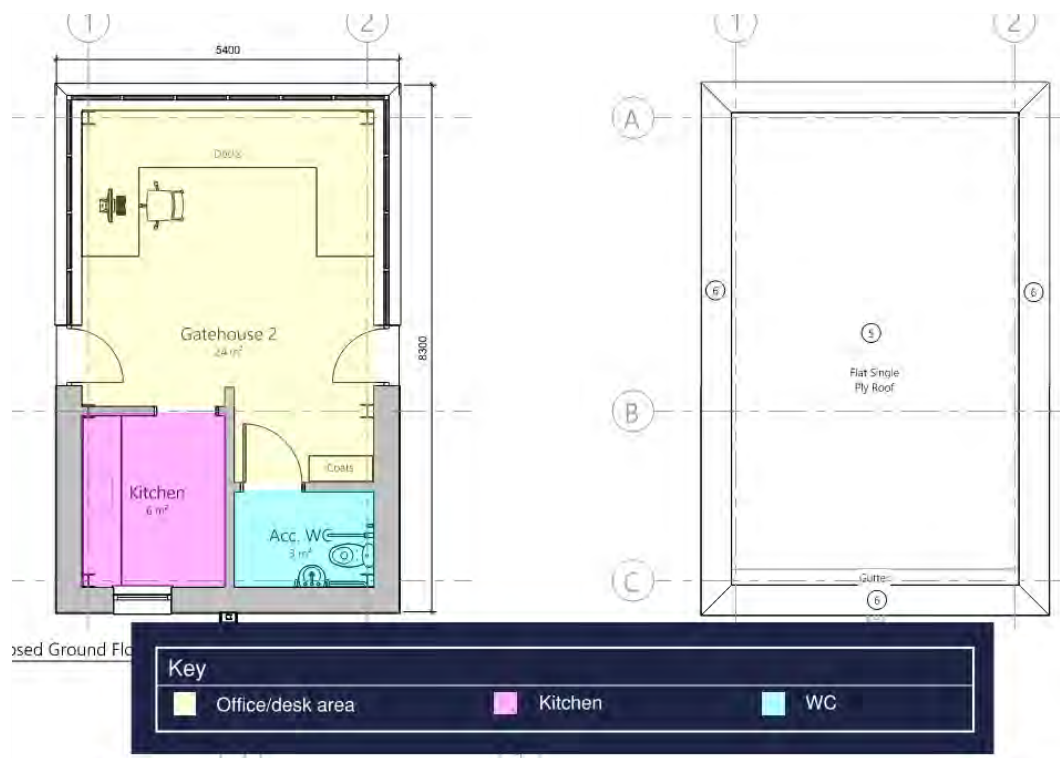


Figure 16: Gatehouse 2 Plan (Source: Inspire Drawing)

1.2.3 Administration Building

Figure 17 below documents the internal layout of the administration building. The building contains a staff office area, a meeting room and board room, a kitchen and plant space. The roof is proposed to be a flat brown roof with photovoltaic (PV) panels.



Figure 17: Administration Plan (Source: Inspire Drawing)

1.2.4 Process Control Room - Ground Floor

Figure 18 below documents the internal layout of the process control room ground floor. The building contains a staff kitchen and seating area, offices, first aid room, permit room and changing rooms, along with specific rooms for process control: telecom room, control room, instrument room, UPS room and battery room.



Figure 18: Process Control Room - Ground Floor (Source: Inspire Drawing)

1.2.5 Process Control Room - Roof

Figure 19 below documents the roof layout of the process control room. The roof is pitched with no access.

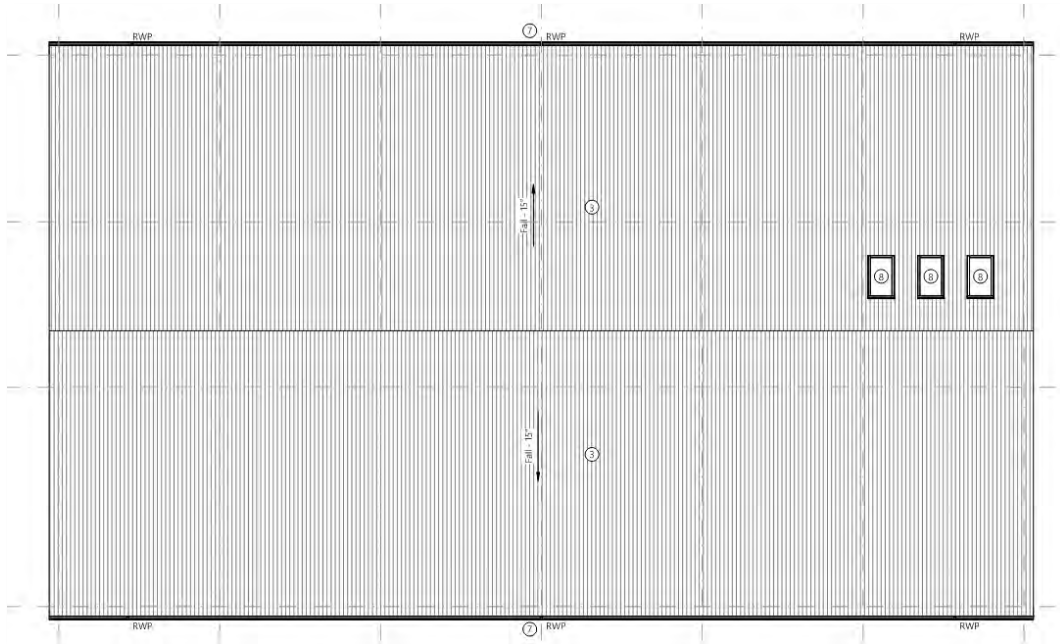


Figure 19: Process Control Room - Roof (Source: Inspire Drawing)

1.2.6 Warehouse - Ground Floor

Figure 20 below documents the internal layout of the warehouse store building. The building contains a single room of storage with indicative locations of racking.

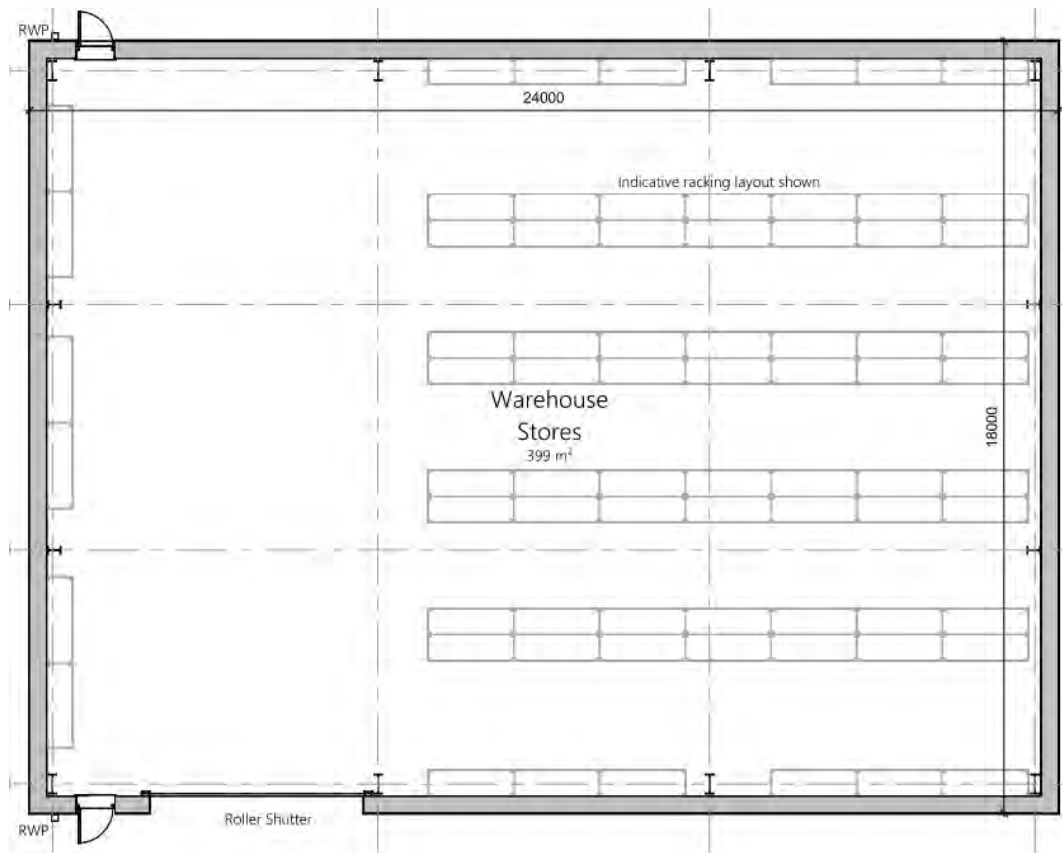


Figure 20: Warehouse Plan - Ground Floor (Source: Inspire Drawing)

1.2.7 Warehouse - Roof

Figure 21 below documents the roof layout of the warehouse. The roof is pitched with no access.

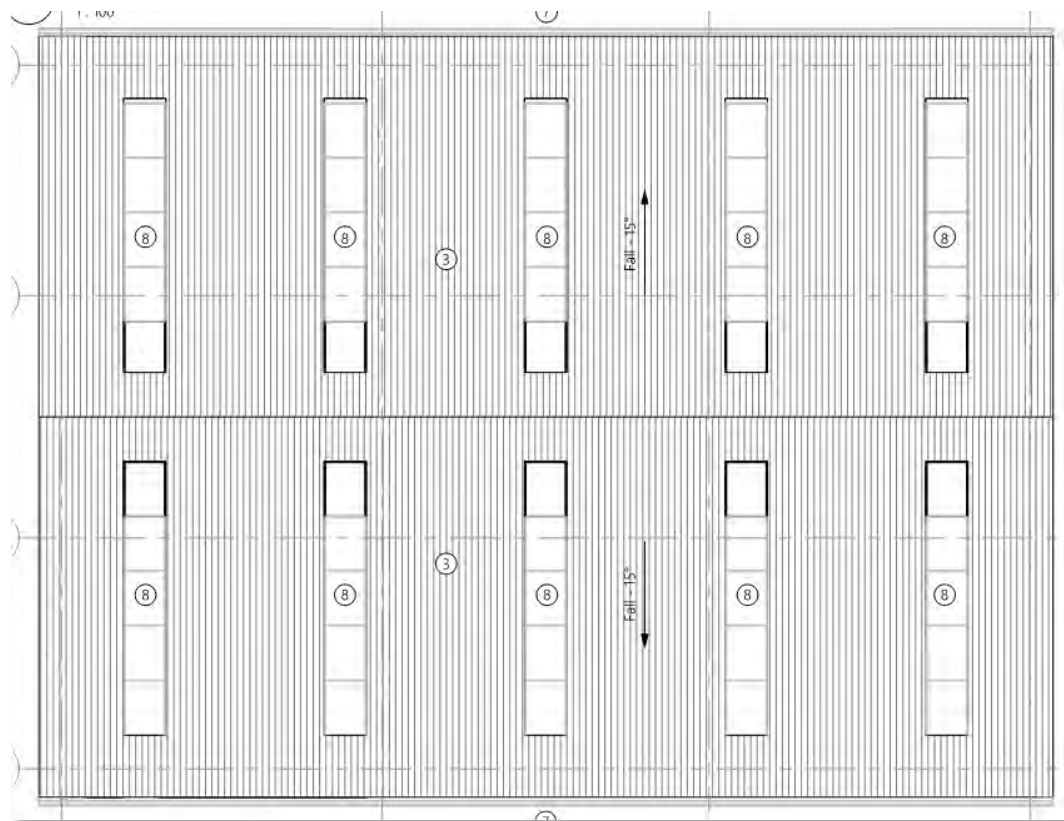


Figure 21: Warehouse - Roof (Source: Inspire Drawing)

1.2.8 Workshop

Figure 22 below documents the internal layout of the workshop. The building contains a main workshop room accessing a lobby, which contains a kitchenette, a WC and a shower. The proposed roof is pitched with no access.



Figure 22: Workshop Building (Source: Inspire Drawing)

1.2.9 Laboratory

Figure 23 below documents the internal layout of the laboratory. The building contains a main testing area, with open-plan workstation, WC and storage. The roof is pitched with no access.

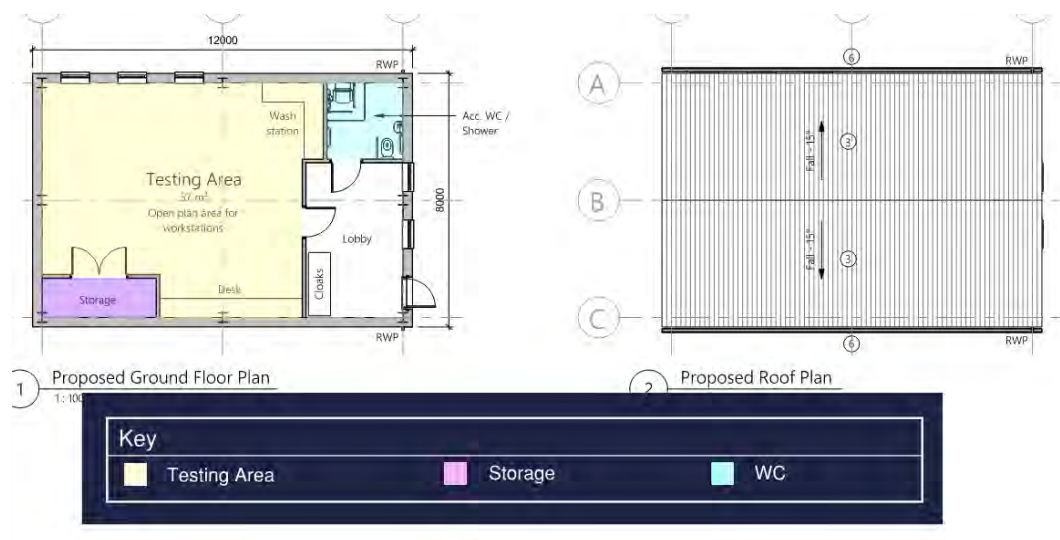


Figure 23: Laboratory - Roof (Source: Inspire Drawing)

1.3 Building Heights

All of the buildings are a single storey and therefore considered to have a maximum height of 0 metres.

1.4 Design Approach - ADB 2020

The development will generally be assessed against guidance in accordance with ADB 2020. Where there are deviations from ADB 2020, they will require agreement with the Approving Authorities and Local Fire Service.

1.5 Fire Strategy Plans

PartB has annotated floor plans provided by Inspire to reflect the following elements of the fire strategy for ease of reference:

- Travel distances
- Compartment lines
- Fire resistance requirements
- Fire door locations and grades

The fire strategy plans are located in Appendix A - Fire Strategy Drawings.

1.6 Purpose Group

ADB 2020 uses purpose groups to describe the use of a building. Table D1 in ADB 2020 gives information on the use of a building and the associated purpose group. Project Dragon is considered as a whole site to be Purpose Group 6 – Industrial. Different areas within the same site can have different purpose groups. The following other purpose groups are considered for areas of Project Dragon:

- Purpose Group 3 – Office
- Purpose Group 7 – Storage and other non-residential

2 Summary of Fire Safety Systems

The primary fire safety systems to be provided within the building are summarised below.

