APPENDIX 17

FIRE SAFETY STRATEGY

Mainfreight Expansion Facility
No. 30-50 Yarrawa Street
Prestons NSW 2170

Goodman Property Services (Aust) Pty Ltd
GPO Box 4703
Sydney NSW 2001

20/02/2013 | Final Issue | Report No. s121167_No.26 Yarrawa Street Prestons_FSS_02

Fire Safety Strategy

Mainfreight Expansion Facility
No. 30-50 Yarrawa Street
Prestons New South Wales

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Report Details

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Report Revision History

REV	DATE ISSUED	COMMENT	PREPARED BY	REVIEWED BY
01	14 December 2012	Draft Issue	**Trent De Maria** *Grad Cert Performance Based Bdg & Fire Codes, Grad Dip Building Fire Safety & Risk Engineering*	**Thomas Newton** *Adv. Dip Mech Eng, MFSE*
02	20 February 2013	Final Issue		

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1 INTRODUCTION

1.1 OVERVIEW

This Fire Safety Strategy has been undertaken to nominate proposed Alternative Solutions for assessing compliance with the nominated performance requirements of the BCA [1] in accordance with the methodologies defined in the IFEG [3].

In order to develop and assess the nominated DtS non-conformances the following flowchart process is to be adopted.

Project Scope	• Provides details of the project team • Provides information to be utilised • Provides limitations of the assessment	
Principal Building Characteristics	• Defines occupant characteristics which may affect their ability to respond and evacuate in fire conditions	Each characteristic can affect the outcome of the fire strategy when assessed in conjunction with each other i.e. occupants requiring assistance may require increased passive and active fire protection.
Dominant Occupant Characteristics	• Details the likely time to fire brigade intervention and relevant fire brigade options for the site.	
Fire Brigade Intervention	• Defines particular construction details of the development applicable to fire safety management	
Fire Hazards and Protective Measures	• Establishes the likely risks for occupant and brigade life safety and suitable measures to address those risks	
BCA DtS Non-compliance Assessment	• Provides methods for justifying the above risks • Defines methods proposed for assessing the performance of the Alternative Solutions and objectives	
Fire Safety strategy	• Details likely passive, active and management requirements to confirm the trial design assesses the nominated non compliances	

Figure 1-1: Fire Safety Strategy Process

The scope of the Fire Safety Strategy is to detail the nominated non-complying BCA DtS provisions with the Performance Requirements of the BCA and provide methodologies for establishing a workable and safe Fire Safety Strategy through a trial design.

1.2 FIRE SAFETY OBJECTIVES

The objective of a Fire Engineering Assessment is to develop a Fire Safety System, which satisfies the performance requirements of the BCA whilst maintaining an acceptable level of life safety, protection of adjacent property and adequate provisions for Fire Brigade intervention. At a community level, fire safety objectives are met if the relevant legislation and regulations are complied with. As stated in the BCA, “A Building Solution will comply with the BCA if it satisfies the Performance Requirements”. In addition to this certain non-regulatory objectives exist as detailed below.

1.2.1 Building regulatory objectives

The following items are a summary of the fire and life safety objectives of the BCA:

- **Life safety of occupants -** the occupants must be able to leave the building (or remain in a safe refuge) without being subject to hazardous or untenable conditions. The objective of the Fire Engineering Assessment is to demonstrate that the proposed building design and fire safety systems would minimise the risk of exposing building occupants to hazardous or untenable conditions in an event of a fire.

- **Life safety of fire fighters -** fire fighters must be given a reasonable time to rescue any remaining occupants before hazardous conditions or building collapse occurs. The objective of the Fire Engineering Assessment is to demonstrate that the proposed building design and fire safety systems would facilitate fire brigade intervention and minimise the risk of exposing fire fighters to hazardous or untenable conditions in an event of a fire.
- **Protection of adjoining buildings** - structures must not collapse onto adjacent property and fire spread by radiation should not occur. The objective of the Fire Engineering Assessment is to demonstrate that the proposed building design and fire safety systems would minimise the risk of fire spreading from one building to another.

1.2.2 Fire Brigade objectives

The overall philosophical Fire Brigade objectives throughout Australia are to protect life, property and the environment from fire according to the Fire Brigade Intervention Model (FBIM) [4] as per the Fire Services State and Territory Acts and Regulations.

Over and above the requirements of the BCA, the Fire Brigade has functions with regard to property and environmental protection and considerations regarding occupational health and safety for its employees.

1.2.3 Non-prescribed objectives

Fire Engineering has an overarching benefit to many facets of the built environment where non-prescribed objectives can have an influence on the Fire Safety Strategy adopted. Although not assessed within, the following can be considered if requested.

- **Business continuity -** will the loss of a particular facility due to fire / smoke damage result in excessive financial impact on the client? For example, is the facility critical to business continuity?
- **Public perception -** should a fire occur within the facility is there likely to be questionable public perception about the safety and operation of the facility?
- **Environmental protection –** fires of excessive sizes can have significant effects on the environment which may require a detailed risk assessment to minimise such outcomes.
- **Risk mitigation / insurance limitations -** are there specific limitations on insurance with respect to risk mitigation and fire safety design?
- **Future proofing (isolation of systems) -** what flexibility is required in the overall design to allow for future development or changes in building layout?
- **OHS requirements -** buildings may have specific fire safety requirements pertaining to OHS requirements.

1.3 REGULATORY FRAMEWORK OF THE FIRE ENGINEERING ASSESSMENT

1.3.1 Building Code of Australia

One of the goals of the BCA is the achievement and maintenance of acceptable standards of safety from fire for the benefit of the community. This goal extends no further than is necessary in the public interest and is considered to be cost effective and not needlessly onerous in its application.

Section A0.5 of the BCA [1] outlines how compliance with the Performance Requirements can be achieved. These are as follows:

(a) complying with the Deemed-to-Satisfy Provisions; or

(b) formulating an Alternative Solution which –

  (i) complies with the Performance Requirements; or

  (ii) is shown to be at least equivalent to the Deemed-to-Satisfy Provisions or

(c) a combination of (a) and (b).

Section A0.9 of the BCA provides several different methods for assessing that an Alternate Solution complies with the Performance Requirements. These methods are summarised as follows:

(d) Evidence to support that the use of a material, form of construction or design meets a Performance Requirement or a Deemed-to-Satisfy Provision.

(e) Verification Methods such as:

(i) the Verifications Methods in the BCA; or

(ii) such other Verification Methods as the appropriate authority accepts for determining compliance with the Performance Requirements.

(f) Comparison with the Deemed-to-Satisfy Provisions.

(g) Expert Judgment.

Section A0.10 of the BCA provides methods for complying with provisions A1.5 (to comply with Sections A to J of the BCA inclusive). The following method must be used to determine the Performance Requirements relevant to the Alternative Solution: These methods are summarised as follows:

(i) Identify the relevant Deemed-to-Satisfy Provision of each Section or Part that is to be the subject of the Alternative Solution.

(ii) Identify the Performance Requirements from the same Section or Part that are relevant to the identified Deemed-to-Satisfy Provisions.

(iii) Identify Performance Requirements from the other Sections and Parts that are relevant to any aspects of the Alternative Solution proposed or that are affected by the application of the Deemed-to-Satisfy Provisions that are the subject of the Alternative Solution.

1.3.2 International Fire Engineering Guidelines

The IFEG [3] document has been developed for use in fire safety design and assessment of buildings and reflects world's best practice. The document is intended to provide guidance for fire engineers as they work to develop and assess strategies that provide acceptable levels of safety.

The document is particularly useful in providing guidance in the design and assessment of Alternative Solutions against the Performance Requirements of the BCA. The prescribed methodology set out in the IFEG has been generally adopted in the Fire Engineering Brief.

2 PROJECT SCOPE

2.1 PROJECT SCOPE

Project Scope

RAWFire Safety Engineering has been engaged to prepare a fire safety strategy for the expansion of the existing Mainfreight distribution facility at Prestons.

The purpose of this fire safety strategy is to outline the fire engineering principles that will be utilised in ensuring that the prescriptive non-compliances noted in the Building Code of Australia report are resolved in order to conform to the building regulations and permit development approval. The complete fire engineered analysis will form the Fire Engineering Report, and as such is not documented herein. This Fire Safety Strategy does however outline the construction and management requirements considered necessary to achieve an acceptable level of life safety within the building and satisfy the performance requirements of the BCA.

RAWFire's scope of works having regard to the redevelopment is proposed to address the following departures from the BCA DtS Provisions:-

- Perimeter access encroaches upon the adjoining transmission line easement; and
- Active smoke hazard management systems shall be provided for post incident clearance use only; and
- Permitting extended travel to the nearest and between alternative exits.

2.2 RELEVANT STAKEHOLDERS

This fire safety strategy has been developed collaboratively with the relevant stakeholders as identified below:

Table 2-1: Relevant Stakeholders

ROLE	NAME	ORGANISATION
Owner	Mike Hercus Khalid Hourani Adrian Tesoriero	Goodman
Principal Certifying Authority / BCA Consultant	Stephen Natilli Brigitte Thearle	McKenzie Group Consulting
Fire Safety Consultant(s)	Trent De Maria Thomas Newton	RAW Fire Safety Engineering
Fire Safety Engineers	Sandro Razzi	

It should be noted that at times some parties may have a vested interest in the outcome of the Fire Engineering assessment. Such parties can include local fire brigades, insurers, project control groups, end users and community representatives. Although not always a legislative requirement, the design team should give due consideration to their inclusion in the Fire Engineering process. Where not required by legislation it is the clients' decision to involve such parties, especially local fire brigade, to ensure a transparent and adequate fire safety solution for all. Where we are not notified of the inclusion of such parties it is assumed the client / representative has given due consideration to the above.

2.3 SOURCES OF INFORMATION

The following sources of information have been provided by the design team:

- Verbal BCA Assessment Advice provided by Brigitte Thearle of McKenzie Group Consulting at the design concept meeting on 23 November 2012; and
- RAWFire Fire Engineering Report s060010-RP02 dated 26 October 2007; and
- Architectural Plans prepared by Nettleton Tribe and provided by Michael Ossit numbered 4167_000-002, 011-012, 015-018,020-021,025,031,041,045 and 051.

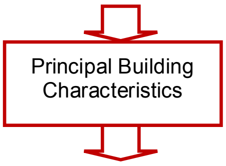
2.4 LIMITATIONS AND ASSUMPTIONS

In this instance the Fire Engineering Strategy is developed based on applicable limitations and assumptions for the development which are listed as follows:

- The report is specifically limited to the project described in Section 2.1.
- The report is based on the information provided by the team as listed above in Section 2.2.
- Building and occupant characteristics are as per Section 3 and 4 respectively of this report. Variations to these assumptions may affect the Fire Engineering Strategy and therefore they should be reviewed by a suitably qualified Fire Engineer should they differ.
- As per any building design, DtS or otherwise, the report is limited to the fire hazards and fuel loads internally and externally of the building. The report does not provide specific guidance in respect of areas, which are used for the storage of dangerous goods and hazardous substances, processing of flammable liquids, explosive materials, multiple fire ignitions or sabotage of fire safety systems. Where dangerous goods and hazardous substances are present in quantities that warrant referral under SEPP 33 specialist advice should be sought to inform the development of fire safety systems appropriate to the commodity being stored. That advice then informs the development of the necessary Fire Engineering process inputs.
- The development complies with the DtS provisions of the BCA [1] with all aspects unless otherwise specifically stated in this report. Where not specifically mentioned, the design is expected to meet the BCA DtS requirements of all relevant codes and legislation at the time of construction and / or at the time of issue of this report.
- The assessment is limited to the objectives of the BCA and does not consider property damage such as building and contents damage caused by fire, potential increased insurance liability and loss of business continuity.
- Malicious acts or arson with respect to fire ignition and safety systems are limited in nature and are outside the objectives of the BCA. Such acts can potentially overwhelm fire safety systems and therefore further strategies such as security, housekeeping and management procedures may better mitigate such risks.
- This report is prepared in good faith and with due care for information purposes only, and should not be relied upon as providing any warranty or guarantee that ignition or a fire will not occur.
- The Fire Engineering Strategy is only applicable to the completed building. This report is not suitable, unless approved otherwise, to the building in a staged handover.
- Where parties nominated in Table 2-1 have not been consulted or legislatively are not required to be, this report does not take into account, nor warrant, that fire safety requirements specific to their needs have been complied with.

3 PRINCIPAL BUILDING CHARACTERISTICS

3.1 OVERVIEW



Building characteristics are assessed as part of the Fire Engineering Review due the following:

1. The location can affect the time for fire brigade intervention and potential external fire exposure issues.
2. The structure will impact on the ability to resist a developing fire and support condition to allow occupants to escape the building and the fire brigade to undertake fire fighting to the degree necessary.
3. The floor area determines the potential fire size and area required to be evacuated in the event of a fire.
4. BCA details such as Type of Construction, classification and height will dictate passive and active fire safety systems.

3.2 SITE DESCRIPTION

The site is situated at No. 30-50 Yarrawa Street Prestons which is approximately 35km west south west of Sydney's central business district in the Liverpool local government catchment. The site is bound by Yarrawa Street to the north, and privately held property to the east, south and west. Those properties separate the site from Yarrunga Street to the south and the M7 Motorway to the east. The two nearest fire brigade stations that are provided with permanent staff are located in Busby and Horningsea Park approximately 5.9km and 4.9km from the site respectively. The legal title of the land is Lots 101 & 102 DP 1117691 and Lot 2 DP 28729.

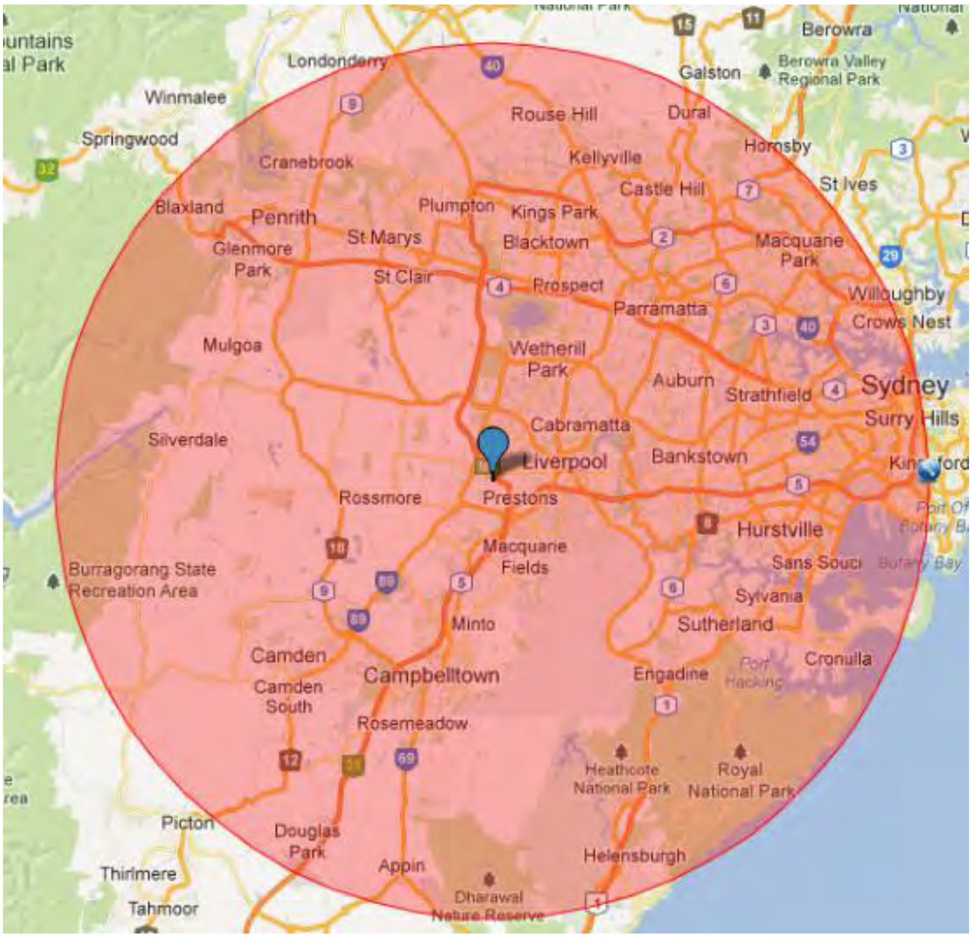


Figure 3-1: Local context, the 'pin' marks the location of the site, 35km radius shown

The land is rectangular in shape and is bisected by a transmission line easement on the eastern portion of the allotment. An aerial view of the site is provided in the figure below.

Figure 3-2: Aerial view of the site and existing facility

The works comprise of the expansion to the existing large isolated building for warehouse storage and distribution. The development incorporates the expansion of the cross dock and warehouse space to the east of the site.

Figure 3-3: Aerial view of the site and existing facility

The scope of works for which consent is sought comprises the following key elements:

- Site works to establish building footprints;
- Construction of expanded warehouse building (12,365m^2), with provision of an ancillary dock office space in the warehouse (200m^2), on-site parking (70 spaces) and extended loading cross docks(1,710m^2);
- Drainage and ancillary services structures (e.g. rainwater tanks, padmounted substation, security fencing);
- Extensive site landscaping;
- Fit-out of each of the warehouse elements; and
- Erection of signage.

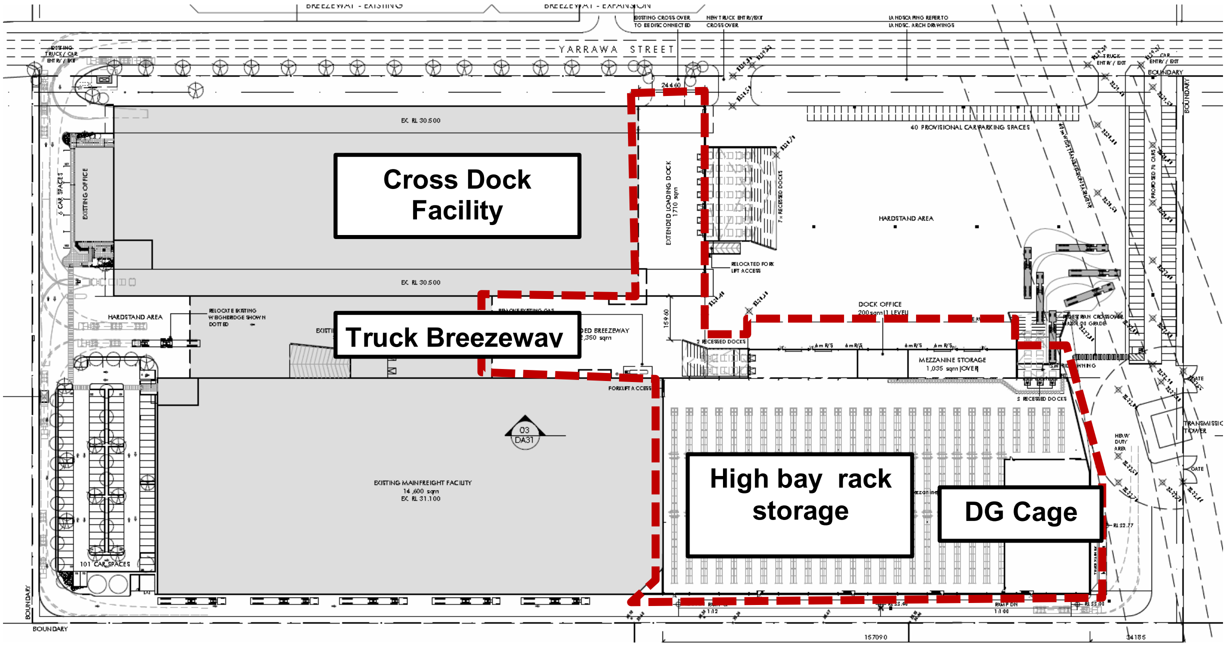


Figure 3-4: Site plan of expansion

3.3 SITE AND BUILDING ASSESSMENT

Table 3-1: Site and Building Assessment

CHARACTERISTIC	DESCRIPTION
Location	The site is located within the industrial area of Prestons. The two nearest fire brigade stations are located within 6km of the site. The building site influences the likely fire brigade intervention times, and given the close proximity to the nearest fire station is expected to facilitate a relatively convenient and expedient fire brigade response. Furthermore being located within a major city outer suburb the development is provided with the services and facilities expected in an urban setting.
Layout	The development shall be considered as a single large isolated building, and shall be used for the storage and handling of goods and chattels prior to final dispatch. The warehouse parts shall have high-bay racking running north to south permitting a clear line of sight along the racking aisles that will assist in occupant evacuation in a fire emergency. Conversely occupant's line of sight will be highly obstructed in the east west direction when located in the racking aisles, thus creating a barrier in determining the safest path of egress in a fire emergency. A ~1,500m^2 dangerous goods caged store will be located in the south east

<table>
<tr><th>CHARACTERISTIC</th><th colspan="2">DESCRIPTION</th></tr>
<tr><td></td><td colspan="2">corner of the new warehouse and shall be stored in accordance with the requirements of the Workplace Health and Safety legislation for storage of those materials.

The cross docks consists of a central block storage (up to 3 pallets high) with recessed truck paths on the north and south of the facility running the full length of the building from west to east. Egress will involve occupants passing across the truck path and in some parts egressing beneath the awning connecting the cross dock and warehouse.

Exit doors are situated around the building's perimeter providing occupants with multiple egress opportunities in the event of an evacuation.</td></tr>
<tr><td>Structure</td><td colspan="2">Materials and finishes are likely to include precast concrete, masonry and steel construction, and glazing throughout. The design of the development is such that it incorporates a combination of contrasting materials and elements so to provide visual interest to the street scape.

Materials and finishes shall be in accordance with the DTS requirements for Type C construction.

Materials used in construction will conform with the testing methodology outlined in the DTS provisions so as to avoid the spread of smoke and fire and minimise the risk to occupants and fire fighters.</td></tr>
<tr><td>Total Floor area & volume</td><td colspan="2">The following approximate area and volume breakdown is provided for information.

Element
Existing Building 29,382 m²

New Warehouse floor area 13,250 m²
New Dock Office floor area 200 m²
New mezzanine storage area 1,035 m²
New Cross Dock floor area 1,710 m²
Breezeway expansion 2,350 m²
<u>Total New Area</u> 18,545 m²</td></tr>
<tr><td>BCA Assessment</td><td>Classification</td><td>Class 5 – Offices

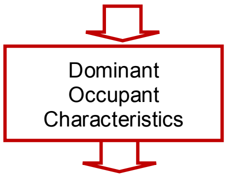
Class 7b – Storage</td></tr>
<tr><td></td><td>Construction Type</td><td>Type B Construction</td></tr>
<tr><td></td><td>Rise in Storeys</td><td>The building has a rise in storeys of three (3)[1]

NB: Increasing the number of floors in a building increases the building population, placing more occupants at risk in the event of a fire, and allowing for overcrowding in stairways and other pinch points in the path of egress to a final exit.</td></tr>
<tr><td></td><td>Effective Height</td><td>The building has an effective height of less than 12-metres.</td></tr>
</table>

[1] The rise is storeys is determined by the Clause C1.2(c) of the BCA, whereby if the average internal height of a storey is more than 6-metres it is counted 2 storeys as it is not the only storey above ground level. This applied directly to the mezzanine storage area. Further information should be obtained from the relevant building surveyor in regard to this application.

4 DOMINANT OCCUPANT CHARACTERISTICS

4.1 OVERVIEW



The occupant characteristics are assessed within the Fire Engineering Strategy due to the following:

1. Population numbers can dictate the time required to evacuate the building and the required life safety systems to be provided due to evacuation times.
2. Physical and mental attributes affects the occupants capacity to respond to various fire cues and react accordingly.
3. Familiarity of occupants can affect the time taken to evacuate the building and subsequent active / passive requirements.