2.1 Fire Detection & Alarm System(s)

PartB recommends a minimum Category L2 fire detection and alarm system is installed throughout the building in addition to a Category M system. For an L2 system, detectors should be installed in the following areas:

- All rooms which open into an escape route
- Any specified areas of high fire hazard level and/or high fire risk

The L2 system should be designed and installed in accordance with BS 5839-1:2017¹.

2.2 Smoke Ventilation System(s)

There is no requirement for smoke ventilation within the buildings on site covered in this fire strategy report.

2.3 Firefighting Lift(s)

There is no requirement for a firefighting shaft or lift within the buildings on site covered in this fire strategy report.

2.4 Dry Fire Main(s)

Fire mains are not required for the ancillary buildings.

2.5 Emergency Lighting & Escape Route Signage

Lighting on escape routes and exit signage shall be provided throughout the building to the extent nominated under BS 5266-1:2016² and BS 5499-4:2013³.

2.6 Secondary Power Supplies

Secondary power supplies are required for life safety equipment within the buildings on site covered in this fire strategy report.

¹ British Standards BS 5839-1:2017 Fire Detection and fire alarm systems for buildings Part 1: Code of practice for design, installation, commissioning and maintenance of systems in non-domestic premises.

² British Standards BS 5266-1:2016 Emergency lighting Part 1: Code of practice for the emergency lighting of premises

³ British Standards BS 5499-4:2013 Safety Signs Part 4: Code of practice for escape route signing

3 B1 - Means of Warning & Escape

This section deals with the following requirement from Part B1 of Schedule 1 of the Building Regulations 2010.

Functional Requirement

Means Of Warning and Escape

- B1. 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

Fire detection and alarm systems are designed to alert occupants at an early stage of a fire, thus giving them the ability to evacuate the building in relatively safe conditions, prior to escape routes becoming untenable due to the products of a fire (smoke, heat, flames, toxic gases, etc.)

3.1 Means of Warning

In accordance with ADB 2020, the minimum fire detection and alarm system to be provided within the building is Category M (manual only) in accordance with BS 5839-1:2017. PartB recommends a minimum Category L2 fire detection and alarm system is installed throughout the building in addition to a Category M system. For an L2 system, detectors should be installed in the following areas:

- All rooms which open into an escape route
- Any specified areas of high fire hazard level and/or high fire risk

The L2 system should be designed and installed in accordance with BS 5839-1:2017.

Manual call points should comply with BS 5839-2:1983⁴ or Type A of BS EN 54-11:2001⁵ and should be designed and installed to BS5839-1:2017. Manual call points should be located such that the travel distance from any point in the building to a manual call point is no more than 45 metres.

3.1.1 Roof

The proposed roof layouts for the building covered within the fire strategy do not have any access for maintenance, therefore no fire detection and alarm system is required on the roofs.

⁴ British Standards BS 5839-2:1986 Fire Detection and Alarm systems in Buildings Part 2: Specifications for manual call points

⁵ British Standards BS EN 54-11:2001 Fire detection and fire alarm systems - Part 11: Manual call points

3.1.2 Fire Alarm System Interfaces

An automatic fire alarm system will have interfaces and links as necessary to operate equipment/devices throughout the building. For more information see BS 5839-1:2017:

- Electromagnetic hold-open devices on fire doors – released to closed position
- Security systems on exit doors – released as required
- Gas supply valves (plant areas) – isolate
- Smoke ventilation systems – relevant system activates depending on location of detection
- Heating, ventilation and air conditioning systems – shut down to restrict spread of smoke and hot gases.

3.2 Horizontal Means of Escape

3.2.1 Evacuation Strategy

The evacuation strategy for the building will be based on a single-staged 'simultaneous' evacuation strategy in accordance with ADB 2020.

3.2.2 Travel Distances

Travel distance is the actual distance a person needs to travel from any point within a building to the nearest storey/final exit.

Travel distance limits have been based on guidance within ADB 2020. The maximum travel distances are given in Table 7 below:

Table 7: Maximum Permitted Travel Distances (Source: Table 2 ADB 2020)

Purpose Group	Use of premises/part of premises	Maximum Permitted Travel Distance (metres)	
		One direction (metres)	More than one direction (metres)
3	Office - Gatehouse 1 and 2, Admin Building	18	45
6	Normal Hazard Industrial - Process Control Room	25	45
7	Storage and other - Warehouse, Workshop, Laboratory	25	45
2 - 7	Plant (within room)	9	13
2 - 7	Place of special Fire Hazard	9	18

Travel distances for all locations have been noted on the fire strategy drawings in Appendix A. All travel distances are acceptable and within the limits given in Table 7 above.

3.2.3 Number of Occupants

The number of occupants within the building will have a direct effect on the number of escape routes required and the width of the escape routes.

The number of occupants within the building can be determined via three different methods:

- Seating layout capacity
- The use of floor space factors
- Conformation from the client

Gatehouse 1 and 2, the administration building, and parts of the process control room have seating layouts provided, so the number of occupants will be assumed based on the number of seats. Table 8 below documents the floor space factors which will be used for all other buildings on site.

Table 8: Floor Space Factors (Source: Table C1 ADB 2020)

Area	Occupant capacity (m ² /person)
Storage and Warehousing	30
Laboratory	5
Workshop	10
Office (where no seating plans)/First Aid Room/Permit Room	6
Plant/Equipment rooms	0 - assumed that occupants only enter for maintenance and are not located in these spaces for day-to-day use
Kitchenettes	0 - Assumed occupants of the kitchenettes are taken into account within the other rooms to avoid counting twice

Occupant numbers are given in Table 9 below. These numbers should be confirmed with the client as being accurate, as the occupancy of the building affects the means of escape requirements.

Table 9: Occupant Numbers

Building	Room	Occupancy (max)
Gatehouse 1	Main Room	2
Gatehouse 2	Main Room	2
Administration	Staff Office	16
	Meeting Room	8
	Boardroom	12
	Reception	1
Total		37
Process Control Room	General Office/Meeting Room	8
	Supervisors' Office	41m ² at 6m ² /person = 8
	First Aid Room	27m ² at 6m ² /person = 5
	Permit Room	28m ² at 6m ² /person = 5
	Control Room	3
Total		29
Warehouse	Stores	399m ² at 30 m ² /person = 14
Workshop	Main Room	292m ² at 10m ² /person = 30
Laboratory	Testing Area	57m ² at 5m ² /person = 12

3.2.4 Number of Escape Routes

In the event of a fire within the building, occupants should be provided with a sufficient number of exits to ensure a prompt evacuation of the building prior to escape routes becoming blocked by the effects of fire and smoke. The minimum number of escape routes required from each area is determined based on the maximum expected occupancy of the area, as outlined in Table 10.

Table 10: Number of Exits (Source: Table 3 ADB 2020)

Maximum Expected Occupancy	Minimum Number of Routes / Exits
Up To 60	1
61-600	2
More Than 600	3

Note: The above numbers are considering occupancy numbers only and not where additional exits may be required due to travel distances.

From Table 9 above, no single room or building is expected to have more than 60 occupants at any one time.

3.2.5 Door Opening Directions

In accordance with ADB 2020 Clause 6.14, where an exit serves more than 60 persons for escape it should be arranged to open in the direction of escape.

All doors are permitted to open in either direction as no more than 60 occupants are expected to use an exit at any one time.

3.2.6 Corridors & Escape Routes

The width of a door in a corridor should not be less than either the calculated corridor width minus 150mm, or 1050mm, whichever is greater.

The width of a corridor or escape route should not be less than the calculated width of any door leading onto it, or 100mm, whichever is the greater (increased to 1200mm where it may be used by wheelchair users).

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

The process control room is the only building with a circulation corridor and meets the requirements stated above.

3.2.7 Dead-End Corridors

Where used as part of a means of escape, every dead-end corridor exceeding 2 metres in length should be constructed as a protected corridor. Protected corridors are required to have 30 minutes' fire-resisting construction with FD30S doorsets for any doors that are off the protected corridor.

There are no dead-end corridors within the building on the Project Dragon site.

3.2.8 Minimum Required Clear Exit Widths

The minimum required exit width depends on the number of occupants that will be using that exit. Table 11 below documents the minimum exit width requirements in accordance with ABD 2020.

Table 11: Escape Route Exit Width Requirements (Source: Table 4 ADB 2020)

Maximum Expected Occupancy	Minimum Exit Width (mm) ^[1]
60	750
110	850
220	1050
More than 220	50mm for each additional 10 persons

[1] In order to follow guidance from Approved Document M, the widths in the table may need to be increased to 850mm

3.2.9 Escape Route Widths

The minimum escape widths for rooms depend on the number of occupants and the number of exit routes. As there are no rooms with more than 60 occupants, the minimum exit width should be 750mm, or 850mm for unassisted disabled access.

3.3 Disabled Access

The Equality Act became law in October 2010. It replaced previous legislation (Disability Discrimination Act 1995) and provides employers and employees information on what they need.

Fire safety procedures will, where appropriate, make provision for occupants who might need assistance to make their way to a place of ultimate safety in a fire. If there is a need to make specific arrangements, then it is assumed that consultation with the individual(s) or representative organisations should take place at the earliest opportunity.

Occupants with visual, hearing or learning difficulties will be expected to use the route of escape through which they entered the building. It is the responsibility of the building management team to ensure resource is available to accommodate individual disabilities where appropriate, for example personal vibration devices.

3.3.1 Ground Floor Access

The ground floor should have level thresholds or be supplied with a ramp with a gradient no more than 1/12 in order for mobility-impaired occupants to enter the building

4 B2 - Internal Fire Spread (Linings)

This section deals with the following requirement from Part B2 of Schedule 1 of the Building Regulations 2010.

Functional Requirement

Internal fire spread (linings)

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, either a rate of heat release or a rate of fire growth, which is reasonable in the circumstances.

(2) In this paragraph “internal linings” means the materials or products used in lining any partition, wall, ceiling or other internal structure

4.1 General

In an event of fire, although unlikely to be the first materials to ignite, the wall and ceiling linings can have a significant impact on how fast a fire spreads. Of particular note is the time it takes for the room to become completely involved, the levels of heat, and the volume of smoke and hot gases that are allowed to build-up.

All surface finishes and floor covering materials should resist flame spread over their surfaces and, when ignited, any heat release or propagation of the fire is limited as recommended.

4.2 Material Classification (Wall & Ceilings)

The recommendations in relation to surface spread of flame are shown in Table 12 below. Guidance allows for two options: for the materials to comply either with the National Class or the European Class. Use of one or the other option would be acceptable.

Table 12: Classification of Linings

Location	National Class ^{A)}	European Class ^{B)}
Small rooms of area not more than 30m ²	Class 3	D-s3,d2
Rooms, Other	Class 1	C-s3,d2
Circulation spaces	Class 0	B-s3,d2

Note:

- A) 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.
- B) When a classification includes 's3, d2' this means there is no limit set for smoke production and/or flaming droplets of particles.

5 B3 - Internal Fire Spread (Structure)

This section deals with the following requirement from Part B3 of Schedule 1 of the Building Regulations 2010.

Functional Requirement

Internal fire spread (Structure)

- 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.
For the purposes of this sub-paragraph a house in a terrace and a semi-detached house are each to be treated as a separate building.
- (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—
- c) sub-division of the building with fire-resisting construction;
 - d) 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.

5.1 General

It is paramount the load-bearing elements of structure and important construction elements of the building remain for defined periods during a fire event. This means they must withstand the effects of fire without loss of stability.

Furthermore, fire should be contained by fire-resisting construction elements to prevent the fire spreading to different parts of the building. Unseen spread of fire and smoke within cavities and voids shall be inhibited to reduce the risk of structural failure and spread of fire and smoke, where they present a threat to the safety of people in and around the building.

5.2 Structural Fire Resistance

To comply with Table A2 of ADB 2020, the highest occupied floor level (FFL, 0 metres) is less than 5 metres above ground level for all buildings. Additionally, the structural fire resistance requirements for load-bearing elements are 60 minutes for all buildings.

Structure that supports only a roof does not need any particular fire resistances, except for those structures that also support a fire-resisting wall, rooftop plant or means of escape over a flat roof.

5.3 Compartmentation

5.3.1 Compartmentation Requirements

The fire resistance performance of compartment walls and floors (and/or any additional parts of the building which are required to avoid the spread of fire) should be not less than that stated below when tested in accordance with the relevant part of BS 476: Parts 20 - 24⁶ or classified in accordance with BS EN 13501⁷ Parts 2, 3 or 4.

This applies to:

Table 13: Compartmentation

Type	Load-Bearing Capacity, Integrity, and Insulation (REI)?	Exposed Side
Load-Bearing Walls	Load-Bearing Capacity, Integrity, and Insulation (REI)	Each side separately
Non-Load-Bearing Walls and Partitions	Integrity and Insulation (EI)	Each side separately
Fire Doors	Integrity Only (E)	Each side separately
Fire Doors (Lifts)	Integrity Only (E)	From the landing side only
Compartment Floors	Load-Bearing Capacity, Integrity, and Insulation (REI)	From the underside only

The key elements of compartmentation and the relevant fire performance is summarised below. Any items not listed below would be in accordance with Table A1 from ADB 2020.

Table 14: Fire Compartmentation Requirements

Element	Fire Resistance
All Load-Bearing Elements	60 minutes
Walls Enclosing Plant Rooms	See Table 15 below
External Walls	See Section 8 of this report

⁶ British Standards BS 476 Fire tests on building materials and structures

⁷ British Standards BS EN 13501 Fire Classification of construction products and building elements

5.3.2 Ancillary Areas

Ancillary areas of the development are to achieve the minimum fire resistance periods outlined in the below table:

Table 15: Fire Separation of Ancillary Areas

Location / Room	Proposed Period of Fire Resistance
Energy Provider Substation	Robust construction having a minimum fire resistance of 240 minutes (to be confirmed by energy provider) including the top slab enclosing.
Life Safety Generator/Plant Room	Robust construction having a minimum fire resistance of 120 minutes.
Storage Areas greater than 450m ²	Robust construction having a minimum fire resistance of 60 minutes.
Storage Areas less than 450m ²	Robust construction having a minimum fire resistance of 30 minutes.
Secondary Power Supply Switch Rooms or Panels	Robust construction having a minimum fire resistance of 120 minutes.
Hazard Areas	Robust construction having a minimum fire resistance of 30 minutes.
Kitchens	Robust construction having a minimum fire resistance of 30 minutes. Not required where kitchens are used for reheating and cold food prep only.

5.4 Fire Doors

The fire doors and its system should meet the appropriate fire resistance rating as shown above when demonstrated with BS 476-22:1987⁸.

Magnetic hold-open devices should be utilised by doors in common areas where such doors are expected to be rendered ineffective by occupants (e.g. chocked open or the high frequency of door opening and closing would wear out the smoke seals). The hold-open devices should be linked to the fire alarm system so the doors are released to the closed position in the activation of the fire alarm/detection.

⁸ British Standards BS 476-22:1987 Fire tests on building materials and structures Part 22: Method for determination of the fire resistance of non-loading bearing elements of construction

The equipment used to control the release of the doors should meet the requirements of Category B actuation in accordance with BS 7273-4:2015+A1:2021⁹.

5.5 Protection of Openings & Firestopping

Where services pass through the compartment floors and walls, the penetrations will be firestopped by suitable means to ensure the fire resistance of the compartment is not degraded.