4.2 OCCUPANT CHARACTERISTIC ASSESSMENT

Table 4-1: Occupant Characteristics

CHARACTERISTIC	DESCRIPTION
Population numbers	The number of occupants expected within the subject building is considered to be generally less than that assumed in the BCA Table D1.13 [1] due to the type of works being undertaken. However the BCA values shall be used on a preliminary basis to provide an estimated value in the absence of accurate numbers being provided by the building tenant. The BCA assumes the following occupant densities per an areas use: ■ 1 person per 30 square metres in the plant areas and warehouse. ■ 1 person per 10 square metres in the office areas. The client has advised that staff numbers are currently capped at 37 people (22/15 male female split) across a single shift. Hours of operation are from 5:00am to 7:00pm.
Population location	The population is expected to be distributed throughout the building. The office is considered to 'on average' be more densely populated than the warehouse, however the building's function and use may dictate an overall lower occupant number in the office areas.
Physical and mental attributes	Occupants in the proposed buildings may be of mixed age, although the elderly and children are generally not expected to be present. The population is therefore expected to be that of the general working public and be adults between the ages of 16 to 70. Due to the nature of the work conducted the majority of occupants are assumed to be able bodied people with a small number of less mobile occupants requiring assistance during an evacuation. All occupants are expected to be awake and alert adults or in the direct company of an adult, capable of entering the leaving the building under their own volition. Occupants in all of these areas are not expected to be adversely impaired by drugs, alcohol, fatigue or other adverse conditions to degrees greater than in other warehouse and office buildings. ■ ***Staff and Security*** – are expected to be mobile with normal hearing and visual abilities, and occupants in this group are considered to take and implement decisions independently, and require minimal assistance during evacuation in a fire emergency. This occupant group is expected to be awake and fully conscious at all times when inside the building; and ■ ***Clients / Visitors*** – are expected to be mobile with normal hearing and visual abilities, this occupant group are expected to be capable of making

CHARACTERISTIC	DESCRIPTION
	and implementing decisions independently however may require assistance in locating the nearest and safest egress path in an emergency; and ■ ***External Maintenance Contractors*** – are expected to be mobile with normal hearing and visual abilities and occupants in this group are considered to take and implement decisions independently and require minimal assistance during evacuation in a fire emergency. The contractors are expected to be awake and aware of their surroundings at all times when inside the building; and ***Fire & Rescue NSW*** – are expected to be equipped with safety equipment and will be educated in fire fighting activities and the dangers associated with fire incidents. This occupant group would be expected to be in a position to assist other occupants requiring assistance to evacuate. It is not expected that this occupant group would be present in the building at the time of fire ignition; however, they are expected to enter the building at a later stage to assist with the evacuation of occupants, if required, and to undertake fire suppression activities.
Familiarity with the building	■ ***Warehouse Staff and Security*** – can be expected to have a good familiarity with the building and the fire safety systems provided and may be trained in emergency procedures; and ■ ***Office Staff*** – can be expected to have a good familiarity with the administration areas and the means of exits from these parts. General familiarity of the building as a whole and the location of main exits; and ■ ***Clients / visitors*** – may or may not be familiar with the layout of the building and may require assistance in locating the exits; and ■ ***External Maintenance Contractors*** – this occupant group is expected to have a reasonable familiarity with the building as they would have to undergo site specific induction prior to commencement of work on site; and ■ ***Fire & Rescue NSW*** – are not expected to have any familiarity of the building layout, however are assumed to obtain the required information from the site block plans and tactical fire plans available prior to entering the building. Notwithstanding this they will be equipped with breathing apparatus and specialist equipment to prevent them from being adversely affected by fire hazards.
Emergency training	Occupants should be familiar with escape procedures through fire drills and designated fire wardens being appointed to mitigate risks under Workplace Health and Safety legislation (AS 3745:2010). Clear escape routes should be maintained with doors unlocked, and no obstructions or rubbish to hinder evacuation. Staff and visitors are not expected to have fire suppression training and such training is not relied upon for this building population; however staff are expected to possibly attempt to extinguish a fire or limit fire spread by removing objects in the vicinity of the fire in order to defend their belongings.
Pre-movement time	Pre-movement times are anticipated to be within the vicinity of that exhibited in buildings of similar use and occupancy. Pre-movement time defines the period after occupants within the building have received the visual, aural or olfactory cues of a fire, and incorporates the initial delay or lag time and immediate behavioural response on receipt of these cues. Within the subject building it is expected that there will be a considerable variance in the response from occupants, and response from occupants in different function areas. In other words occupants remote from the fire are expected to react slower to remote fires than staff or occupants in close proximity to the fire. In the case of occupants who are in the vicinity of the fire, the decision to evacuate is likely to be a function of the perceived threat associated with the

CHARACTERISTIC	DESCRIPTION
	fire and its intrinsic cues. If the fire is not perceived as threatening, then the occupants may decide not to evacuate. However, if the opposite is true, evacuation will begin almost at once. It is assumed that most of the occupants will associate flaming fires and black smoke with a threatening situation. Thus, in undertaking calculations of evacuation, this can be assumed to commence once a threat is perceived. In the situation where the occupants are intimate with the development of the fire (area of fire origin), it is reasonable to suggest that occupant avoidance will be immediate, as they will be presented with multiple fire cues and would include: ■ Visual - smoke and flames ■ Tactile - heat radiated and convected from fire ■ Audible - sound generated by burning materials ■ Olfactory - smell of smoke and other combustion products Where required for assessment pre-movement times will be drawn from CIBSE [5] which suggests 1-minute in the office areas and 3-minutes at worst in the warehouse.
Travel speed	Occupants should be able to reach a safe exit route quickly. This is ensured by relating the volume of a space to the prescriptive number of exits and maximum length of escape routes to a place of safety. Travel speeds will be determined by the physical and mental characteristics of the occupants, and their familiarity with the building. The SFPE Handbook [66] indicates that individuals will move under their own volition at a speed of between 0.8-1.2m/s if the population density is less than 0.54 persons/m^2. Given the function of the warehouse and office this range is considered applicable and reasonable for egress approximations. Assuming the median travel speed, the additional travel distance can be quantified by allowing an additional 1 second travel time for every additional 1-metre of travel distance.

5 FIRE BRIGADE INTERVENTION

5.1 OVERVIEW

Fire Brigade Intervention

The fire brigade characteristics are assessed within the Fire Safety Strategy due to the following:

1. Fire Brigade characteristics can dictate the time required for fire brigade intervention including search and rescue and fire attack.

5.2 FIRE BRIGADE INTERVENTION

In order to assess the likely fire brigade response times and probable requirements additional to those normally presented within a DtS design an indicative assessment of fire brigade intervention has been undertaken based on the methods defined in the Fire Brigade Intervention Model (FBIM. Figure 5-1 illustrates the building layout with the entry points to the buildings.

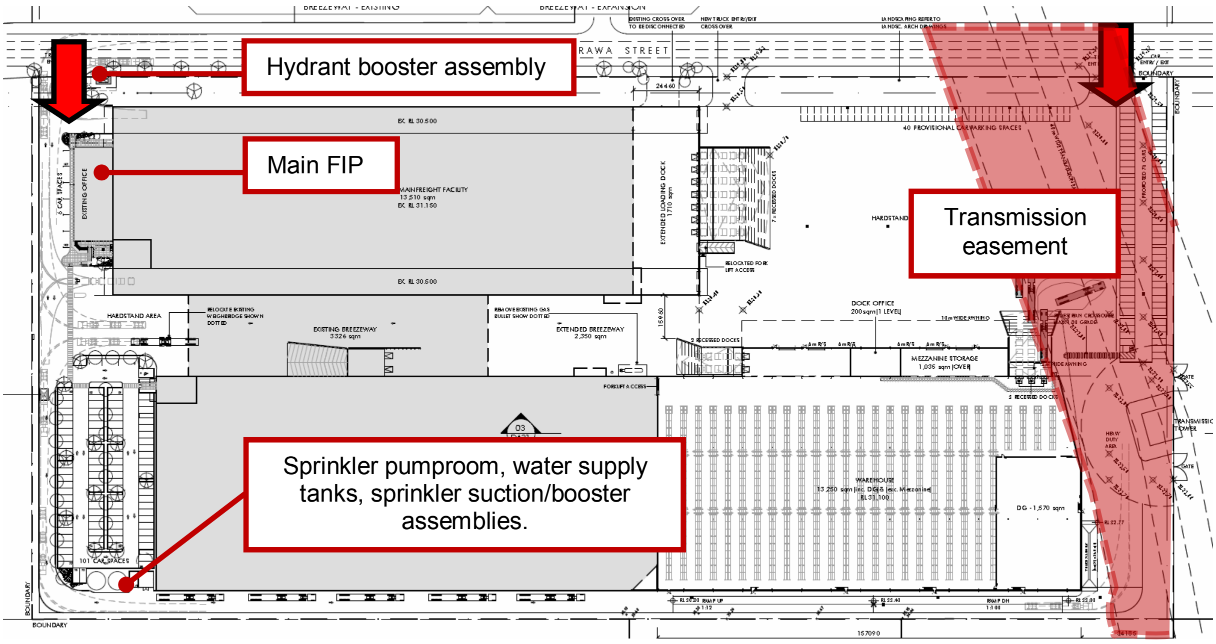


Figure 5-1: Fire brigade access and site facilities

The building is located within the Fire and Rescue New South Wales (FRNSW) jurisdictional turnout area. The closest two fire stations to the site are listed in Table 5-1 and the expected routes from these stations to the project site are illustrated in Figure 5-2.

Table 5-1: Station Locations

Station Name	Station Address	Distance from site
Busby Fire Station	Lot 2 Cartwright Avenue, Busby NSW 2168	5.9km
Horningsea Park Fire Station	162 Greenway Drive, Horningsea Park NSW 2171	4.9km

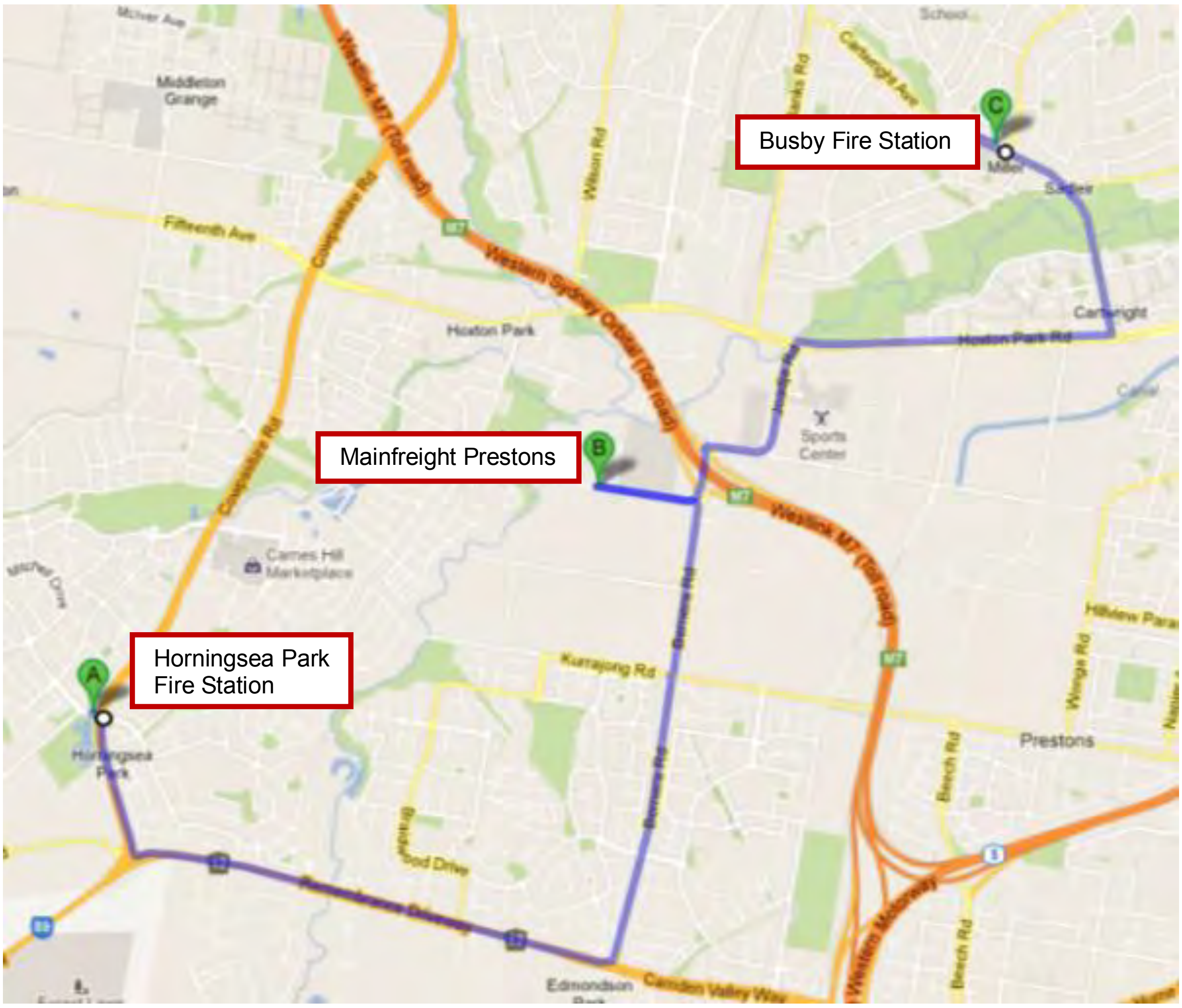


Figure 5-2: Site location with respect to the closest two FRNSW stations (Source: googlemaps.com.au)