Where a compartment wall or compartment floor meets another compartment wall or an external wall, the junction should maintain the fire resistance of the compartmentation. Compartment walls should be able to accommodate the predicted deflection of the floor above by either:

- A suitable head detail between the wall and the floor, which can deform but maintain integrity when exposed to a fire, or
- The wall may be designed to resist the additional vertical load from the floor above as it sags under fire conditions and thus maintain integrity.

5.6 Ductwork

Ductwork will commonly be used for day-to-day ventilation. Where ductwork penetrates fire-resisting elements, it must be firestopped appropriately using one of the three methods outlined in Clause 11.9 in ADB 2020:

- Protection using fire dampers (not suitable for kitchen ductwork)
- Protection using fire-resisting enclosures
- Protection using fire-resisting ductwork

5.7 Concealed Spaces

Concealed spaces and cavities in the construction of the building provide a ready route for smoke and flame spread, especially in voids above and below ceilings/floors.

They should be provided in accordance with Clause 10.2 in ADB 2020:

- Divide cavities
- Sub-divide extensive cavities (e.g. ceiling voids)

5.7.1 Cavity Barriers

For non-domestic buildings, cavity barriers should be provided to limit the extent of any unseen cavities to no more than 10 metres (which can be increased to 20 metres if all the surfaces within the cavity achieve a UK Class 1 or European Class C performance or better).

Within external walls, cavity barriers should be provided in line with any locations where fire rated walls or floors meet the façade. Cavity barriers should also be provided around all openings

⁹ British Standards BS 7273-4:2015+A1:2021 Code of practice for the operation of fire protection measures Part 4: Actuation of release mechanisms for doors

in the external walls, such as windows, doors and service penetrations, as well as at the top and bottom of the cavity.

Cavity barriers should achieve a fire resistance of at least 30 minutes for integrity and 15 minutes for insulation. Alternatively, if located in a stud wall or partition, or provided around openings in the external wall, they may be formed of:

- Steel at least 0.5mm thick
- Polythene-sleeved mineral wool, or mineral wool slab, in either case under compression when installed in the cavity, or
- Calcium silicate, cement-based or gypsum-based boards at least 12mm thick.

Firestopping (between the fire rated compartment wall/floor and the external wall) should be of the same fire resistance as the fire rated wall/floor.

6 B4 & Regulation 7 - External Fire Spread

This section deals with the following requirement from Part B4 of Schedule 1 of the Building Regulations 2010.

Functional Requirement

External fire spread

- B4. (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

6.1 Regulation 7

Requirement B4 of the Building Regulations regards the external wall construction. The building design will need to conform with both Requirements of B4 and Regulation 7.

Regulation 7 is a prescriptive requirement and therefore no engineering judgements (alternative solutions e.g. such as risk assessment, or 'boxing in' of non-compliant materials) are permitted under Regulation 7.

6.2 Unprotected Areas

During a fire event, heat will radiate through non-fire-resisting openings in the external walls of the building.

This heat can be so significant that heat radiation through the unprotected openings is sufficient to set adjacent buildings on fire. To reduce the possibility of this transpiring, the Building Regulations place restrictions on the area of unprotected areas on external elevations.

Walls within 1000mm (1 metre) of the site boundary, which have no openings, will provide 30 minutes' fire resistance (integrity and insulation) from both sides. If the external walls are less than 1 metre from boundary, small openings (up to 1m²) in the external wall can be permissible, depending on size and separation. More detail can be found in Figure 44 in ADB.

For external walls more than 1 metre from boundary, BRE Report BR187 External fire spread: building separation and boundary distances has been applied as a suitable method for calculating minimum boundary distances or maximum unprotected areas, as recommended in ADB. This approach assumes:

- There is full flashover fire throughout the compartment
- Any fire resistance (EI) less than 60 minutes has failed
- Heat is emitted from all unprotected openings
- Boundary locations are taken as the centre of a public highway, the boundary of the site or a notional boundary mid-way between buildings on the same site.

6.3 BRE 187: Enclosing Rectangle Assessment

External boundaries are taken to either:

- The site boundary, or
- A notational boundary, which is halfway between two buildings on the same site, or
- To the centre of a public highway

Figure 24 below documents the external boundaries for the buildings on the Project Dragon site. Gatehouse 2 is located on the far side of the site and not shown in Figure 24. All elevations not shown below are large enough to allow 100% unprotected area.



Figure 24: External Boundaries (Source: Inspire Drawing)

Table 16 below documents the enclosing rectangle assessment for Project Dragon. The compartment height is taken as 3 metres. The widths have been rounded up to the nearest whole values in BR187.

Table 16: Enclosing Rectangle Assessment

Elevation	Width (metres)	Height (metres)	Boundary distance (metres)	Permissible unprotected area (%)
1	24 - 40	3	108.8	100
2	24	3	19.6	100
3	15	3	1.8	0
4	21	3	2.3	23
5	21	3	2.8	28
6	21	3	2	20
7	30	3	30.2	100
8	9	3	2.1	26
9	15	3	8.1	100
10	30	3	7.5	100
11	9	3	8.5	100

Elevations 3, 4, 5, 6 and 8 are not permitted to have 100% unprotected area, therefore will require fire resistance to the external wall. Figure 25 below documents the external walls which will require fire resistance apart from the permitted percentages in Table 16 above, where the red line indicates a 60-minute fire-resistant wall.

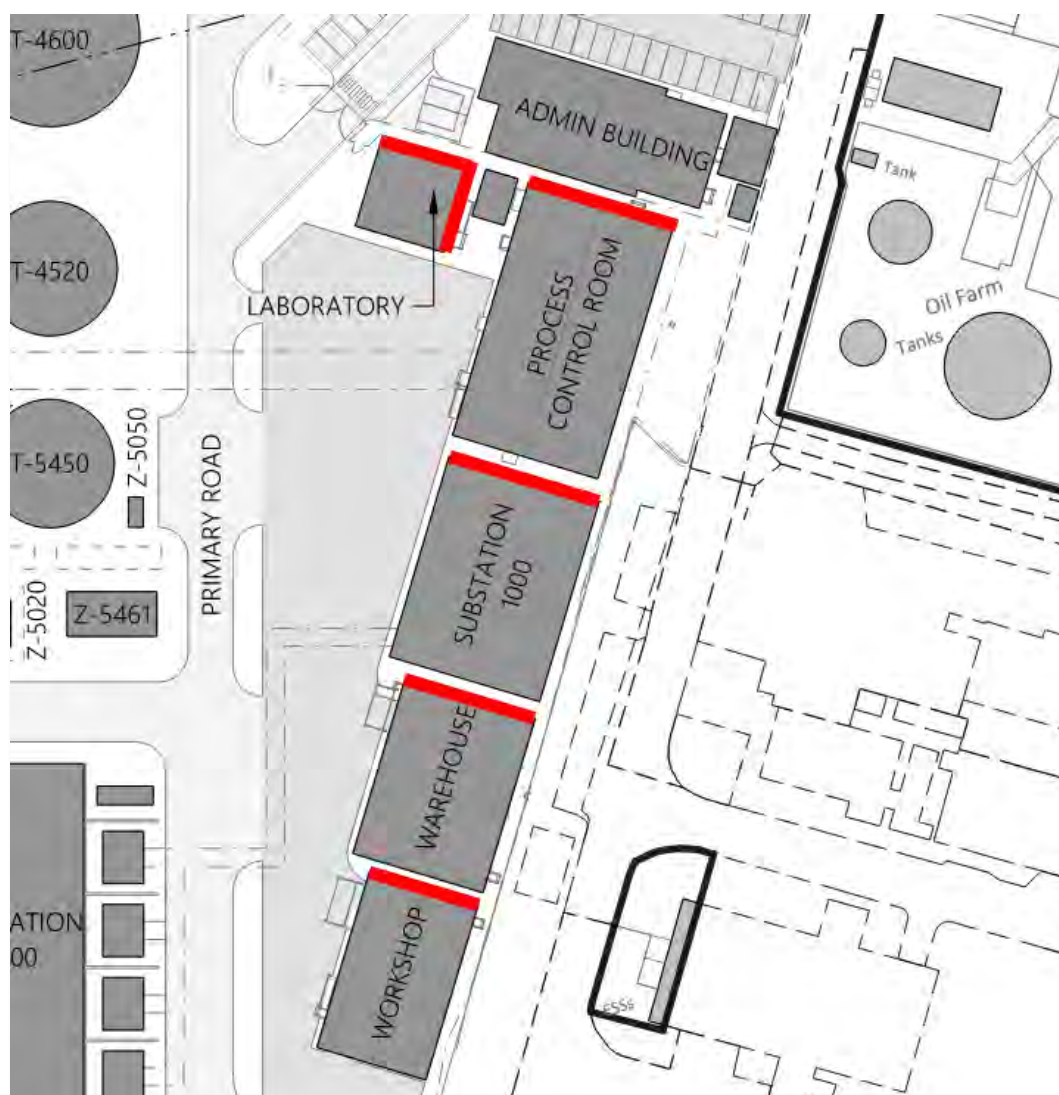


Figure 25: Areas Requiring Fire Resistance (Source: Inspire Drawing)

6.4 External Walls

The external surfaces of the building should meet the recommendations set out in Diagram 40 in ADB 2020.

The external walls have no requirement in terms of provisions of external wall surfaces in accordance with Diagram 40.

PartB recommends the external walls meet European Class B-s1,d0 or better, in line with the recommendations given in draft for consultation.

6.5 Roof Coverings

Roof coverings should comply with the recommendations of Table 16 in ADB 2020, given below in Table 17.

Table 17: Limitations on Roof Coverings (Source: Table 16, ADB 2020)

Designation ⁽¹⁾ of covering of roof or part of roof	Distance from any point on the relevant boundary			
	Less than 6 metres	At least 6 metres	At least 12 metres	At least 20 metres
B _{ROOF} (t4)	■	■	■	■
C _{ROOF} (t4)	□	■	■	■
D _{ROOF} (t4)	□	■ (2)(3)	■ (2)	■
E _{ROOF} (t4)	□	■ (2)(3)	■ (2)	■ (2)
F _{ROOF} (t4)	□	□	□	■ (2)(3)

■ Acceptable. □ Not Acceptable.

1. The designation of external roof surfaces is explained in Appendix B.

2. Not acceptable on any of the following buildings:

A) Dwellinghouses in terraces of three or more dwellinghouses.

B) Any other buildings with a cubic capacity of more than 1500m³.

3. Acceptable on buildings not listed in (1) if both of the following apply.

A) Part of the roof has a maximum area of 3m² and is a minimum of 1500mm from any similar part.

B) The roof between the parts is covered with a material rated class A2-s3, d2 or better.

7 B5 - Access & Facilities for the Fire Service

This section deals with the following requirement from Part B5 of Schedule 1 of the Building Regulations 2010.

Functional Requirement

Access and Facilities for the Fire Service

B5. (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.

7.1 Firefighting Access

7.1.1 Road Access

The vehicle access roadways should achieve the following in accordance with Table 20 in ADB 2020.

Table 18: Vehicle Access Requirements (Source: Table 20, ADB 2020)

Appliance Type	Width of road between kerbs (metres)	Width of gateways (metres)	Turning circle between kerbs (metres)	Turning circle between walls (metres)	Clearance height (metres)	Carry capacity (tonnes)
Pump	3.7	3.1	16.8	19.2	3.7	12.5
High Reach	3.7	3.1	26	29	4	17

7.1.2 Building Access

For buildings without fire mains, the vehicle access should be in line with Table 19 in ADB 2020. All the buildings have less than 2000m² floor area, therefore in accordance with ADB 2020, at least 15% of the perimeter of each building will need to be accessible to the fire service, or all areas within the building should be reached within 45 metres of the parked pump appliance.

Every elevation to which the vehicle access is provided should have suitable doors for fire service access i.e. 750mm wide, and should be provided such that there is no more than 60 metres between each door and/or the end of the elevation. An elevation is considered accessible to the fire service if they can reach it within 18 metres of a parked appliance. Figure 26 below documents the fire service access for Project Dragon.

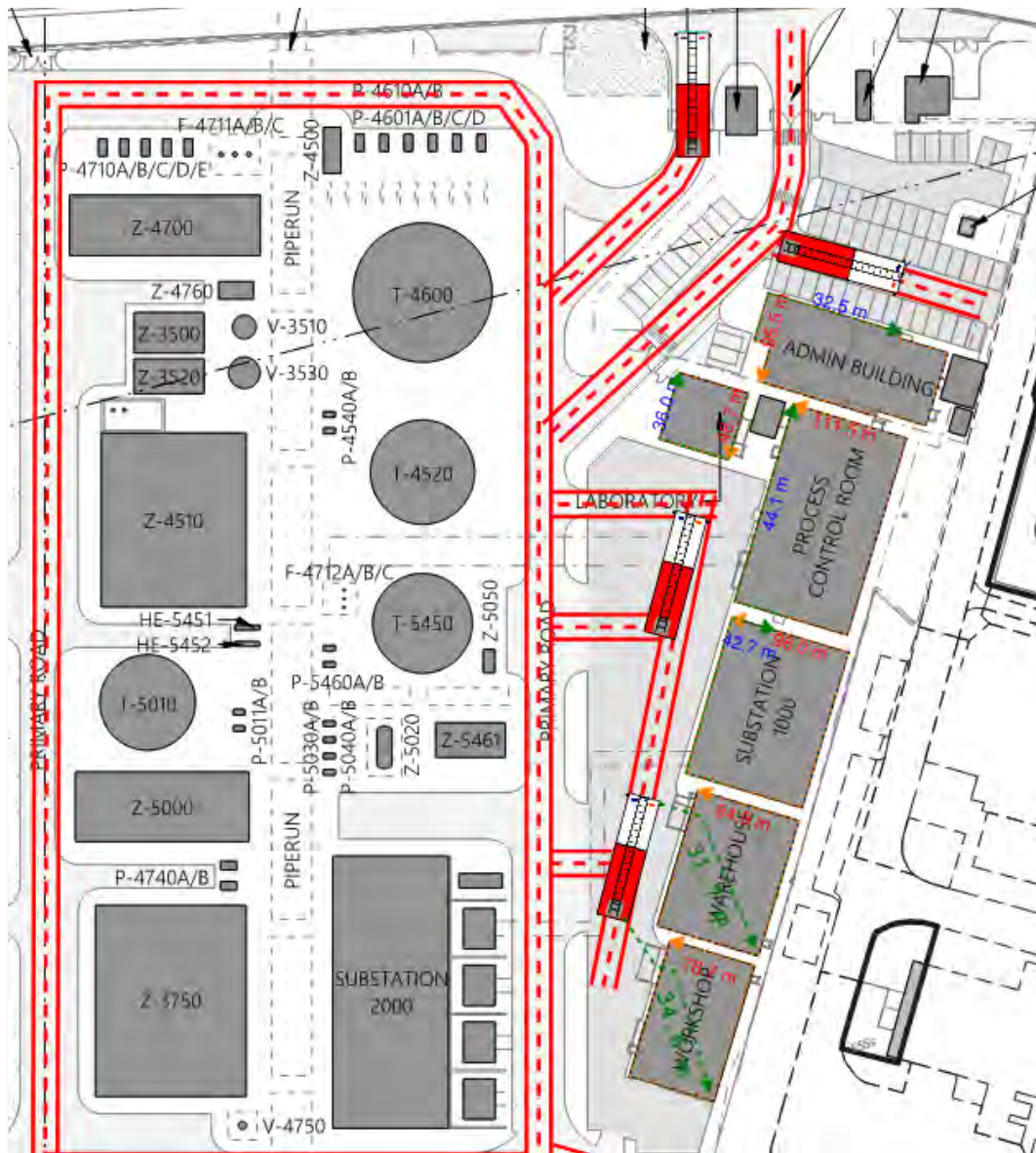


Figure 26: Firefighting Access (Source: Source: Inspire Drawing)

All buildings meet the criteria of fire service access.

7.2 Firefighting Shafts

There is no requirement for a firefighting shaft in the buildings in Project Dragon.

7.3 Firefighting Mains

Firefighting mains are required where parts of the ancillary buildings are not within 45 metres of the parked pump appliance. All areas can be reached within 45 metres, therefore no mains area required.

7.4 Fire Hydrants

In accordance with BS 9991:2015, it should be ensured a fire hydrant is provided within 90 metres of the firefighting entrance to the buildings.

7.5 Smoke Ventilation

There is no requirement for smoke ventilation within the buildings at Project Dragon.

7.6 Premises Information Box

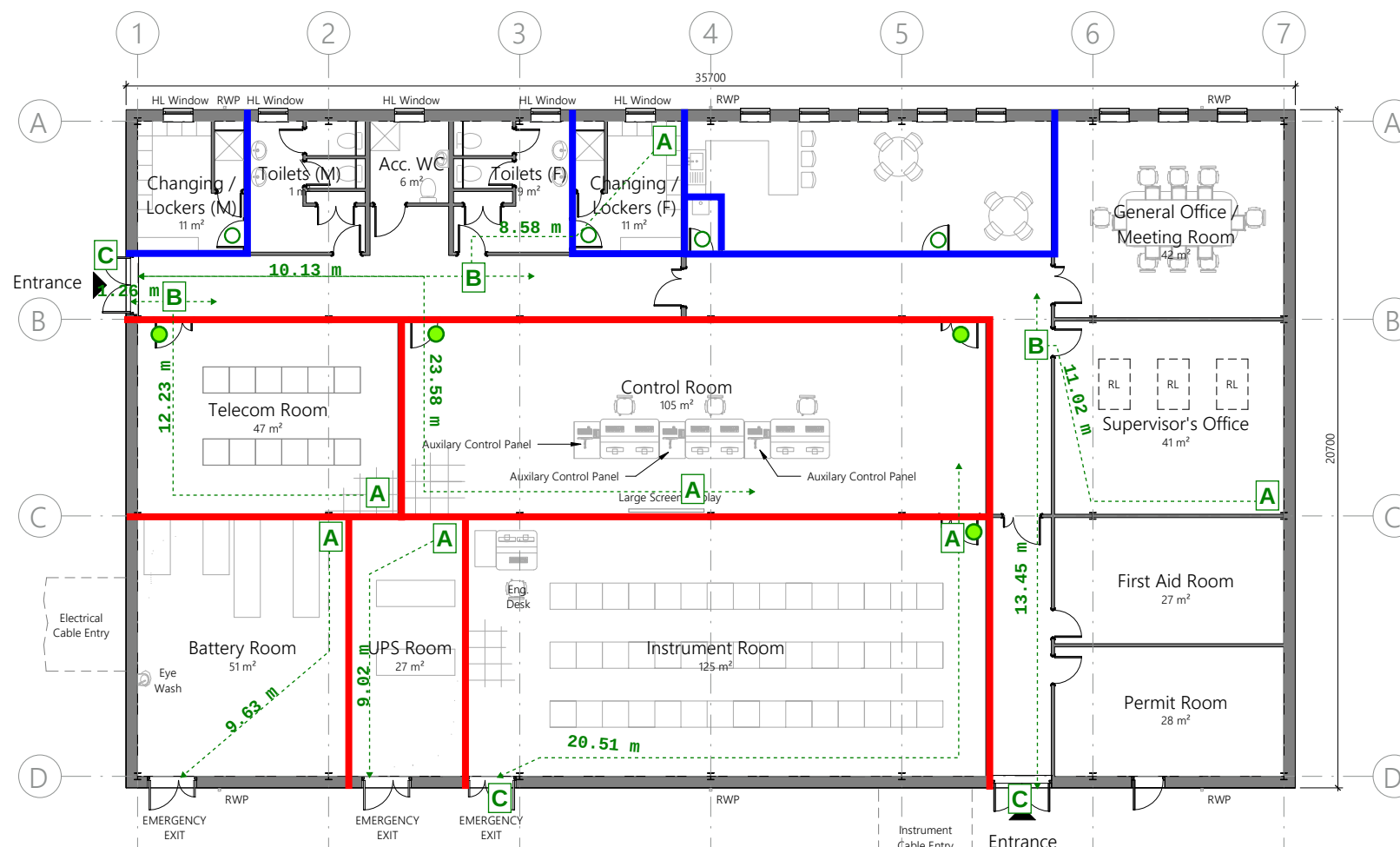
A premises information box (PIB) allows for the storage of information for a building, which is easily accessible to the fire service. A PIB would be expected to contain the following:

- Fire strategy plans
- Evacuation plans
- Locations of shut-off valve access points
- Different access points into the building

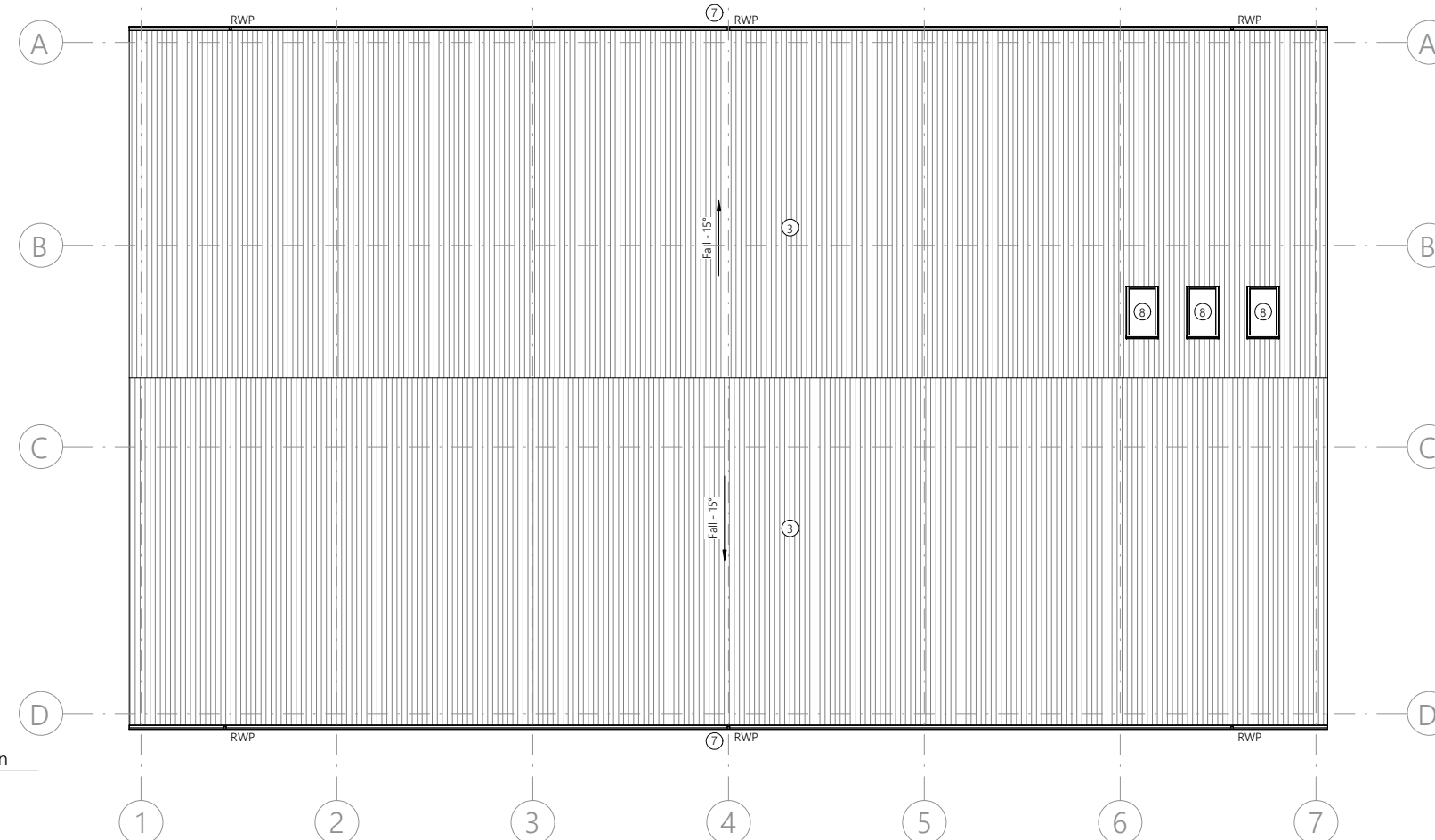
8 Summary

Overall, the proposed development of Project Dragon complies with the relevant standards following the Fire Strategy Report. LanzaTech will continue to work with PartB throughout RIBA Stages 3-4 to update the Fire Strategy with relevant information.

9 Appendix A - Fire Strategy Drawings



1 Proposed Ground Floor Plan
1:100



2 Proposed Roof Plan
1:100

Legend

- FD30 Fire Door
- FD30S Fire Door
- 30 minutes Fire Rated Construction
- 60 minutes Fire Rated Construction
- Travel Distance