Due to the nature of the Fire Brigade Intervention Model (FBIM), it is necessary to justify the results through the inclusion of assumptions. The accuracy of results weighs heavily upon the measure of which assumptions are made and the sources from which they are derived. The model produced details the time it will take for brigade personnel within the aforementioned location to receive notification of a fire, time to respond and dispatch resources, time for resources to reach the fire scene, time for the initial determination of the fire location, time to assess the fire, time for fire fighter travel to location of fire, and time for water setup such that suppression of the fire can commence. The following are details of the assumptions utilised in this FBIM:

Location of Fire

- This FBIM will only be an indicative model of one fire scenario within the building. For conservative purposes, the FBIM will consider a fire in the furthest possible location from the point of entry.

Time between Ignition and Detection

- It is assumed that the initial brigade notification is via the sprinklers. The alarm time calculated has considered a fire with an Ultra-Fast t-squared growth rate, which is expected to be indicative of the rate of growth expected in an area of such use.
- Based on calculations utilising Alpert's Correlation (refer to Figure 5-3), the alarm time has been calculated to occur 208 seconds following fire ignition.

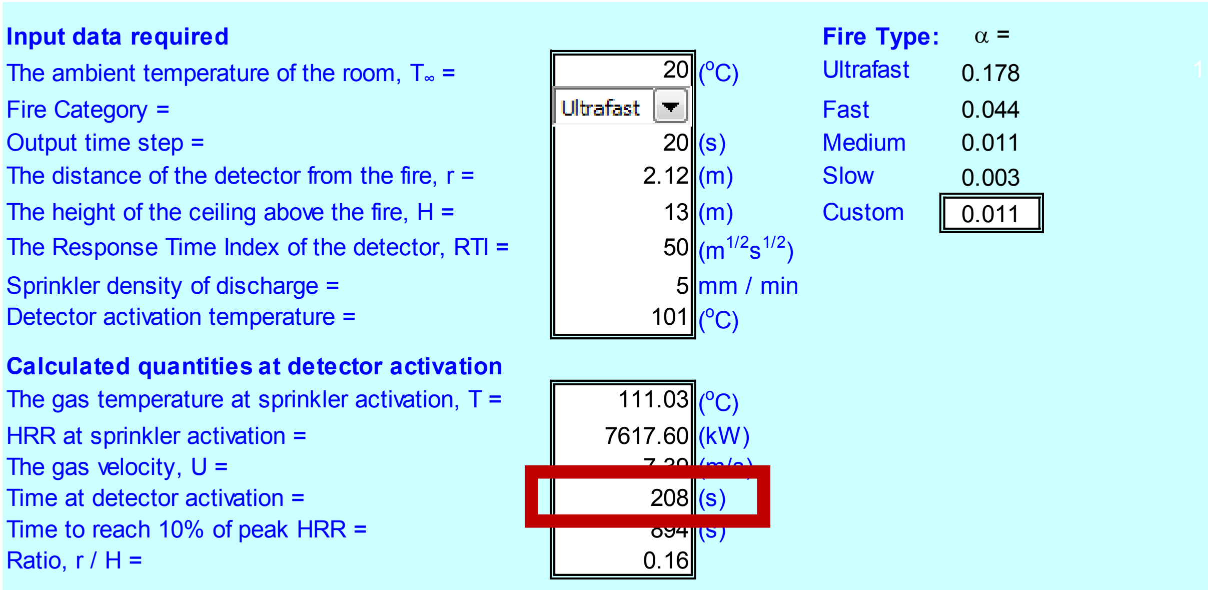


Figure 5-3: Sprinkler Activation Time ***(Ultra-Fast t-squared fire & 101°C storage mode sprinklers)***

<u>Time for Initial Brigade Notification</u>

- Fire brigade notification is expected to occur via a direct monitored alarm.
- Time for alarms/fire verification and any notification delays is 30 seconds based on Table B of the Fire Brigade Intervention Model [4] and onsite experience of similar facilities.
- Therefore the time from ignition at which the fire brigade will be notified is (208+30) = 238 seconds

<u>Time to Dispatch Resources</u>

- The two fire stations are assumed to be manned at the time of the fire.

Time for fire fighters to respond to dispatch call and leave fire station is included in the travel time for fire brigade in NSW [7].

<u>Time for Resources to Reach Fire Scene</u>

- Table 5-2 provides data for the calculation of speed in km/hr by taking into account the mean speed (μ) and standard deviation (σ) specific to the Fire and Rescue New South Wales (FRNSW) and is obtained from the Fire Brigade Intervention Model (FBIM) Manual. The values in the table are obtained from the relevant graphs provided within the FBIM Manual.

Table 5-2: FBIM data for the FRNSW (Fire fighters response times included)

Graph	Region Classification	Speed (km/h)	
		μ Mean	σ Standard Deviation
F2.1	Major city central business district	26.8	11.3
F2.2	Major city inner suburb	26.3	11.9
F2.3	**Major city outer suburb**	**29.5**	**12.2**
F2.4	Rural town centre	21.6	11
F2.5	Rural country	40.5	15.6

- Since the mean speed would result in this particular travel speed occurring 50% of the time, there is an equal likelihood that the travel speed would take longer. Hence, it is desirable to introduce a margin of safety of using a greater percentile of 90%. In order for the speed to be within the 90% percentile value, a safety factor of 1.28 is applied to the standard deviation as noted in Table 4.3 of Fire Brigade Intervention Model.

- As such, an appliance travel speed of 29.5-(1.28x12.2) = 13.88 km/hr has been used for the calculations. The travel time from the fire stations is therefore 1530 seconds and1270 seconds respectively.

Time for Initial Determination of Fire Location

- On arrival, the fire location is not visible to the approaching brigade personnel, thus requiring information to be obtained from the Fire Indicator Panel (FIP) and evacuating occupants.
- Fire brigade personnel assemble at the FIP in the office area.
- Fire brigade tactical fire plans will be provided.
- It is assumed that a fire would occur during business hours and that staff are present on site providing assistance to fire brigade personnel in relation to identifying the fire location and entry into the building. As such, forced entry into the building is not required.

Time to Assess the Fire

- Horizontal egress speeds have been based on fire brigade personnel dressed in turnout uniform in BA. An average travel speed of 1.4m/s with a standard deviation of 0.6m/s are utilised. As such, for the purposes of the calculations, a horizontal travel speed of 1.40-(1.28x0.6) = 0.63m/s is utilised.

Table 5-3: FBIM data for Horizontal Travel Speeds

Graph	Travel Conditions	Speed (km/h)	
		μ Mean	σ Standard Deviation
Q1	Dressed in turnout uniform	2.3	1.4
Q2	Dressed in turnout uniform with equipment	1.9	1.3
Q3	**Dressed in turnout uniform in BA with or without equipment**	**1.4**	**0.6**
Q4	Dressed in full hazardous incident suit in BA	0.8	0.5

- Horizontal travel distances (not including travel via lifts or stairs) will include the following:
  - Travel from kerb side adjacent to the office into the building and to the Fire Indicator Panel is 20m.
  - Travel from FIP to the farthest point is 520m.
  - Based on the above, the total horizontal travel distance of 540m coupled with an egress speed of 0.63m/s results in a horizontal travel time of up to 858 seconds.

Time for Water Setup

- The first appliance would be expected to commence the initial attack on the fire.
- Time taken to connect and charge hoses from on-site hydrants to the fire area is based on V3 Table V of the Fire Brigade Intervention Model Guidelines, which indicates an average time of 45.3 seconds, and a standard deviation of 17.1 seconds. Using a 90th percentile approach as documented in the FBIM [**7**], the standard deviation is multiplied by a constant *k*, in this case being equal to 1.28. Therefore, the time utilised in this FBIM is 45.3 + (1.28 x 17.1) = 68 seconds.

Search and Rescue

- Search and Rescue of the warehouse will consist of a perimeter search of large areas and a walk in and out of rooms, i.e. circumnavigate the warehouse. This will provide fire fighting personnel with an additional 520m of travel. At a speed of 0.63m/s, this will take fire fighting personnel approximately 826 seconds.

Table 5-4 Summary of the Fire Brigade Intervention Model (FBIM)

Fire Station	Time of Alarm	Travel Time to Scene	Time to access and assess the fire	Assumed Set-up Time	Time of Attack	Time for search and rescue
Busby Fire Station	238s	1530s	858s	68s	2,694s (45 min)	826s
Horningsea Park Fire Station		1270s			2,434s (41 min)	

As summarised in Table 5-4, the FBIM indicates that the arrival times of the brigade from the nearest fire stations are approximately 30 and 25 minutes respectively after fire ignition, and it is estimated that it takes another 15 minutes for the fire brigade to carry out activities including the determination of fire location and preparation of fire fighting equipment. As such, the initial attack on the fire is expected to commence between approximately 41 and 45 minutes after fire ignition, with an additional 14 minutes required in undertaking initial perimeter search and rescue of the building.

6 FIRE HAZARDS AND PROTECTIVE MEASURES

6.3 OVERVIEW

Fire Hazards and Protective Measures

The fire hazard analysis forms the basis for the review of non-compliances within the building. In assessing expected and statistically validated hazards, preventative and protective measures are developed commensurate with those expected risks. The following section reviews applicable hazards and recommends possible measures to address those risks. Furthermore, hazards identified can form a justified basis for selected scenarios.

6.4 FIRE STATISTICS

In order to assess the most likely fire hazards within the building, and subsequently the risk presented by these hazards it is necessary to develop an understanding of the factors that have an influence on the fire safety of building occupants. The best method in doing so is to review existing statistical data.

Existing data is an invaluable tool in providing an overview of the situations in which occupant deaths have, and are likely to occur, and factors that contribute to more severe fires. This aids in understanding, and helps evaluate the effectiveness of, and the need for various fire safety systems. Reference is made to the American database as it is significantly larger than Australian data sets, but is generally considered to be representative of the Australian situation.

Table 6-1: Fire Statistics in all building types

STRUCTURE TYPE	FIRES PER YEAR	CIVILIAN FATALITIES PER YEAR	CIVILIAN FATALITIES PER 1000 FIRES
Offices	**5,800**	**1**	**0.17**
Storage facilities	**22,900**	**15**	**0.66**
Retail shopping complexes*	NA	NA	0.74
Public assembly, excluding eating/drinking	6,000	5	0.83
Facilities that care for the sick	2,600	5	1.92
Hotels & Motels	4,900	28	5.7
Apartments	96,200	632	6.57
Homes	406,400	3,498	8.61

*From the FCRC 'Fire Safety in Shopping Centres' Project 6 all other data from the NFPA 'U.S. Fire Problem Overview Report'.

Based on the National Fire Protection Association, the statistics are based upon recorded fire events occurring between:

- 2003 – 2007 Structure fires in Warehouses (excluding cold storage)

Note that the statistics below have been compiled from U.S. fires reported to U.S. municipal fire departments between 2003 and 2007, and do not include fires where private or government fire brigades responded or fires that were not reported. Further, it should be noted that cold storage, residential storage and self-storage are excluded. Despite the fact that cold storage is not reported within the statistics it is considered that they still provide a reasonable basis for the general understanding of the risk presented by a high storage warehouse, cold storage or otherwise.