Project Title Project Dragon

Drawing Title Process Control Building - Fire Strategy

Drawing Number PJD-PTB-ZZ-XX-FE-DR-1001

Revision 00 Date 30.10.2023

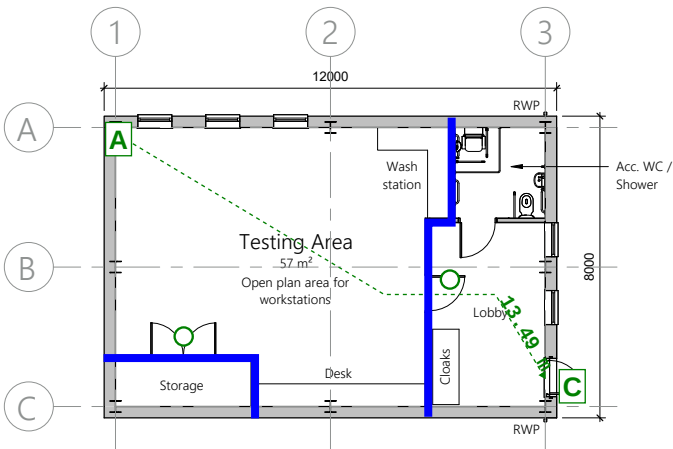
Drawn by Jessica Price

Reviewed by Jon Preston

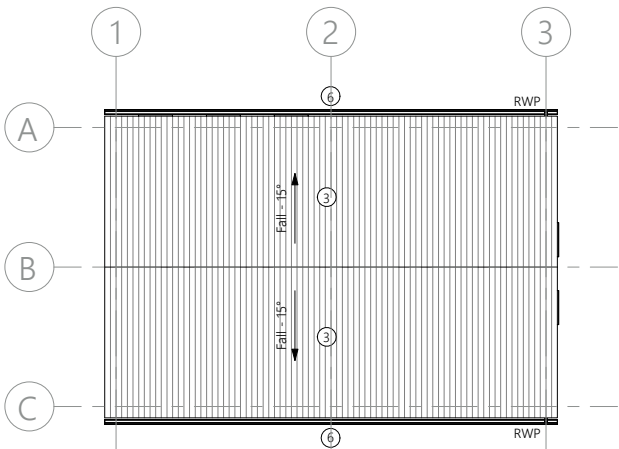
PART B

Legend

- FD30 Fire Door
- 30 minutes Fire Rated Construction
- Travel Distance



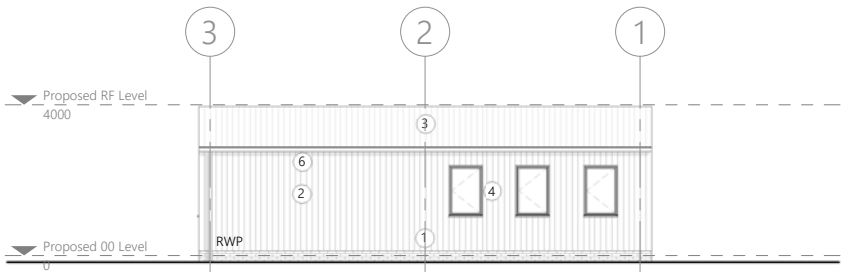
1 Proposed Ground Floor Plan
1:100



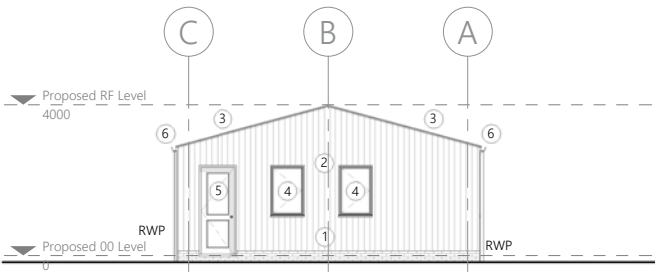
2 Proposed Roof Plan
1:100



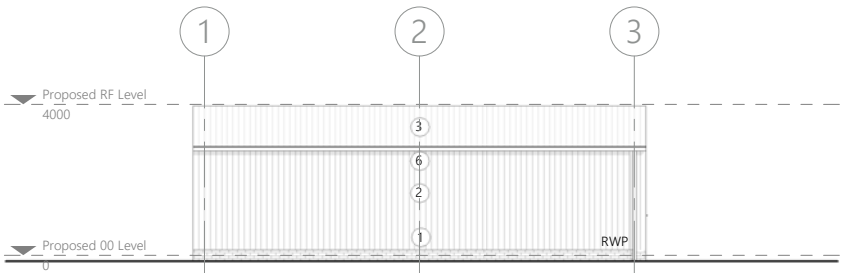
7 Laboratory 3D View 1



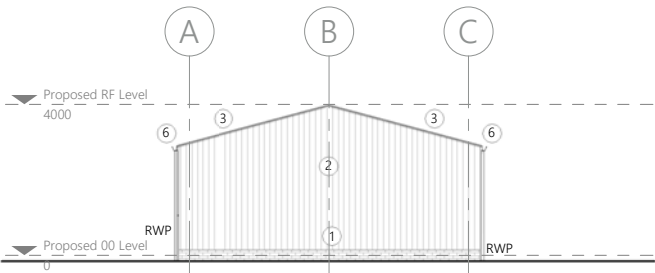
3 Proposed North Elevation
1:100



4 Proposed East Elevation
1:100



5 Proposed South Elevation
1:100



6 Proposed West Elevation
1:100

Project Title Project Dragon

Drawing Title Laboratory - Fire Strategy

Drawing Number PJD-PTB-ZZ-XX-FE-DR-1002

Revision 00 Date 30.10.2023

Drawn by Jessica Price

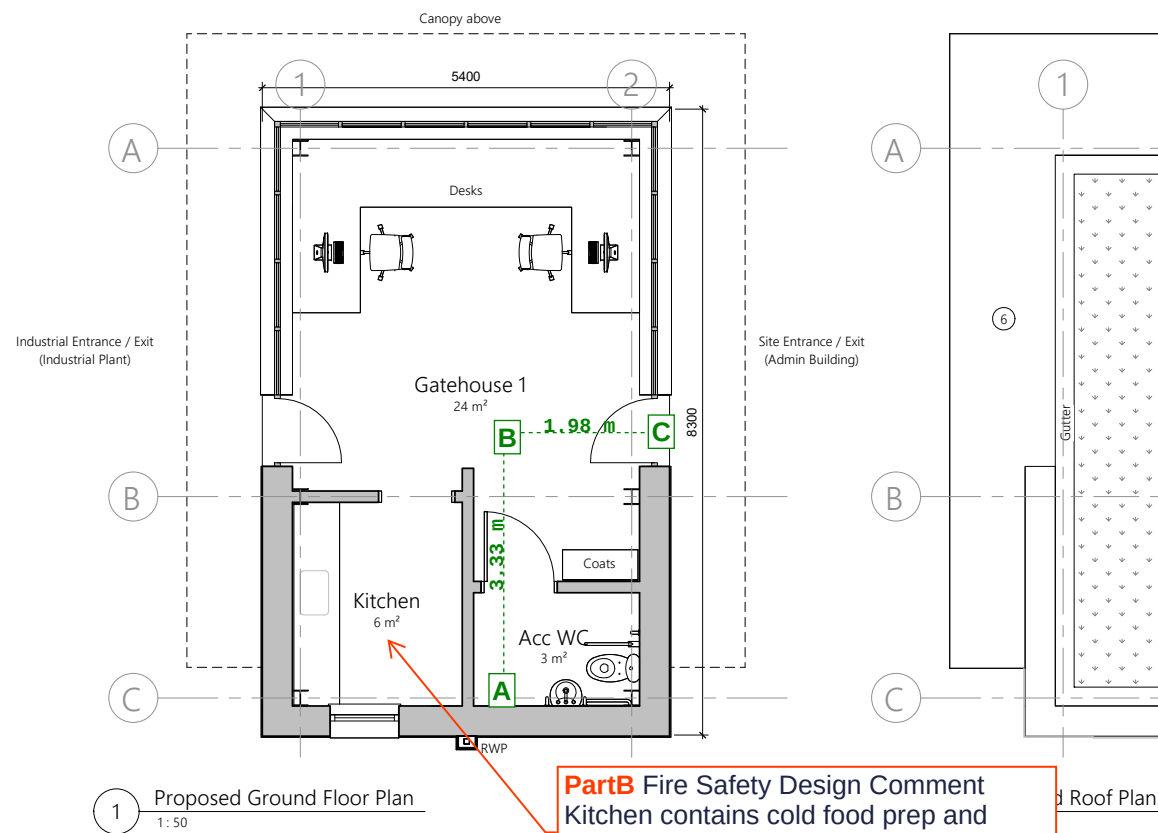
Reviewed by Jon Preston

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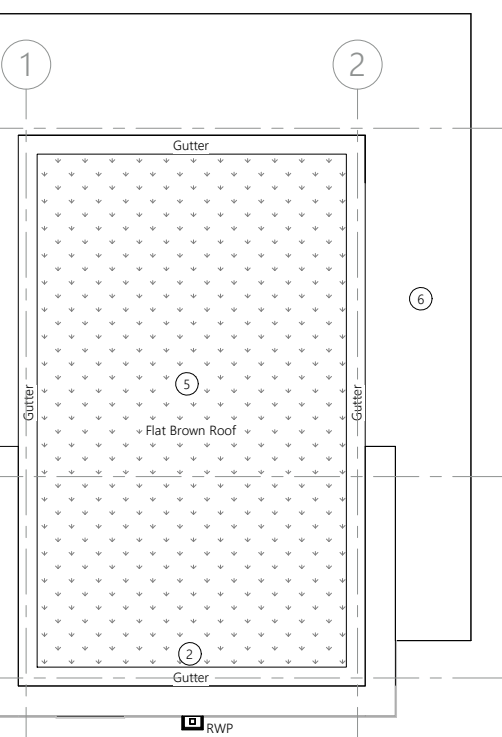
PART B

Legend

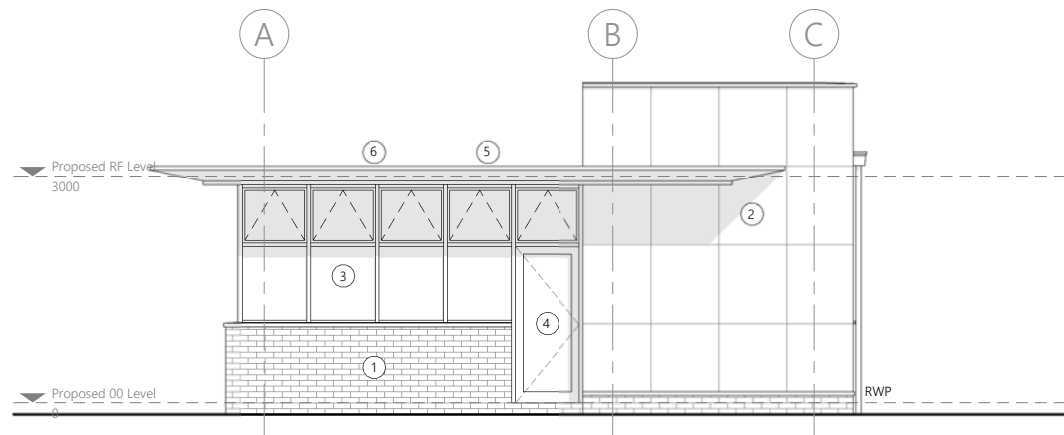
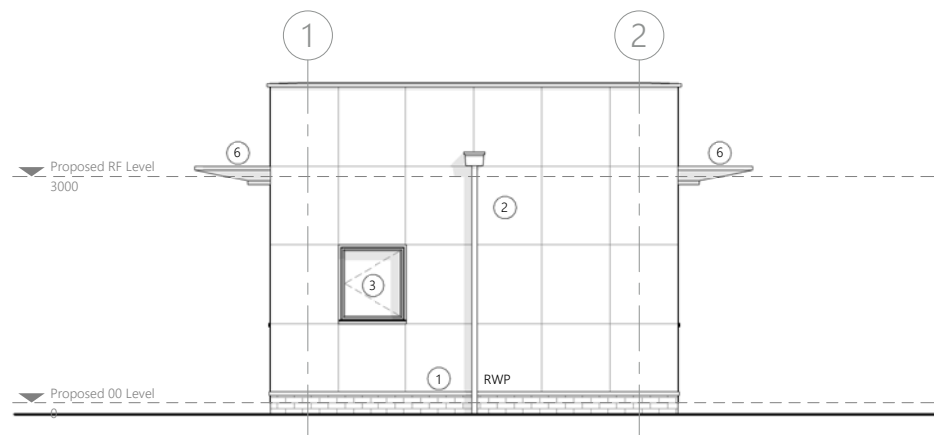
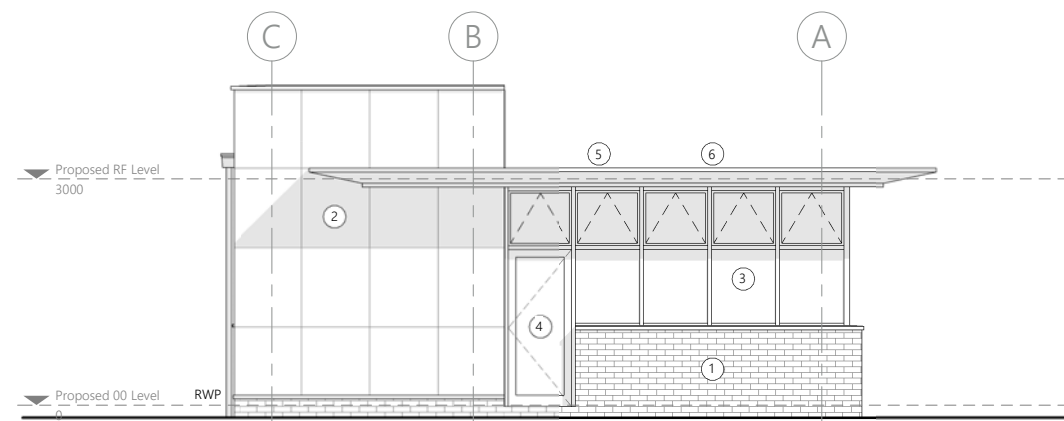
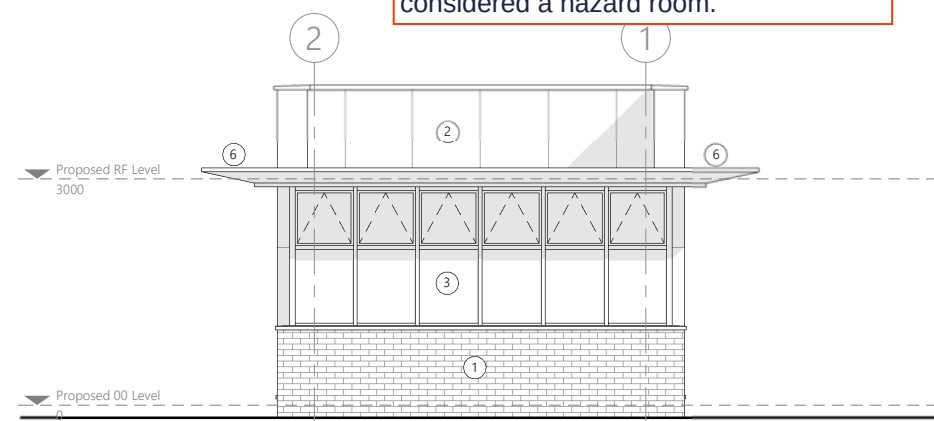
Travel Distance



PartB Fire Safety Design Comment
Kitchen contains cold food prep and
re-heat (microwave) only, therefore is not
considered a hazard room.



7 Gatehouse 3D View 1



Project Title Project Dragon

Drawing Title Gatehouse 1 - Fire Strategy

Drawing Number PJD-PTB-ZZ-XX-FE-DR-1003

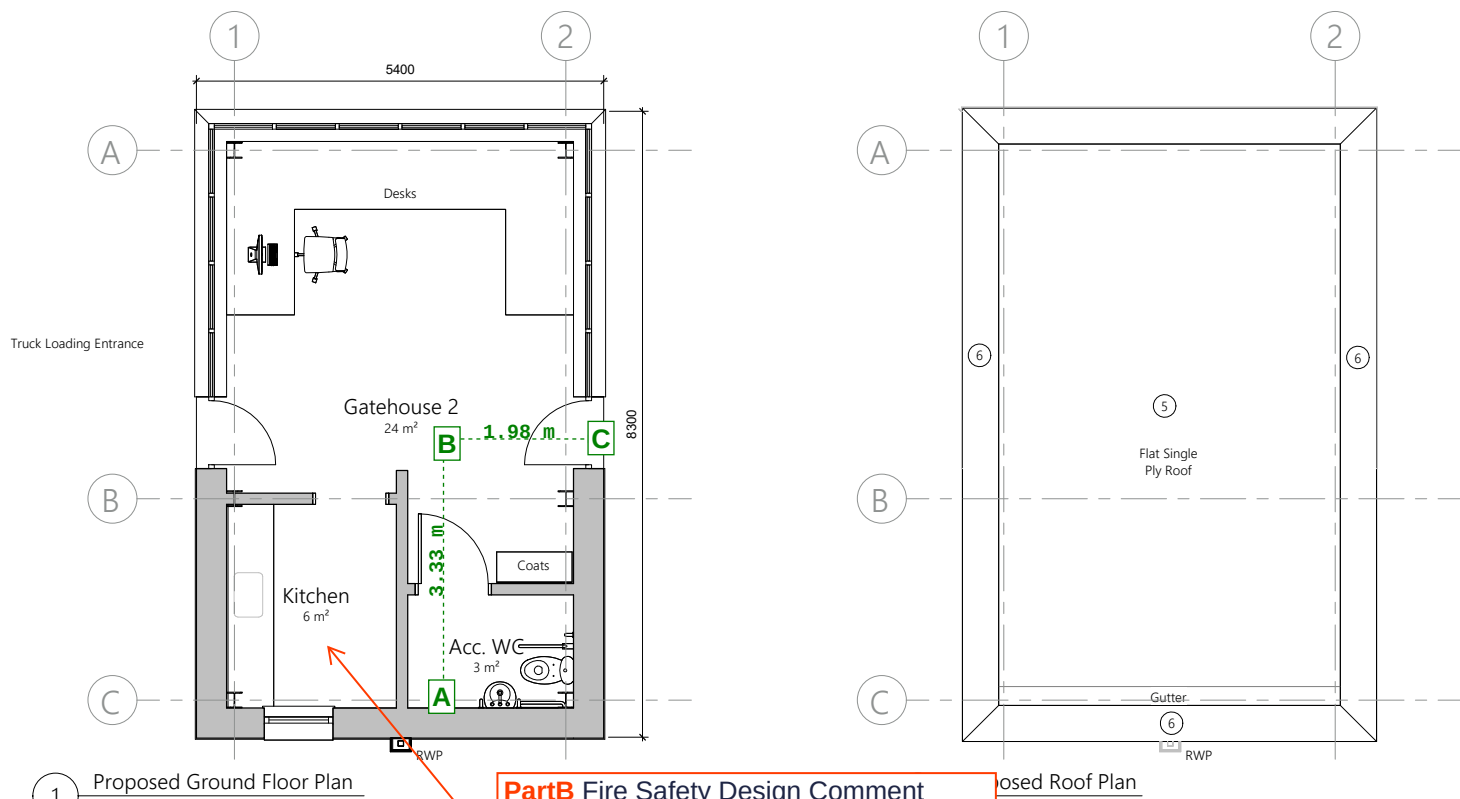
Revision 00 Date 30.10.2023

Drawn by Jessica Price

Reviewed by Jon Preston

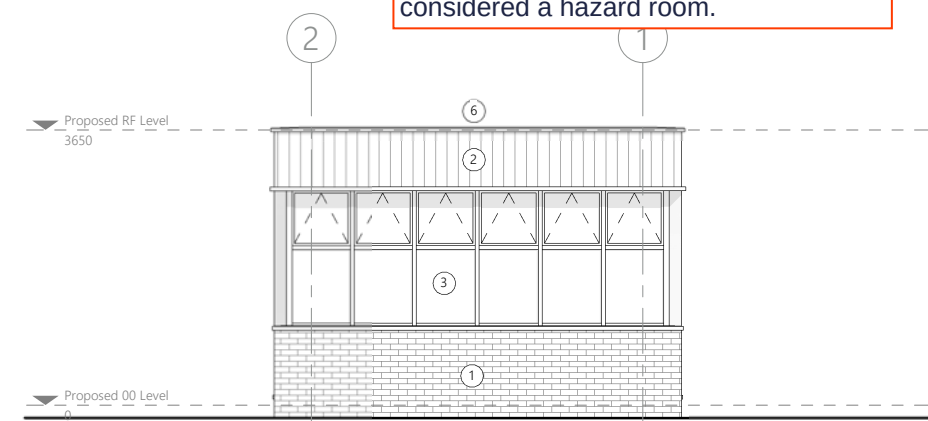
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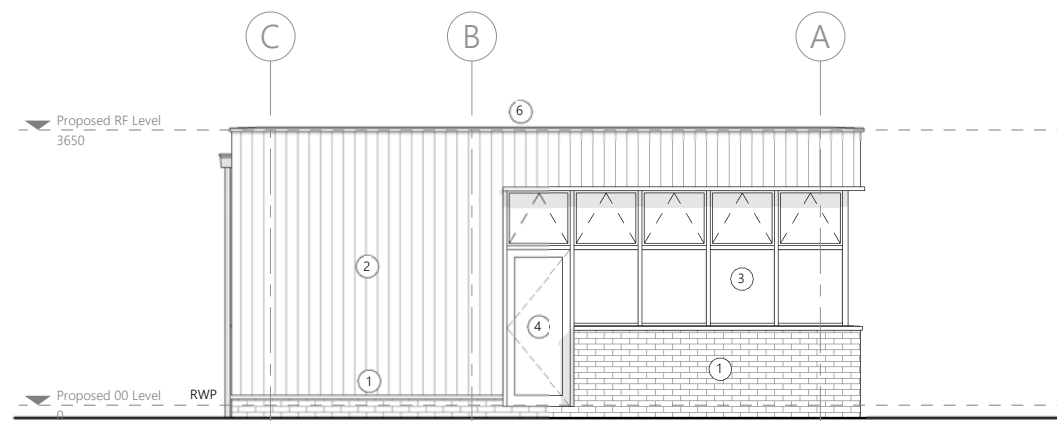