It is a common misconception that fires do not occur in cold store. However, factors such as an ultra dry atmosphere and the highly combustible nature of polyurethane or polystyrene foam insulation, wooden pallets and plastic wrapping present a high fire risk in these environments. Electrical faults from conveyor/transport equipment, lighting, or hot spots caused by maintenance operation can also contribute to this risk. Additionally the holding capacity of a cold store demands specialized high volume storage racking which can affect the airflow and impede the detection and response to a fire event.

These statistics represent a much greater number of events than Australian statistics and therefore have a greater statistical reliability. Building construction types and fire hazards are estimated to be sufficiently similar between Australia and the U.S. for the following results to be applicable.

Warehouse (excluding cold storage) Fire Statistics

A total of 1,350 structure fires occurred in warehouses. The fires recorded resulted in 5 occupant fatalities, and 21 occupant injuries and $124 million in direct property damage per year. The leading cause of fires in Warehouses (excluding cold storage) is from electrical distribution or lighting resulting in 17% civilian injuries. The leading area of fire origin in warehouses comes from an unclassified storage area resulting in 21% civilian injuries.

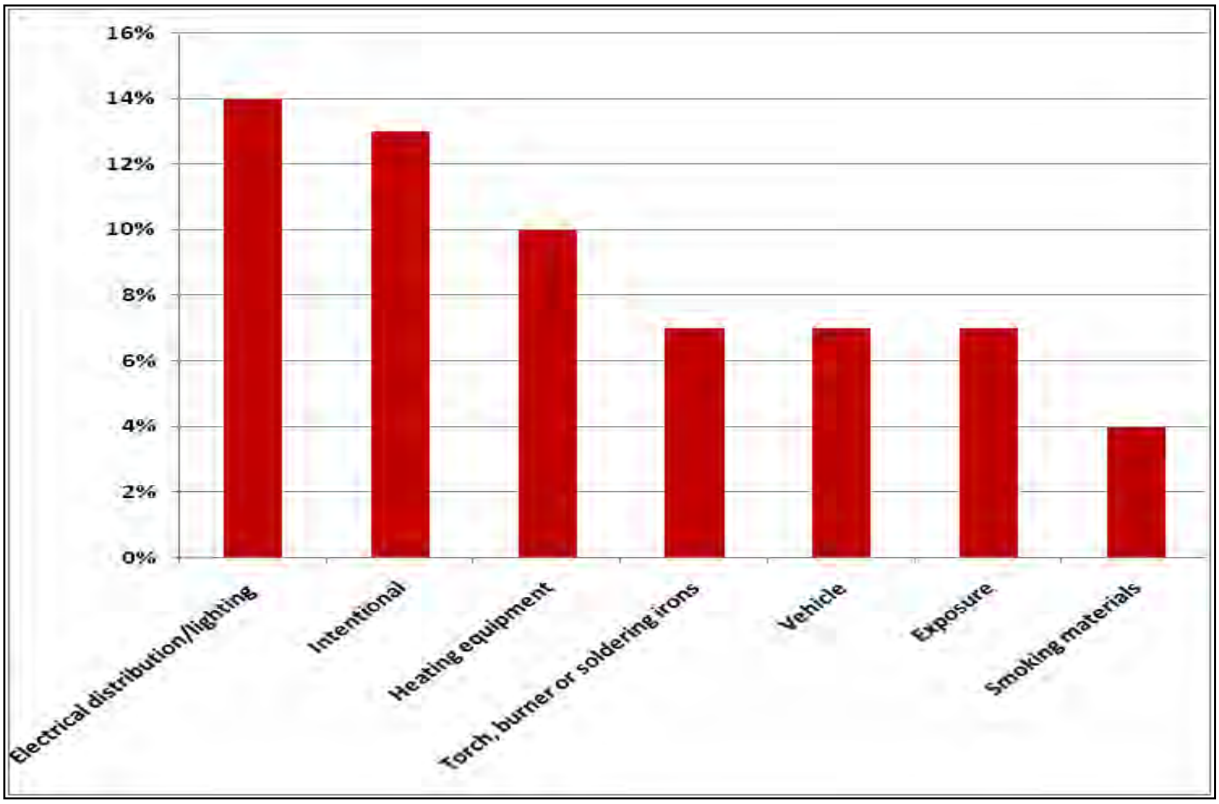


Figure 6-1: Leading causes of fires in warehouse (excluding cold storage) structures

The potential fire hazards (inclusive of the leading causes, as well as area of origin of a fire) identified throughout the development are illustrated in the graphs below. The statistics as illustrated in the figures below have been obtained from the National Fire Protection Association (NFPA) website (www.nfpa.com).

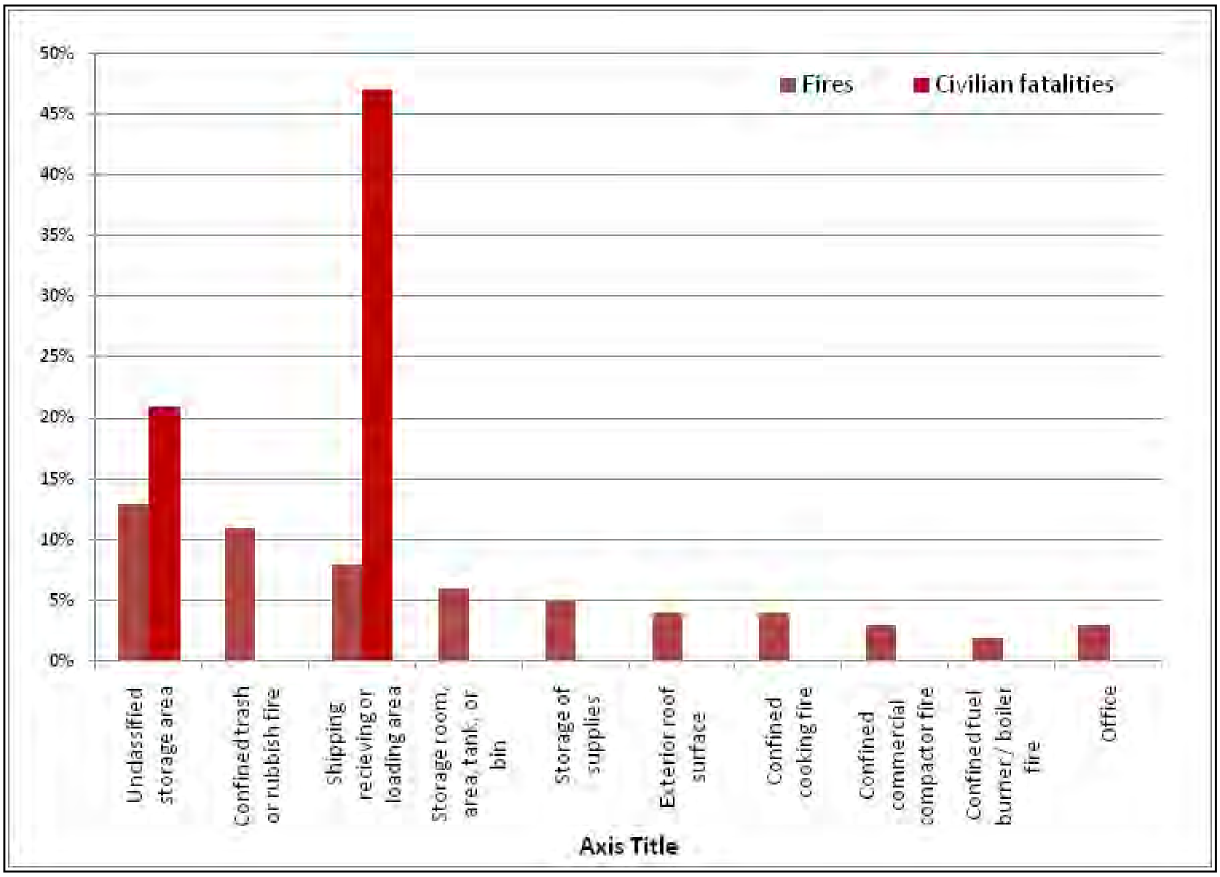


Figure 6-2 Structure fires in warehouse (excluding cold storage) structures by area of origin

Office Facilities

Fire statistics for offices in Australia as reported in Technical Report 96-02 [16] show that the most common cause of fires in these types of buildings are attributed to faults in electrical equipment, with lighting fixtures being the equipment most often cited. Ahrens (2001) [18] reports that fire statistics from the U.S confirm the same key ignition sources. It should be noted that with so few fire fatalities in office fires, the data for fatalities should be considered holistically, representing a low likelihood of fatalities overall in offices. The identification of the comparative risk of fatality within different areas or by different ignition sources is lacking in accuracy by virtue of a limited data set of 1 fatality per year.

Table 6-2: Office fire statistics by cause of ignition

CAUSE OF FIRE	FIRES	CIVILIAN FATALITIES
Electrical Distribution	21.1%	51.6%
Other Equipment; motors, generator, elevators, office equipment etc.	17.0%	21.4%
Incendiary or suspicious	15.7%	26.9%
Smoking Materials	8.6%	0.0%
Heating equipment	8.1%	0.0%
Appliance, tool or air conditioning	7.5%	0.0%
Open flame or torch	7.3%	0.0%
Cooking equipment	5.7%	0.0%
Other, less than 6% of fires per area	9.0%	0.0%
Total:	**100%** **5,800 fires per year**	**100.0%** **1 fatality per year**

Ahrens also indicates that 17.7% of all recorded office fires occur within the specific office area. This figure is likely to be highest by virtue of the proportion of the buildings which the general office space occupies and as such may not actually represent the high ignition risk of the office space but the risk of fire resulting from the application of a minor risk over the majority of the floor space. The next four most frequent areas of ignition are grouped around 5% each and include kitchens, exterior walls, concealed spaces and heating equipment rooms. Any correlation between the area of ignition and the likelihood of fatalities is likely to be misrepresentative due to the low number of fatalities relied upon to draw such conclusions.

Table 6-3: Office fire statistics by area of fire origin

AREA OF FIRE ORIGIN	FIRES	CIVILIAN FATALITIES
Office	17.7%	40.7%
Kitchen	6.0%	0.0%
Exterior wall surface	5.6%	0.0%
Attic or ceiling/roof assembly or concealed space	5.2%	0.0%
Heating equipment room	5.1%	0.0%
Hallway, Corridor or Mall	3.5%	21.2%
Crawl space or substructure space	1.6%	21.2%
Other, less than 5% of fires per area	55.3%	16.9%
Total:	**100% 5,800 fires per year**	**100.0% 1 fatality per year**