Gatehouse 2 3D View 1

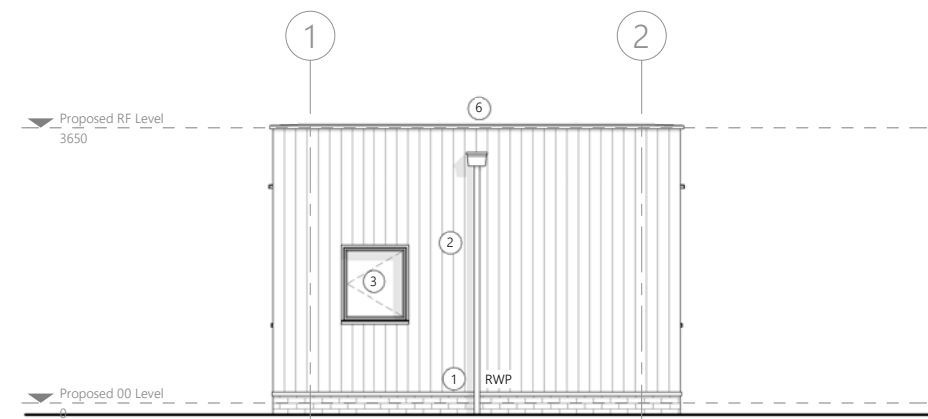
PartB Fire Safety Design Comment
Kitchen contains cold food prep and re-heat (microwave) only, therefore is not considered a hazard room.



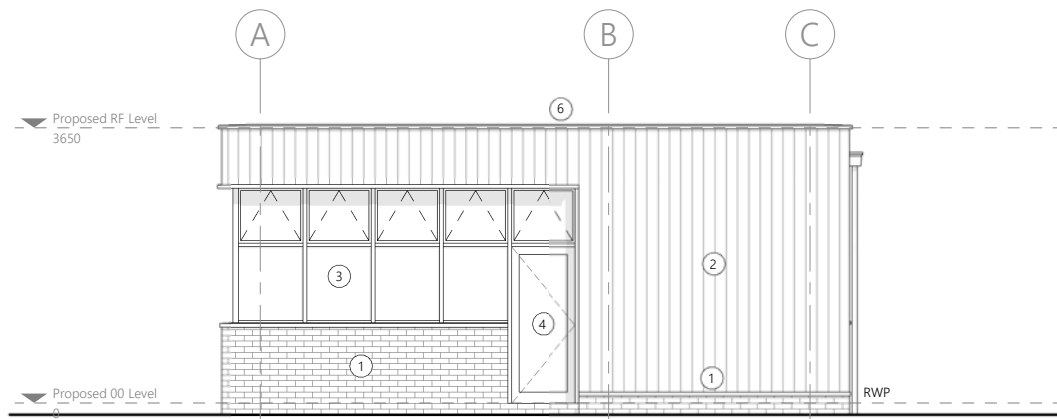
Proposed South Elevation
1:50



Proposed West Elevation
1:50

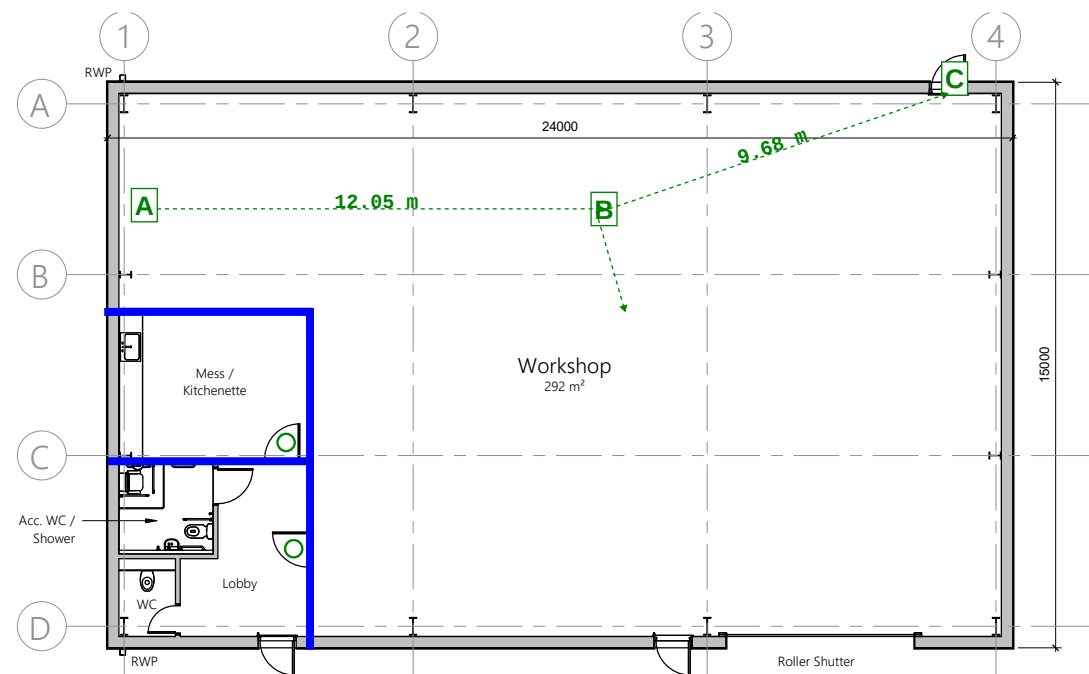


Proposed North Elevation
1:50

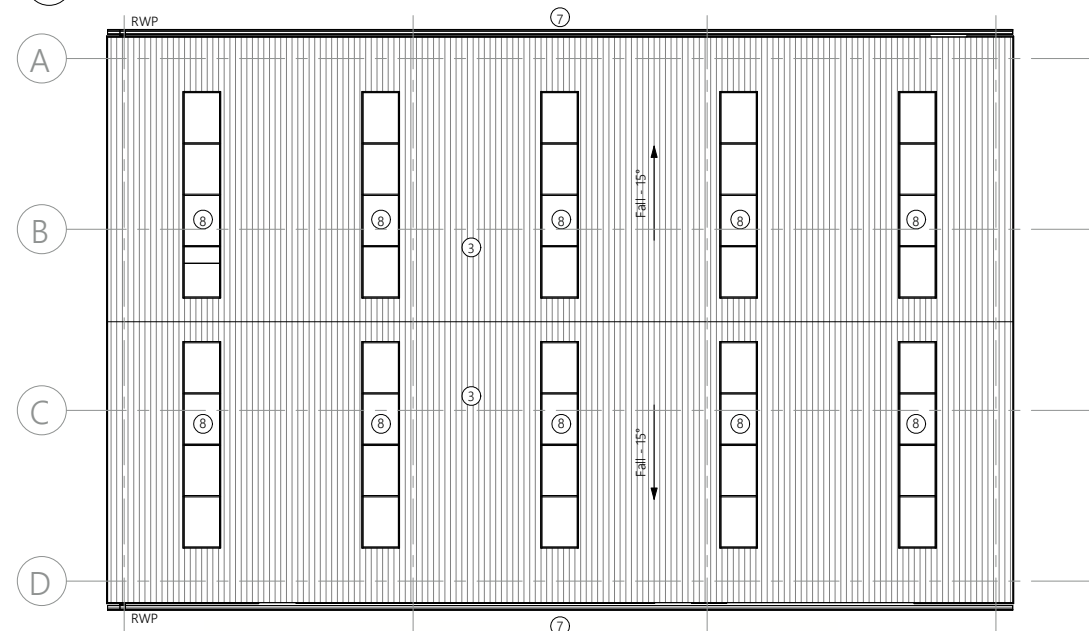


Proposed East Elevation
1:50

Project Title		Project Dragon	
Drawing Title		Gatehouse 2 - Fire Strategy	
Drawing Number		PJD-PTB-ZZ-XX-FE-DR-1004	
Revision 00	Date	30.10.2023	PartB Group Pera Business Park Nottingham Melton Mowbray LE13 0PB
Drawn by		Jessica Price	
Reviewed by		Jon Preston	



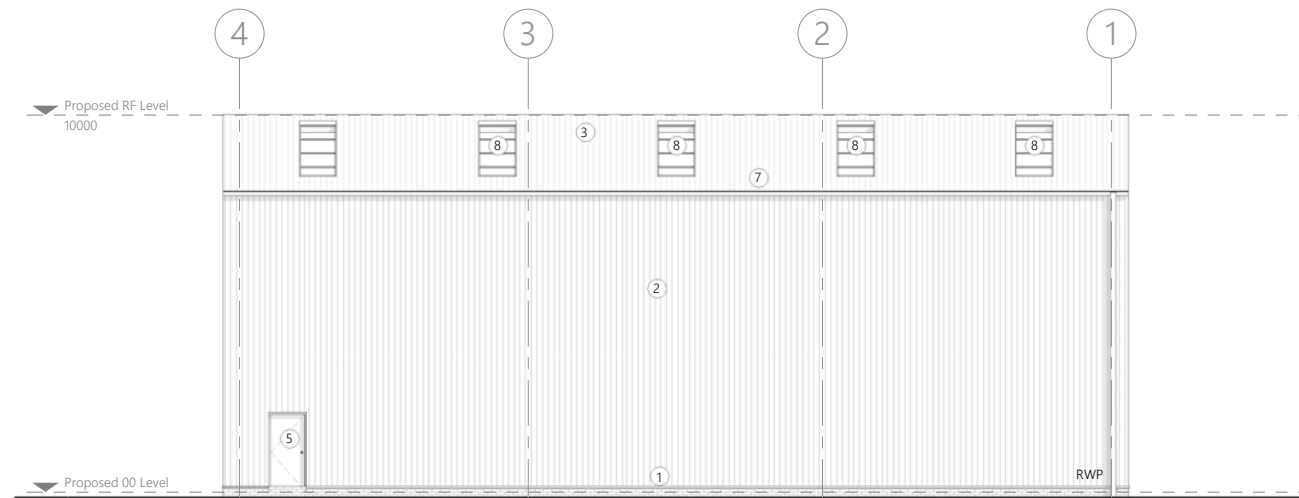
1 Proposed Ground Floor Plan
1:100



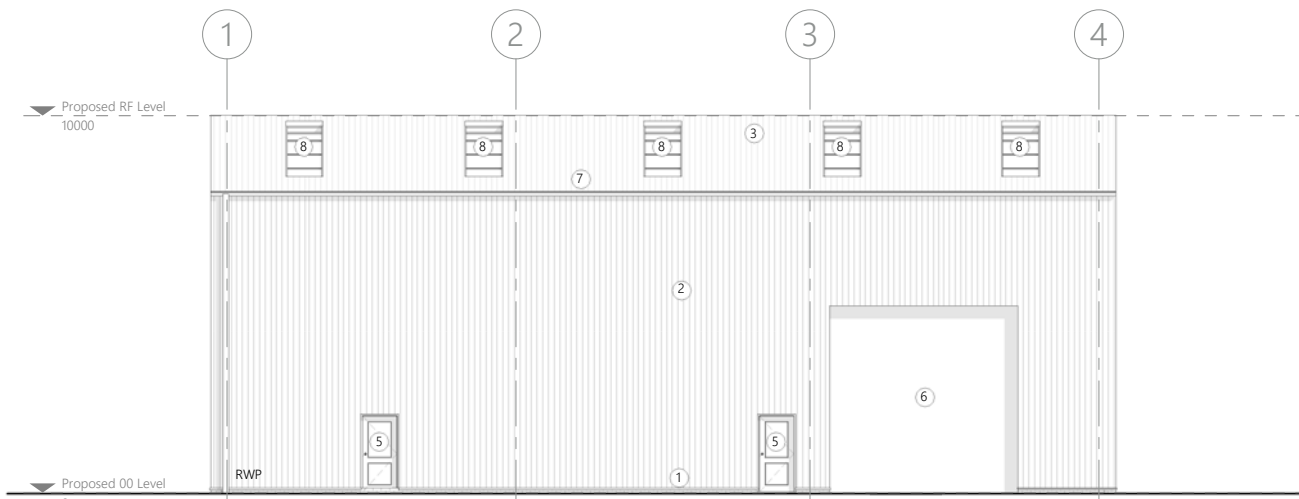
2 Proposed Roof Plan
1:100



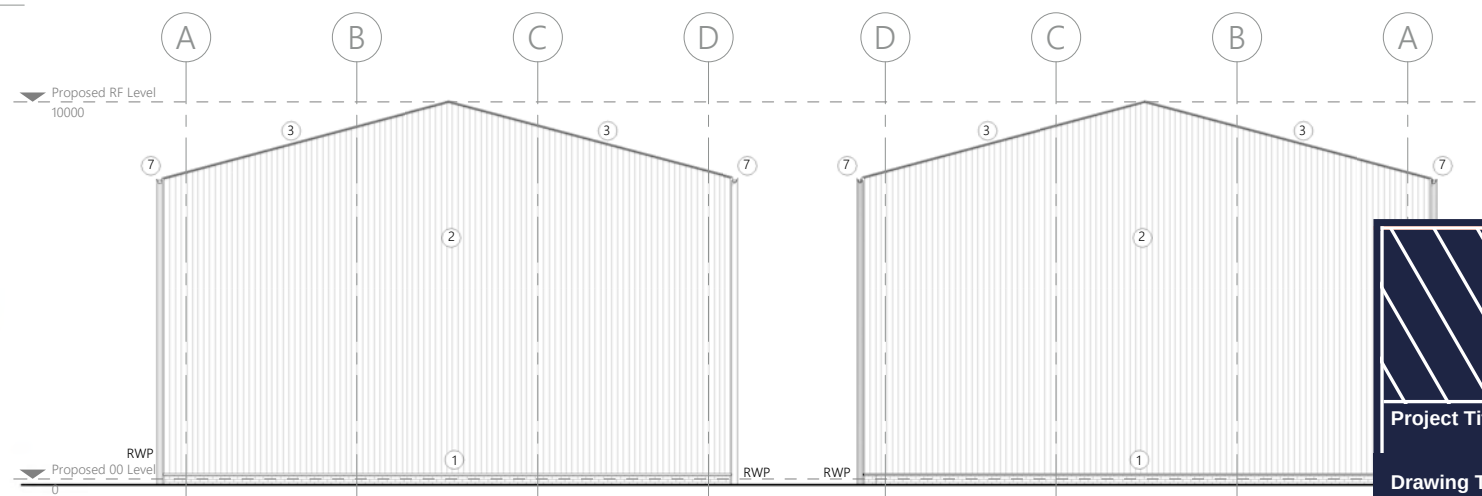
7 Workshop 3D View 1



3 Proposed East Elevation
1:100



4 Proposed West Elevation
1:100



5 Proposed South Elevation
1:100

6 Proposed North Elevation
1:100

Legend

- FD30 Fire Door
- 30 minutes Fire Rated Construction
- Travel Distance

Project Title Project Dragon

Drawing Title Workshop - Fire Strategy

Drawing Number PJD-PTB-ZZ-XX-FE-DR-1005

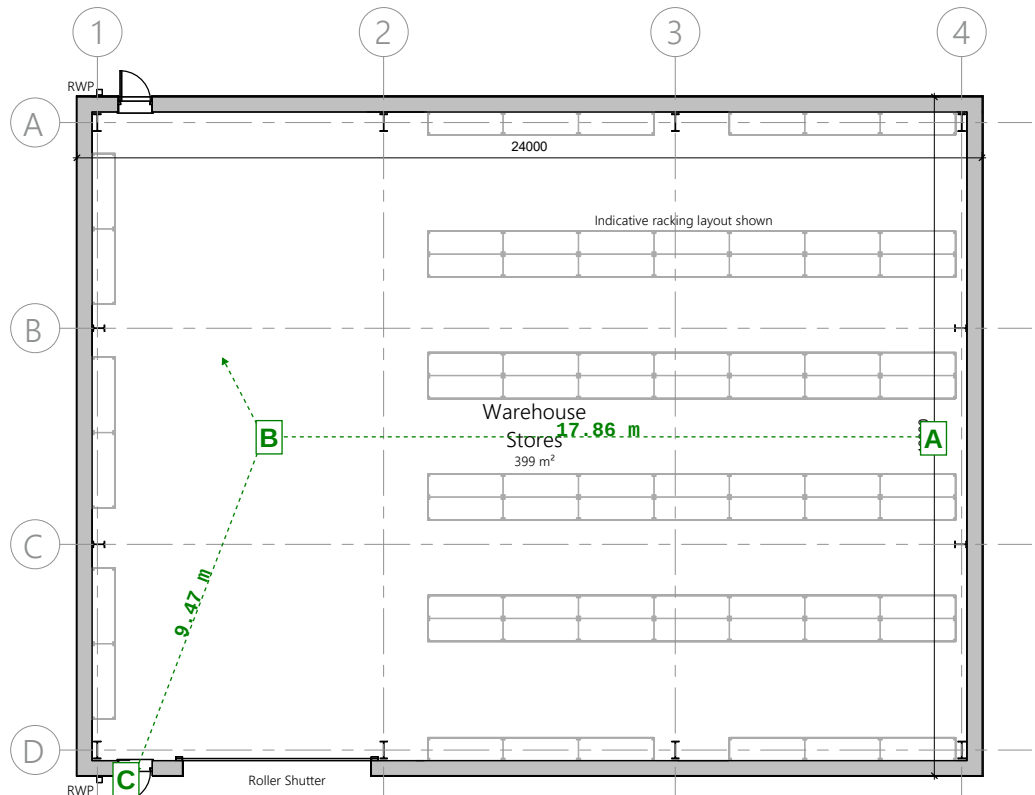
Revision 00 Date 30.10.2023

Drawn by Jessica Price

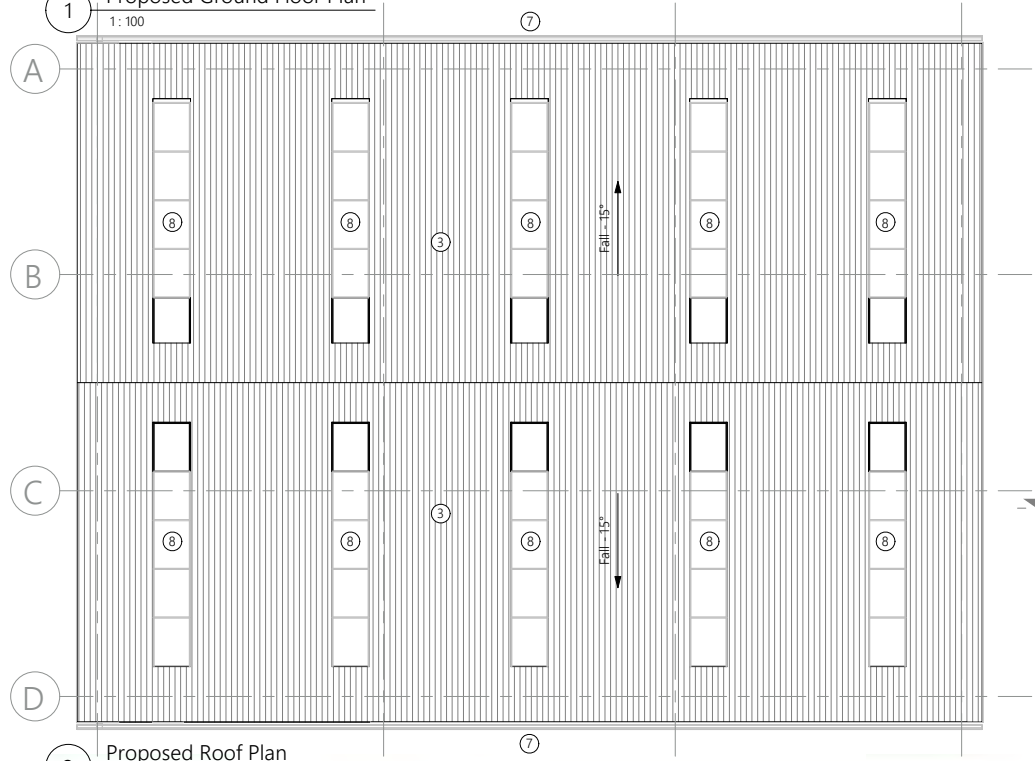
Reviewed by Jon Preston

PART B

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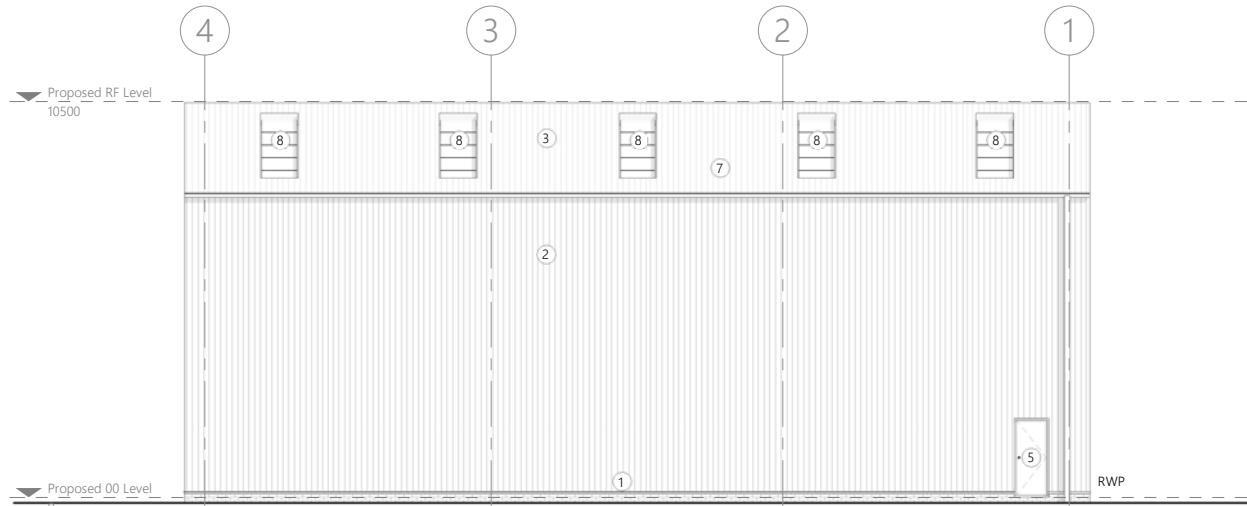
1 Proposed Ground Floor Plan
1:100