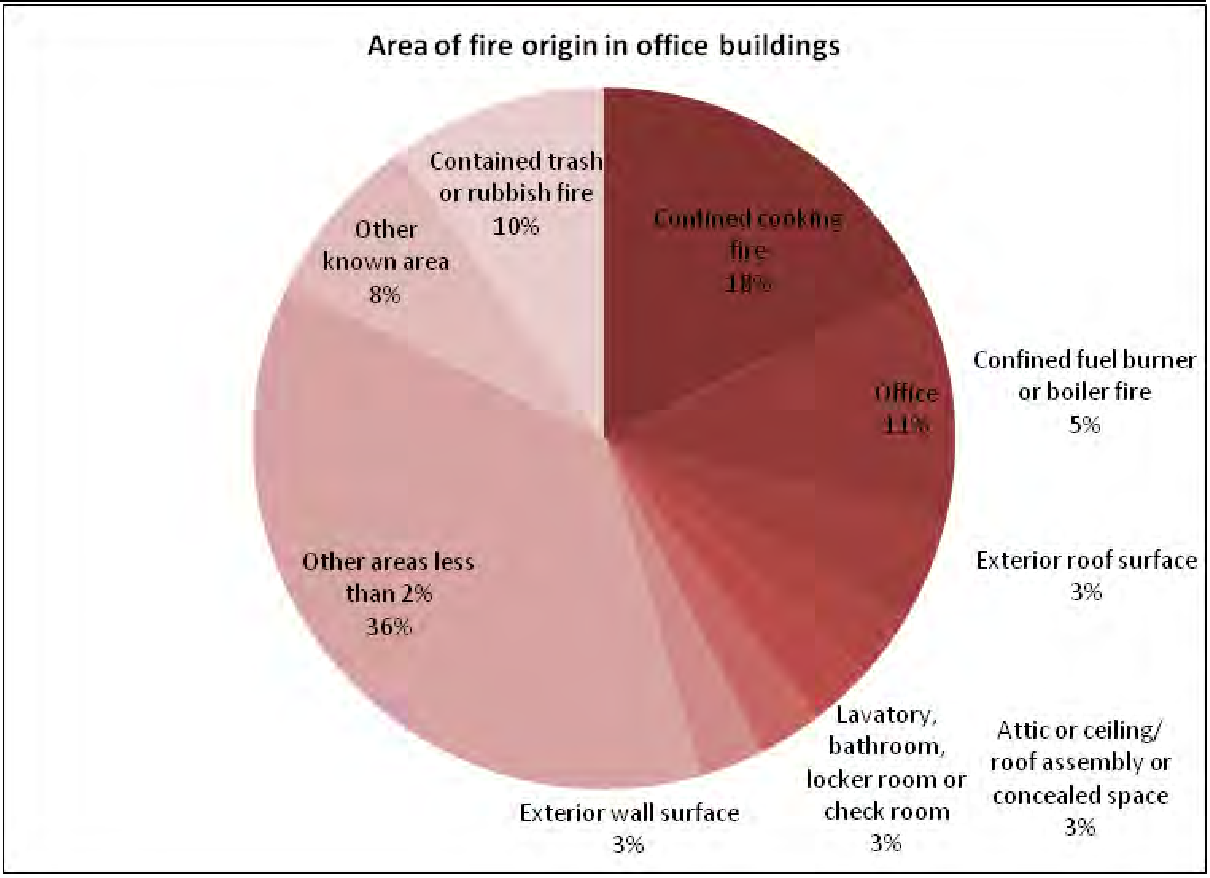


Figure 6-3: Area of fire origin in office buildings

Statistics shown in Figure 6-3 are published in the document 'U.S Structure fires in office properties' by Flynn (2007) [17], and is the most recent available statistics from the National Fire Protection Association in the U.S.A, relating to office buildings. A total of 5,800 fires were considered in the statistical data and had recorded one civilian fatality in these fires. It can be seen from the above figure that office, cooking and rubbish areas are the most common areas for fire origins within office buildings, which is consistent with the findings of Ahrens.

6.5 SPRINKLER EFFECTIVENESS & RELIABILITY

The effectiveness of automatic fire sprinklers in general in limiting fire spread and growth is supported by statistics and studies undertaken into the effects of automatic fire sprinklers within buildings. These studies show that fire sprinkler systems operate and control fires in 81% to 99.5% of fire occurrences [3]. The lower reliability estimates of 81.3% [10] as well as some of the higher values of 87.6% [12] appear to reflect significant bias in data in terms of the small number of fire incidents and the lack of differentiation between fire sprinklers and other fire suppression systems. A number of the lower figures are results of dated studies.

It must be noted that the higher reliability of fire sprinklers reported by Marryatt [14] of 99.5% reflect fire sprinkler systems where inspections, testing and maintenance exceeded normal expectations and applies to installations specifically in Australia and New Zealand. The statistical data indicate that sprinklers with appropriate maintenance are highly effective in reducing the loss of life and limiting fire spread and in particular the storage (ESFR) system has an exemplary record.

With reference to FM Global data sheet (2-2) as of 2002 [7] there had been six known fires involving suppression mode sprinkler protection. In all of these incidents, the sprinkler system was successful in suppressing the fire and no more than four sprinkler heads operated.

FM Global Data Sheet 2-0 states that, FM Global loss history over the past twenty years indicates that approximately 25% of the time, the operation of a single sprinkler will control or suppress a fire if the sprinkler system has been properly designed and installed. This percentage increases to approximately 50% of the time with the operation of 3 or fewer sprinklers, and 75% of the time with the operation of nine or fewer sprinklers.

In addition analysis of the likelihood of sprinkler failure shows that most sprinkler system failures are due to impaired water supplies such as closed valves, blocked pipes, impaired sources, etc., which tend to affect sections of or the entire system [12]. As such, system reliability can be increased by active monitoring of water supplies and controls. The general consensus within the fire protection industry is that problems with individual sprinkler heads are rare. This information combined with sprinkler reliability data is favourable when compared with the reliability of fire compartmentation [3].

Moinuddin and Thomas [12] have found that masonry fire rated construction had a reliability of 81-95%, and gypsum 69-95%, with the upper level in both instances having been reported within the IFEG [3]. Both reported ranges are considered to be less than that offered by automatic sprinkler systems. Table 6-4 lists the effectiveness of sprinkler systems in the event of a fire growing to a size that facilitates sprinkler head activation [12].

Table 6-4: Effectiveness of Sprinkler systems

PROPERTY TYPE	EFFECTIVENESS OF SPRINKLERS IN EVENTS WHERE SPRINKLERS OPERATE
Public Assembly	90%
Educational	93%
Health care / Correctional Centre	95%
Residential (average)	97%
Office / Retail	91%
Manufacturing	93%
Storage	86%
Cold Storage	89%
All properties	7%

Statistics for general sprinkler effectiveness in storage properties is provided in the table below which is drawn from the research of Rohr [**15**]. The data indicates over 77% of storage fires and 84% of manufacturing facility fires are confined to the area of fire origin where sprinklers are fitted.

Table 6-5: The Effectiveness of Sprinkler in Storage Facilities

EXTENT OF FLAME DAMAGE	FIRES WITH SPRINKLER PROTECTION	FIRES WITHOUT SPRINKLER PROTECTION
Confined to object of origin	50.0%	19.9%
Confined to area of origin	27.8%	14.1%
Confined to room of origin	6.7%	4.9%
Confined to fire-rated compartment of origin	1.1%	0.6%
Confined to floor of origin	2.4%	1.1%
Confined to structure of origin	10.0%	45.0%
Extended beyond structure of fire origin	2.2%	14.3%
Total:	900 fires	29,330 fires

According to the tests undertaken by FM Global Property Loss Prevention Data Sheets [7], automatic smoke exhaust systems would operate prior to an installed sprinkler system. This would result in the removal of hot smoke from the ceiling causing a critical delay in sprinkler operation. As such, FM Global recommends that a sprinkler system should not be installed in conjunction with automatic smoke exhaust systems.

It is considered likely that the BCA DTS smoke management would hinder and prevent the activation of the sprinkler system as discussed in the FM Global Property Loss Prevention Data Sheets. The failure of the sprinkler system would allow fire development and cause uncontrolled spread throughout the building leading to a more rapid onset of untenable conditions, significant property loss, and restriction of fire fighter access into the building.

Furthermore, rapid fire development and spread could eventually overrun the sprinkler system by resulting in the activation of several fast response sprinkler heads, over and above the system design requirement, potentially depleting the water supply. In this instance, the system may be rendered ineffective and unable to hydraulically perform as intended. As such, it is recommended that the removal of the BCA DTS smoke management system would allow hot smoke to build up in the ceiling leading to the activation of the sprinkler system as intended by design parameters which are based on tested systems and therefore improving the likelihood of fire control and/or suppression.

6.6 FIRE LOAD

The fire load within a room or compartment will influence the duration and severity of a fire and resultant hazard to occupants. The effective fire load for the building has been estimated by consideration of the typical spaces within the building.

The following fire loads have been extracted from Chapter 3.4 of the International Fire Engineering Guidelines [3] and are listed in Table 6-6. This data is derived from Switzerland, however is also deemed applicable to buildings in Australia of similar use.

The warehouses are considered to generally contain mixed types of commodities, where in some cases cellulosic materials are mixed with plastics and non-combustible materials on the same racks. There is a large amount of data concerning the burning rates of items and materials; however, this information is not often presented such that it is sufficiently generic to be universally adopted.

Also, while the current occupants within the buildings may be known during the design stages of the development the length of their occupancy cannot be definitively identified. Therefore while what can be representative of the current fuel loadings for the enclosure, these may not be the case in the future use of the building. Therefore, it would be a rare assessment in which the specific items forming the fuel load had been tested to provide the fire heat release data. As such it is considered that the application of generic burning rates, translated through simplified mathematical expression (time squared growth rates) is a suitable means of estimating fire development.

Table 6-6: Fire Load Densities

TYPE OF OCCUPANCY	AVERAGE FIRE LOAD
Office, Business	300 MJ/m^2
Forwarding facility dealing in; Beverages, food, furniture, glassware, plastic product, printed goods, varnish/polish.	Range from; 200 MJ/m^2 - 1700 MJ/m^2
Storage of rubber products	5000 $MJ/m^2/m$
Storage of paper	1000 $MJ/m^2/m$

6.7 FIRE GROWTH RATE AND INTENSITY

As the fire increases in size, the rate of fire growth accelerates. The growth rate of a fire can result in various hazards for occupants due to the following:

- Protective and preventative measures may not be adequate.
- Occupants may have insufficient time to evacuate.
- Occupants may perceive a reduced threat from slow growing fires.

The rate of fire growth is generally expressed in terms of an energy release rate. The most commonly used relationship is what is commonly referred to as a quadratic time-squared fire. The basis of the time squared fire arises from the fact that the growth during the flaming stage can be approximated by a smooth curve that can be expressed mathematically. The rate of heat release is given by the expression:

$$Q = ({}^{t}/_{k})^2$$

Where: t = time from after ignition of the fire (seconds)

K = the growth time (seconds)

Q = a heat release output of 1.055 MW.

Studies of actual fires have led to the adoption of five (5) standard fire growth rates covering a wide range of potential fire scenarios and fuel loads. It should be noted, the times of fire incubation are not included in the time-squared growth fire models. National Fire Protection Association Standard NFPA 92B [12] provides information on the relevance of time-squared approximation to real fire as depicted in the figure below.

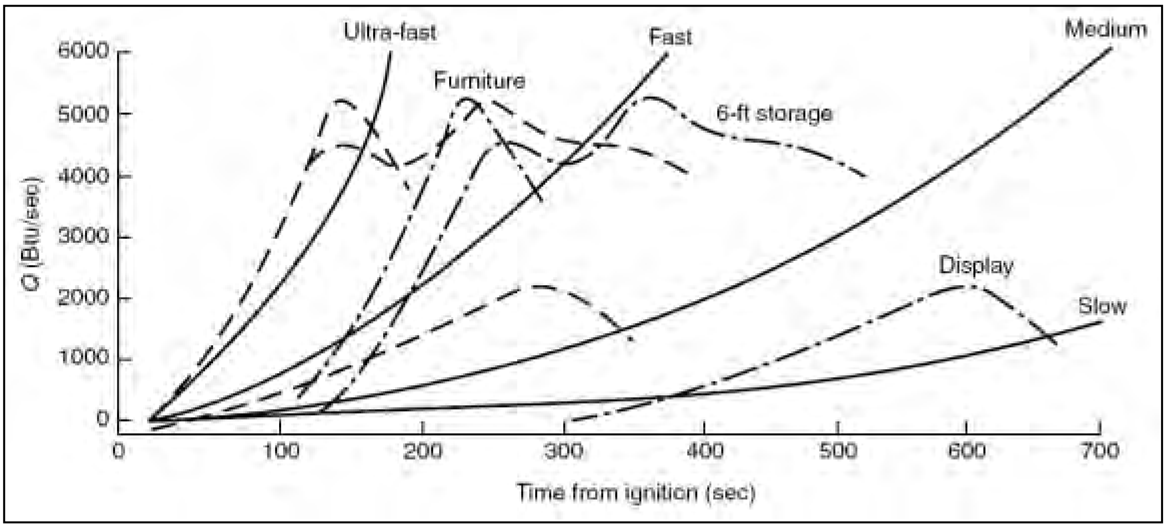


Figure 6-4: NFPA 92B: T-squared fire, rates of energy release

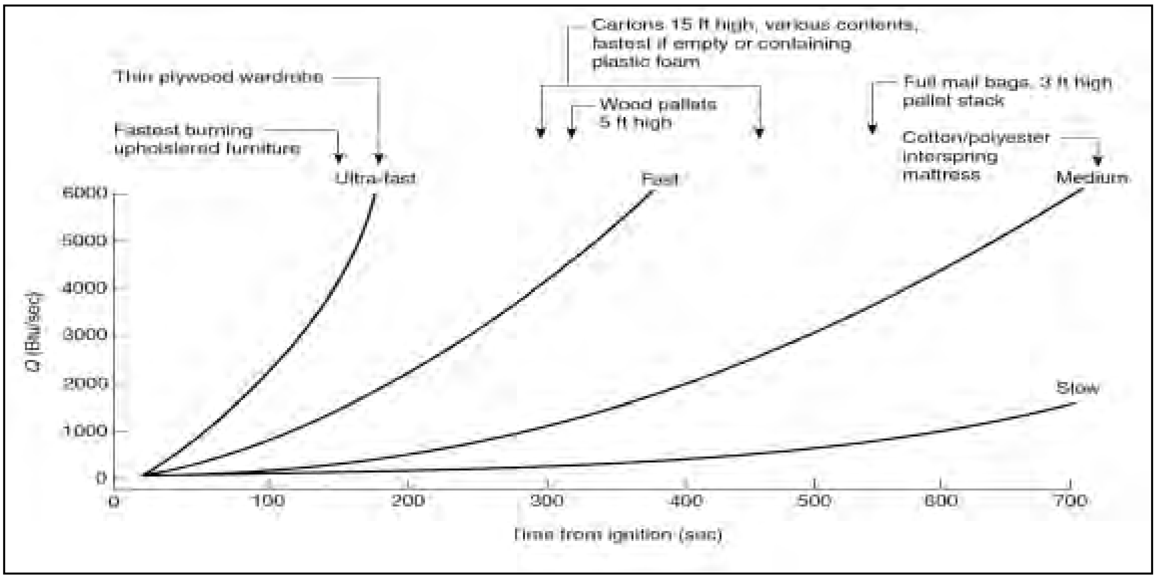


Figure 6-5: NFPA 92B: Relation of t-squared fires to some fire tests

The rate of fire growth can also be estimated from data published in British Standard (BS) 9999:2008 [**7**] as shown below in Table 6-7, and Table 6-8.

Table 6-7: Summary of Fire Growth Rates per Building Type

BUILDING AREA PROVIDING FUEL	GROWTH RATE	BUILDING AREA PROVIDING FUEL	GROWTH RATE
Reception area	Slow	Restaurant/Canteen	Medium
Office	**Medium**	Teaching Laboratories	Fast
Shop	Fast	Meeting Room	Medium
Warehouse	**Medium/Fast/Ultra-Fast**	Waiting Room	slow

The variation in warehouse growth rates can be understood from the following table illustrating the types of stored items.

Table 6-8: Fire Growth Rates as described in BS 9999:2008

FIRE GROWTH RATE	STORED MATERIALS
Slow t^2	Banking hall, limited combustible materials
Medium t^2	**Stacked cardboard boxes, wooden pallets**
Fast t^2	Baled thermoplastic chips, stacked plastic products, and baled clothing
Ultra-Fast t^2	**Flammable liquids, expanded cellular plastics and foam**

From the above tables (and figures) it is concluded that the likely fire scenarios in the high bay racking may be approximated by an Ultra-Fast standard time-squared fire growth rate curve, while the office areas can be approximated with a Medium time-squared fire growth rate.

6.8 FIRE SOOT YIELD

The materials that make up the fuel load will determine the soot yield of a fire. The fire soot yield should be assessed with respect to hazard due to the following:

Soot yield can affect visibility for occupants trying to escape a fire.

Soot yield can be directly related to other products of combustion which may cause untenable conditions.

The fire load materials within an office is likely to involve plastics in the form of computer equipment and telephones etc. and large quantities of cellulosic materials in the form of chip board desks, paper and general office stationary. Generally cellulosic materials have far lower smoke yields than plastics. A common plastic is polyurethane which has a soot yield of 0.1 kg/kg as referenced from Babrauskas in the NFPA Handbook. As a conservative input to the computer modelling all material involved in the fire has therefore assumed to be plastic.

6.9 FIRE HAZARD SUMMARY

Subsequent to a review of the relevant fire statistics and hazards presented above the fire hazards for the building are listed in the following table. Hazards due to functions or characteristics are reviewed based on the building in question and relevant statistics; and

1. A description is provided on the nominated hazards; and
2. Relevant preventative / protective measures are provided to address the nominated hazards.

Table 6-9: Building Hazard Assessment

POTENTIAL HAZARDS DUE TO:	DESCRIPTION / DETAILS		PREVENTATIVE & PROTECTIVE MEASURES TO ADDRESS HAZARDS
Building layout	Egress provisions	Exits are provided around the building perimeter to allow for multiple alternative egress opportunities. Areas within the warehouse have limited dead end travel routes to exits. Due to the size of the building extended travel distances to the nearest of the alternative exits and between alternative exits exist. Within the subject building it is not expected that there will be any greater exposure to fire as a result of the Alternative Solution. No hazards to adjoining buildings have been identified, hazards generally relate to any internal exposures. Occupants in the area of fire origin are expected to be aware of fire and commence evacuation – apart from those intimately involved in ignition are expected to be aware of the fire. The building is located adjacent to a high voltage transmission line which will restrict activities to the eastern end of the facility.	Type C construction, BCA Spec C1.1 (Table 5). Fire Hydrants, BCA Clause E1.3, AS2419.1: 2005. Booster set, BCA Clause E1.3, and AS2419.1:2005. Fire Hose Reels, BCA Clause E1.4, and AS2441:2005. Fire Extinguishers,

<table>
<tr><th>POTENTIAL HAZARDS DUE TO:</th><th colspan="2">DESCRIPTION / DETAILS</th><th>PREVENTATIVE & PROTECTIVE MEASURES TO ADDRESS HAZARDS</th></tr>
<tr><td>Activities</td><td colspan="2">With regard to activities it is not expected that regular hot work processes, use of highly flammable materials, manufacturing processes or operation of high friction or high temperature machinery will be performed within the building.
The development is a storage facility likely to contain a large number of high piled and racking containing combustibles and dangerous goods and hazardous substances. With the storage of those goods it is likely that a range of hazards will be identified, the applicable and credible hazards relate to:
■ Spillage of goods and liquids; and
■ Development potential of a flammable atmosphere; and
■ Fire associated with the development of a flammable atmosphere.
Risks associated with these hazards shall be identified and addressed in accordance with HIPAP. The fire protection equipment shall be designed so the equipment is appropriate to the type and class of dangerous goods stored. The fire protection measures implemented must be able to quickly control or extinguish a fire and prevent a fire nearby from affecting the store.
In that respect the provision of a high hazard storage mode sprinkler system suitable for the particular commodity being stored (as tested by FM Global), and a combination of internal and external hydrants will be provided to facilitate fire brigade intervention.
Corridors, stairs and lobbies will generally be used only for transient purposes, occupants travelling to and from the various parts of the building.</td><td rowspan="5">BCA Clause E1.6, and AS2444:2004.

Post Incident Smoke Clearance fans in the storage areas and smoke exhaust to AS/NZS 1668.1:1998 to the cross dock (with reduced exhaust rates).

Automatic Suppression System, BCA E1.5, and AS2118.1:1999, and FM 2-0 & 8-9.

Occupant Warning System, AS1670.1:2004 Clause 3.22.

Extended Grid Spaced Automatic Smoke Detection System, BCA E2.2a Clause 5(b) and Alternative Solution

Automatic Link to Fire Brigade, BCA Spec E1.5.

Emergency Lighting, BCA Clause E4.2/E4.4, and AS2293.1:2005.

Exit Signage, BCA Clause E4.5, NSW E4.6, NSW E4.8, and AS2293.1:2005</td></tr>
<tr><td>Ignition sources</td><td colspan="2">Based on the statistical review contained above the ignition sources relevant to this site, in order of occurrence and likelihood
■ Electrical Equipment / lighting
■ Intentional fire starts
■ Stored waste or rubbish
■ Heating equipment</td></tr>
<tr><td rowspan="3">Fuel sources</td><td>Quantity of materials</td><td>Dangerous goods and hazardous substances are to be stored within the facility. Storage of those items is to be in accordance with relevant Workplace Safety statutes and the relevant Australian Standards in a dedicated caged storage room.
The workplace health and safety regulations will govern storage allowances (quantity) and requirements in terms of fire safety systems.</td></tr>
<tr><td>Location of materials</td><td>Products in high storage racking, store room, waste and rubbish containers.
The lobbies, stairways and corridors are to be maintained clear of furniture, stored items and the like and constructed with materials and assemblies in accordance with C1.10 to reduce fire spread and smoke production in the event of fire in common areas. Significant fuel loads will therefore be generally limited to the warehouse and offices.</td></tr>
<tr><td>Fire behaviour</td><td>Fire growth rates will vary with fuel type and conditions of ventilation and compartmentation. The most likely</td></tr>
</table>

POTENTIAL HAZARDS DUE TO:	DESCRIPTION / DETAILS		PREVENTATIVE & PROTECTIVE MEASURES TO ADDRESS HAZARDS
		outcome of any fire outbreak within the building is expected to be sprinkler controlled fire. This would be expected to grow at an Ultra-Fast time squared fire growth rate An office fire would likely be smaller in size due to the limited fuel density and would be expected to grow at a Medium time squared fire growth rate.	
Fire origins	Refer to previous charts whereby fires are likely to occur in the following origins: ■ High storage racking areas. ■ Waste and rubbish containers. ■ Store room.		

7 BCA DtS NON-COMPLIANCE ASSESSMENT

7.1 OVERVIEW

In this instance the BCA DtS non-compliances have been formulated based on the regulatory review as provided by the project building surveyor and / or design team. Where not listed herein the building is required to achieve compliance with relevant DtS provisions or if existing, comply with relevant codes, reports and / or Standards approved at the time of consideration.

The following table lists the departures from the DtS provisions of the BCA for the proposed building and the analysis methodology proposed for the Fire Engineering assessment, which is to be generally in accordance with the IFEG [3].

Table 7-1: Summary of Alternative Solutions

BCA DTS PROVISIONS & PERFORMANCE REQUIREMENT	PERFORMANCE BASED SOLUTION
Emergency Services Access **BCA DtS Provisions** Clause C2.4: Vehicular access **Performance Requirement** CP9	***BCA DTS Provision*** Clause C2.4 requires vehicular access as a continuous means of passage for emergency vehicles in a forward direction around the entire building. Further to this, the roadway is required to have a width of no less than 6m and be located within 18m of the building. ***Non Compliance*** Whilst vehicular access is provided around the whole of the building, an existing non-conformance exists on the northern side of the property and access around the eastern side of the warehouse expansion encroaches on the easement of the transmission line and is not conducive for staging of fire brigade appliances. ***Alternative Solution*** The Alternative Solution will, in consultation with Fire & Rescue NSW demonstrate that the configuration of perimeter access combined with the fire safety systems installed within the building ensure that fire fighting capabilities are not adversely disadvantaged. ***Assessment Methodology*** The assessment methodology follows Clauses A0.5(b)(i), A0.9(b)(ii), A0.9(c) and A0.10 of the BCA. An absolute and qualitative approach fire safety engineering assessment shall be completed to establish that the design matches the relevant Performance Requirement in facilitating direct adequate access and entry into the building to undertake fire and emergency intervention activities.
Access and Egress **BCA DtS Provisions** Clause D1.4: Distance to the nearest exit. Clause D1.5: Distance between alternative exits. Clause E2.2: Smoke hazard	***BCA DtS Provision*** Clause D1.4 states that the travel distance to the nearest exit must not exceed 40-metres. Clause D1.5 states that the travel distance between alternative exits must not exceed 60-metres. Clause E2.2 (inter alia Table E2.2a) requires large isolated buildings with a ceiling height above 12m and a having floor area or volume more than 18,000m^2 or 108,000m^3 respectively to be equipped with an automatic smoke exhaust system in compliance with the requirements of Specification E2.2b. ***Identified Non-Conformance*** The distances of travel to and between exits are proposed to exceed the BCA DtS prescribed limitations to the nearest and between alternative exits. Maximum travel distances are to be confirmed but are not to exceed more than