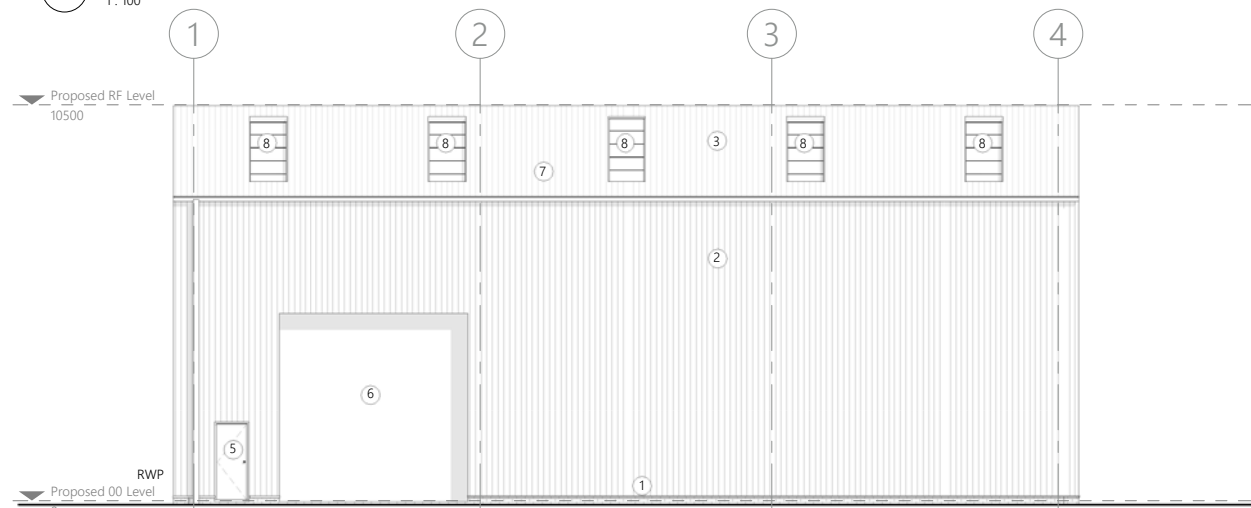
2 Proposed Roof Plan
1:100



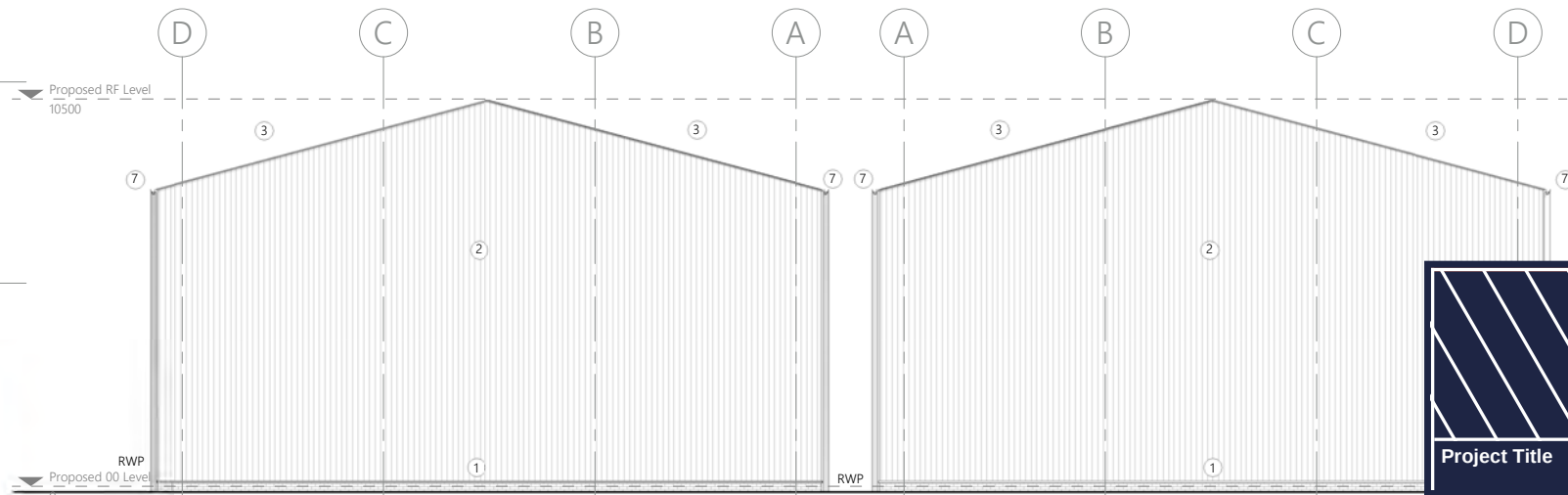
7 Warehouse 3D View 1



3 Proposed East1 Elevation
1:100



4 Proposed West1 Elevation
1:100



5 Proposed East Elevation
1:100

6 Proposed West Elevation
1:100

Project Title Project Dragon

Drawing Title Warehouse - Fire Strategy

Drawing Number PJD-PTB-ZZ-XX-FE-DR-1006

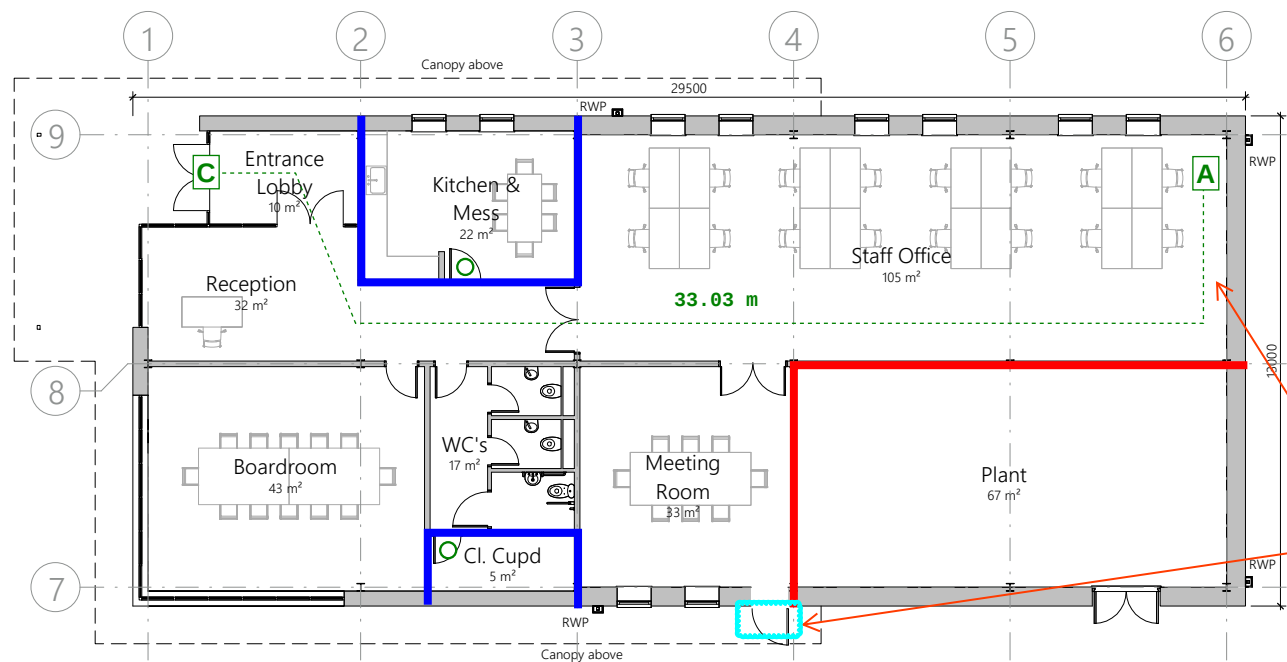
Revision 00 Date 30.10.2023

Drawn by Jessica Price

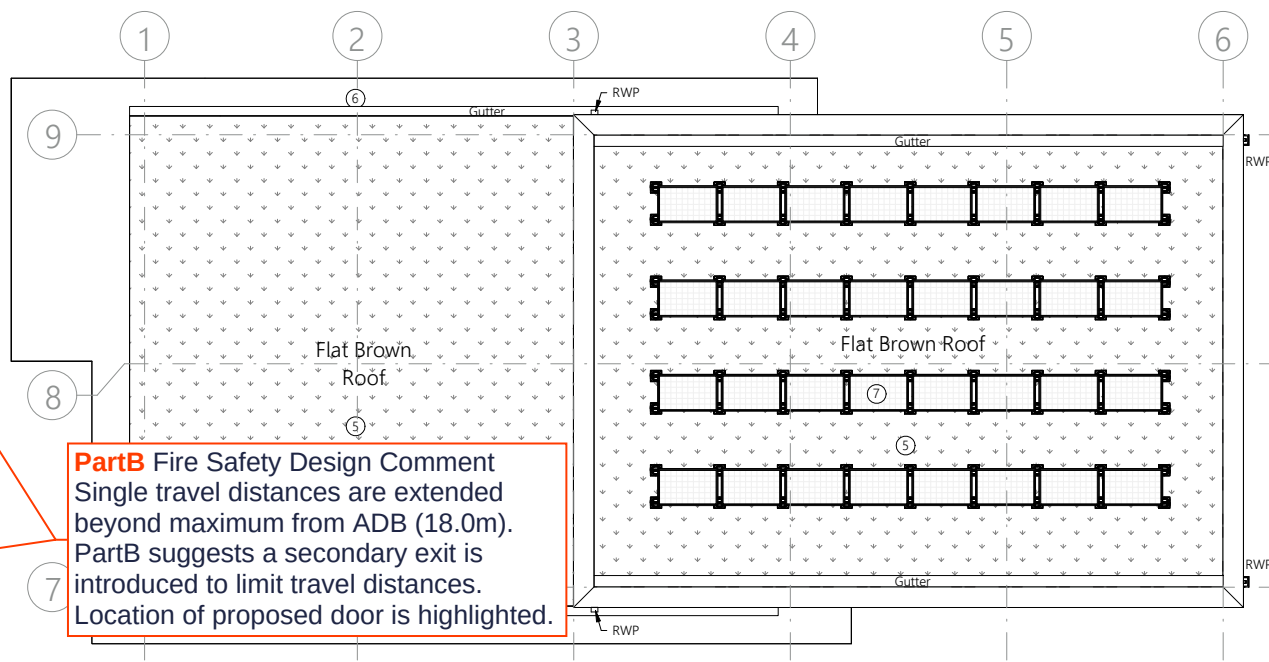
Reviewed by Jon Preston

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PART B



1 Proposed Ground Floor Plan
1:100

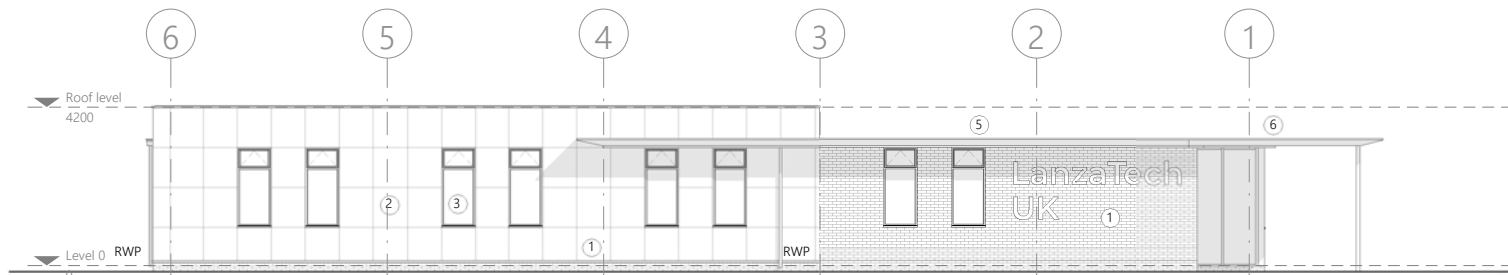


2 Proposed First Floor Plan
1:100

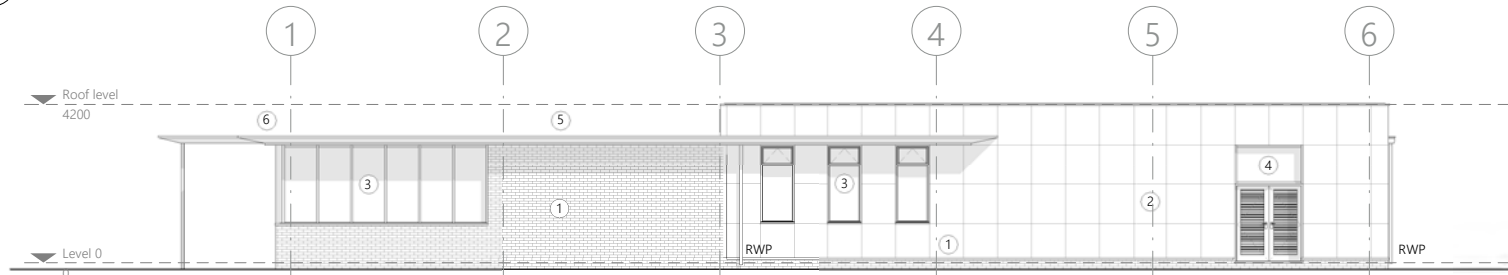
PartB Fire Safety Design Comment
Single travel distances are extended beyond maximum from ADB (18.0m). PartB suggests a secondary exit is introduced to limit travel distances. Location of proposed door is highlighted.

- Legend**
- FD30 Fire Door
 - 30 minutes Fire Rated Construction
 - 60 minutes Fire Rated Construction
 - Proposed additional door
 - Travel Distance

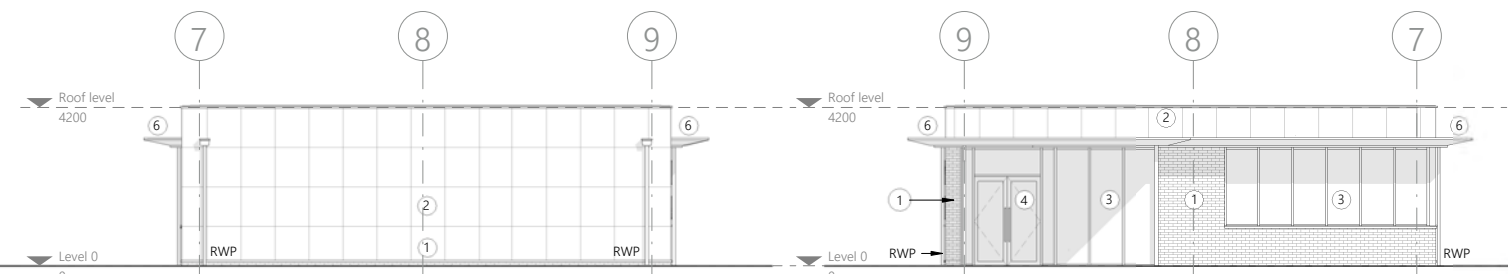
NOTES
• North arrow above indicates 'True North'



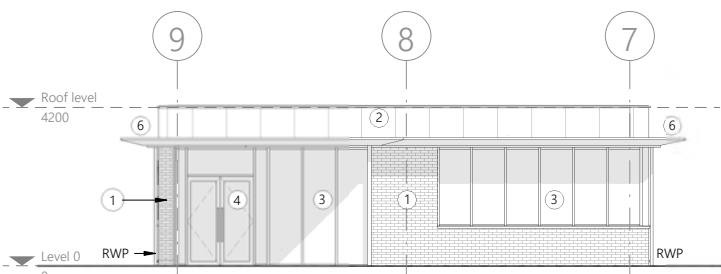
3 Proposed North Elevation
1:100



4 Proposed South Elevation
1:100



5 Proposed East Elevation
1:100



6 Proposed West Elevation
1:100



7 Admin Building 3D View 1



8 Admin Building 3D View 2

Project Title		Project Dragon
Drawing Title		Admin Building - Fire Strategy
Drawing Number		PJD-PTB-ZZ-XX-FE-DR-1007
Revision 00	Date	30.10.2023
Drawn by		Jessica Price
Reviewed by		Jon Preston
		PartB Group Pera Business Park Nottingham Road Melton Mowbray LE13 0PB

10 Appendix B – Full List of Liquids on Site

Table: Raw Materials LanzaTech

Substance	Approximate Annual Consumption	Use	Risks	Typical Storage Capacity	Storage Location	Containment	Safety Data Sheet provided
e.g. Hydraulic Oil	0.5L for plant operation	For Valves	Flammable fluid	1m ³	Storage shed	IBC with drip tray	Doc ref: ABC123
Process Fluids							
Ethanol	155,200 tonnes/year	Feedstock	Flammable liquid Irritant	4 x 5000 m3 tanks	T-6000A/B/C/D	Floating roof storage tank bund area	MSDS Ethanol
Propane	no consumption	Refrigerant for product cooling	Flammable gas	6800 kg	Z-3000	Pressure Vessel kerbed area	MSDS - Propane
Propanol	no consumption	Heat transfer fluid for product heating	Flammable liquid	IBC (1 m3)	Z-7320	Pressure Vessel kerbed area	MSDS - 1-Propanol
Caustic / Sodium Hydroxide Solution (23.5 wt%)	3,200 tonnes/year	Ion exchange resin regeneration and water treatment	Corrosive	80 m3	T-5501	Fixed roof storage tank bund area	MSDS - Caustic Soda
Sulphuric acid (96 wt%)	1,100 tonnes/year	Ion exchange resin regeneration and water treatment	Corrosive	20 m3	T-5801	Fixed roof storage tank bund area	MSDS - Sulphuric Acid
Raw Water	770,000 tonnes/year	Hydrogen Generation Utility Water Fire Water Cooling Water make-up Demineralised/Boiler Feed Water make-up	Not classified	15000 m3	T-4520 T-4600 T-5010 T-5450	Fixed roof storage tank	N/A
Air	2.5x10 ⁸ Nm3/y	Utilised for instrument air, plant air and combustion air for boiler.	Not classified	None	N/A	N/A	N/A
Liquid Nitrogen	5,600 tonnes/year	Inert gas	Cryogenic liquid Asphixiant	250 t	Z-3750	Pressure Vessel	MSDS - Liquid Nitrogen
Fuels							
Natural Gas	12,000 tonnes/year	Import of natural gas from Wales & West Utilities utilised as a fuel source for the HP Steam boiler.	Flammable gas	None (Imported on demand)	N/A	N/A	MSDS - Natural Gas
Diesel	50 litres	Fuel utilised for emergency fire water pumps and emergency electricity generators during total power failure scenario.	Flammable fluid Health Hazard via contact, inhalation and ingestion	100 litre tank	close to fire water put	Fixed roof storage tank kerbed area	MSDS - Diesel Fuel MSDS
Fuel Gas	6,000 tonnes/year	Product generated through the primary process utilised as a fuel source for the HP Steam Boiler for Recovery of calorific value.	Various Flammable gases	None (Used upon generation)	N/A	N/A	Multiple MSDS apply Fuel gas and liquid fuel composition
Liquid Fuel	360 tonnes/year	Product generated through the primary process. Normally utilised as liquid fuel source for the HP Steam Boiler for recovery of calorific value.	Various Flammable liquids	46 m3	V-4250	Pressure Vessel	Multiple MSDS apply Fuel gas and liquid fuel composition
SPK/SPD Product Additives							
Antioxidant	2.5 tonnes / year	SPK additive	Hazardous to aquatic environment	IBC (1 m3)	Warehouse	IBC with drip tray	MSDS - 2,6 ditertiary-butyl phen
Conductivity improver	0.3 tonnes / year	SPD additive	Flammable Liquid Health hazard (Irritant, potentially carcinogenic)	IBC (1 m3)	Warehouse	IBC with drip tray	MSDS - STADIS 450
Lubricity additive	0.3 tonnes / year	SPD additive	Health Hazard (damage to eyes) Harmful to aquatic environment	IBC (1 m3)	Warehouse	IBC with drip tray	MSDS- Diesel Fuel Lubricity Impr

Water Treatment Chemicals							
Dispersant	3942 kg/y	Cooling Water Dosing Effluent Waste Water Treatment	Health Hazard (Irritant) Hazardous to aquatic environment	IBC (1 m3)	Warehouse	IBC with drip tray	MSDS - NALCO 73550
Oxidising Biocide	2 tonnes (every 2 years)	Cooling Water Dosing	Health Hazard Harmful to aquatic environment	IBC (1 m3)	Warehouse	IBC with drip tray	MSDS Chlorine Dioxide 3%
Antifoulant	2796 kg/y	Cooling Water Dosing	Health Hazard (skin burns and eye damage)	IBC (1 m3)	Warehouse	IBC with drip tray	MSDS - Nalco 77352NA
Antiscalant	3942 kg/y	Cooling Water Dosing	Non hazardous	IBC (1 m3)	Warehouse	IBC with drip tray	MSDS NALCO 3D133
Oxygen Scavenger	240 kg/y	Boiler feed water dosing	Corrosive chemical	IBC (1 m3)	Warehouse	IBC with drip tray	MSDS - NALCO 1720
Phosphate	400 kg/y	Boiler feed water dosing	water contaminant	IBC (1 m3)	Warehouse	IBC with drip tray	MSDS - Phosphates
Corrosion inhibitor	320 kg/y	Boiler feed water dosing Cooling Water Dosing	Health hazard (skin burns and eye damage, harmful if	IBC (1 m3)	Warehouse	IBC with drip tray	MSDS - NALCO 3DT184
Flocculant	5 tonnes / year	Effluent Waste Water Treatment Package	Skin/eye irritant	IBC (1 m3)	Warehouse	IBC with drip tray	provided
Mechanical Fluids							
Lubricant	200 kg/y (estimated)	Rotating equipment	Not classified	Drum	Warehouse	Warehouse	MSDS - Lube Oil
Turbine oil	50 kg/y (estimated)	Rotating equipment	Not classified	Drum	Warehouse	Warehouse	MSDS - Chevron GTS 68
Grease	20kg/y (estimated)	Valves	Not classified	Drum	Warehouse	Warehouse	MSDS Greases
Other							
FFF concentrate (Florine-free foam)	200 kg/y	safety feature	Hazardous to aquatic environment Health Hazard (Irritant)	IBC (1 m3)	Storage shed	kerbed area	MSDS - FF Protec F3