BCA DTS PROVISIONS & PERFORMANCE REQUIREMENT	PERFORMANCE BASED SOLUTION
management **Performance Requirement** DP4 & EP2.2	100-metres to the nearest exit, nor 30-metres to a point of choice between two exits. ***Alternative Solution*** The Alternative Solution will rely upon the volume of the warehouse enclosure to act as a smoke reservoir for hot combustion products and the implemented smoke management system in order to provide the population with adequate time to safely evacuate the building prior to the onset of untenable conditions. ***Assessment Methodology*** The assessment methodology will adhere to Clauses A0.5(b)(i), A0.9(b)(ii), and A0.10 of the BCA. The analysis will be absolute and quantitative where the results of the deterministic assessment are measured directly against the agreed acceptance criteria, with a supporting qualitative argument. Computational Fluid Dynamic (CFD) programs will be used to simulate the fire development and smoke spread in the warehouse with these results utilised in an ASET/RSET time-line analysis.
Directional signage heights **BCA DTS Provisions** Clause E4.6 – Direction signs (inter alia AS2293.1: 2005) **Performance Requirement** EP4.2	***BCA DTS Provision*** BCA DTS Clause E4.6 (NSW) states that if an exit is not readily apparent to persons occupying or visiting the building, then exit signs must be appropriately provided in accordance with AS2293.1. AS2293.1 Clause 6.8.1 requires exit signs be mounted not less than 2m and not more than 2.7 above floor level. ***Non-Compliance*** The exit lighting design shall incorporate signage in the warehouse parts that are positioned above a height of 2.7m to permit the passage of picking machinery below. ***Alternative Solution*** The Alternative Solution shall rely upon the volume of the warehouse enclosures to provide for adequate time for building population to evacuate prior to the directional exit signs becoming compromised by the hot smoke layer. Further to this, the simplicity of the racking layouts and the familiarity of the occupants within the building shall provide for a rapid evacuation along familiar egress routes. ***Assessment Methodology*** The assessment methodology will adhere to Clauses A0.5(b)(i), A0.9(b)(ii), and A0.10 of the BCA. The analysis will consist of a qualitative discussion to demonstrate compliance with the relevant Performance Requirements. Further to the above the deterministic results of the CFD modelling shall demonstrate that the directional exit signage will not be obscured by the descending smoke layer prior to the completion of occupant evacuation, thereby permitting adequate and sufficient way-finding provisions to complete an evacuation.

8 PROPOSED FIRE SAFETY STRATEGY

The fire safety strategy outlined below has been proposed to satisfy the fire and life safety objectives specified for this project by the relevant stakeholders. In addition, the fire safety strategy is required to adequately address the specific fire and life safety hazards identified for the proposed development, and as such have been generally derived from the preventative and protective measures outlined within the BCA, and fire engineering literature and research. Where items of non-compliance have not been identified by the design team in the concept design it is considered that those items are expected to be deemed-to-satisfy solutions.

The specified fire safety strategy will undergo analysis as part of the Fire Engineering Report to ascertain whether the relevant Performance Requirements of the BCA are satisfied. The fire safety strategy will incorporate the following elements:-

8.1.1 Fire Resistance, Compartmentation and Separation

<u>*General Design Guidance:*</u>

- Elements of construction that perform a separating function in case of fire should maintain their integrity and insulation for the required duration.
- Horizontal and vertical elements should be used to limit the spread of fire between fire-separated areas.
- All primary structural concrete and steel elements should be protected as required to:-
  - Maintain life safety;
  - Allow for fire brigade intervention;
  - Mitigate structural damage and prevent progressive collapse;
  - Minimise economic impact; and
  - Allow reasonable ‘return to service time’.

<u>*Design Requirement*</u>:

- The structure including floors, walls, columns and shafts shall be constructed in accordance with the requirements of BCA Clause C1.1, Spec C1.1, Table 5 as applicable to Type C construction.

  Note that the roof does not need to comply with Table 3 above provided that its covering is non-*combustible* and the building has a sprinkler system complying with Specification E1.5 of the BCA installed throughout.

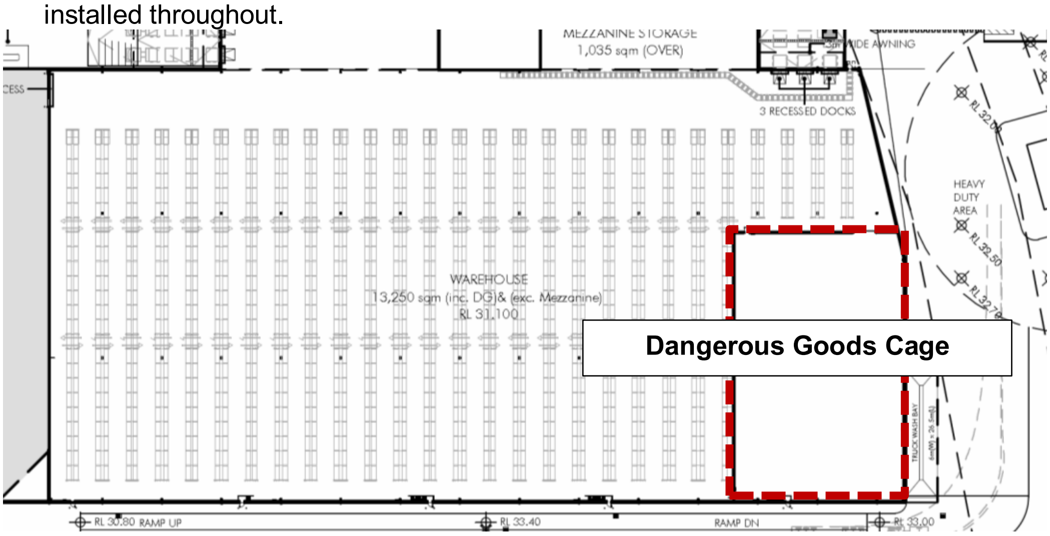


Figure 8-1: Fire Rated Dangerous Goods store

The dangerous goods and hazardous substances are to be contained in a separate caged goods area within the warehouse. The separation shall achieve the relevant requirements as determined by the dangerous goods consultant.

8.1.2 Finishes and linings

General Design Guidance:

Where practicable finishes, linings and materials used throughout the building should be non-combustible.

Design Requirement:

New wall, floor and ceiling, and roof and ceiling assemblies must be tested and rated for their fire hazard properties in accordance with the prescriptive requirements of BCA Clause C1.10 and Specification C1.10.

8.2 EGRESS PROVISIONS

General Design Guidance:

The system should exhibit the following general design principles:-

- Walking surfaces, paths of travel, doorways provided and their dimensions and operation, where practical, and unless specified herein, are to be in accordance with the BCA prescriptive provisions;
- Spacing between exits should typically be in accordance with the BCA prescriptive provisions unless specified herein;

Design Requirement:

Travel distances to an exit, between alternate exits and to a point of choice are permitted to exceed the deemed-to-satisfy provisions subject to verification in the fire engineering. By way of guidance travel to a point of choice between exits should not exceed 30-metres and travel to the nearest exit should not exceed 100-metres.

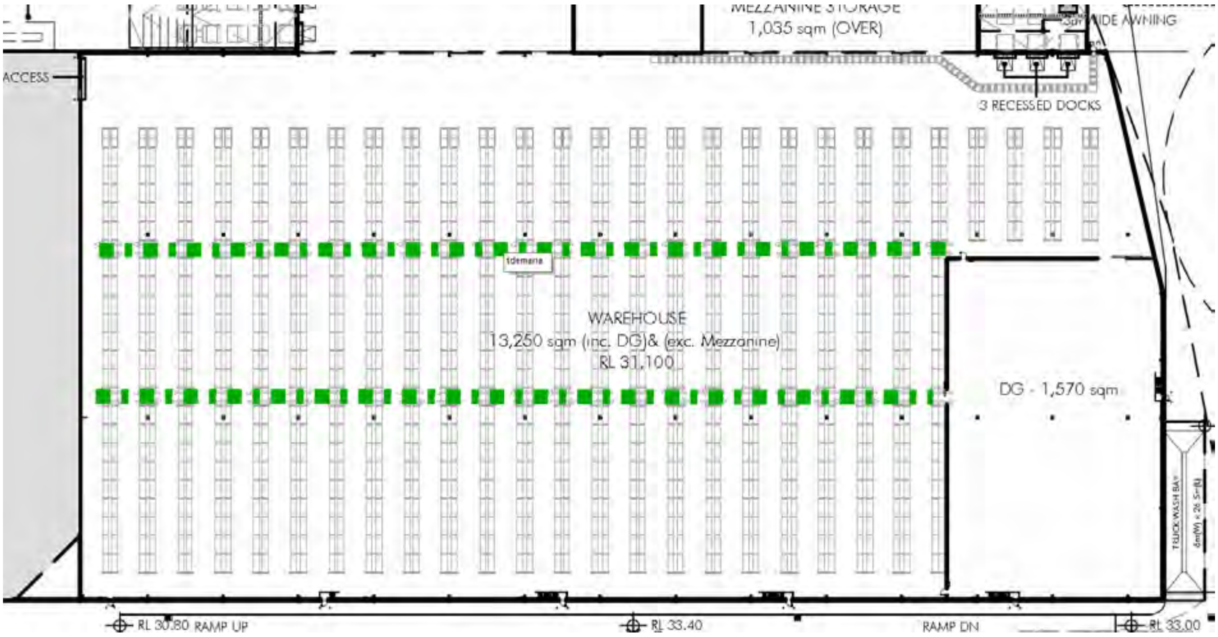


Figure 8-2: Through rack travel paths

Suitable exit locations are to be provided around the perimeter of the building to ensure conformance with the travel distances nominated above. In this regard it is noted that suitable aisle cross over has been provided through the racking bays (as indicated above).

8.3 SERVICES & EQUIPMENT

8.3.1 Fire Detection System

General Design Guidance:

The system should exhibit the following general design principles:-

- The system shall be configured to permit localisation of the fire incident as required for appropriate emergency response and activation of other systems;
- A fault in one zone must not render all other zones inoperative
- Installation and configuration should be designed to minimise false or spurious activations
- Systems and components must be suitable for the environment and normal operating atmosphere.

Design Requirement:

Our experience indicates that a smoke detection system shall typically be required throughout the cross dock facility to activate the smoke hazard management system and through the warehouse parts of the building. The existing fire safety statement indicates the provision of smoke detection but does not confirm the location of the system. The detailed fire engineering analysis prepared prior to the issuance of the building permit shall confirm this requirement.

Where it is established that smoke detection is required the detectors must form part of a system complying with AS1670.1:2004 (spaced in accordance with BCA Specification E2.2a clause 5 i.e. AS/NZS 1668.1:1998 extended grid spacing 20m x 20m). Given the likelihood of there being a hostile environment a number of detection options need be considered.To this end a number of strategies may be employed:-

1) Hostile area smoke detectors.
2) Stainless steel hermetically sealed heat sensitive detectors can be used to ensure corrosion resistance and reliability. Being hermetically sealed the detectors offer moisture-proof and dust-proof installations .
3) Intelligent Multi-Criteria Detector (e.g. Smart4 or equivalent). These detectors use a combination of Carbon Monoxide, heat, optical smoke sensing and infrared flame sensing elements to detect the broadest range of fire conditions providing the earliest warning.
4) Aspirated smoke detection systems (e.g. VESDA)

In addition to the above the application of an analogue detector will permit the interrogation of constant data at the FIP as to the condition of the detector. This means that apart from standard alarm and fault conditions being reported additional conditions such as:-

1) Dirty Detector – when contamination in the detector reaches a pre-set level a maintenance fault is reported at the FIP. This will help to reduce the number of false alarms reported to the fire service.

2) Pre-Alarm – when the smoke/heat level increases towards the full alarm set point, an intermediate set point can be used to give a pre-alarm signal at the FIP. This allows an investigation of the area to take place before the brigade is called and evacuation procedures take place.

The smoke detection system must also activate any electromagnetic devices or locks that are required to fail safe open upon general alarm and the building occupant warning system.

8.3.2 Fire Suppression

General Design Guidance:

The system should exhibit the following general design principles:-

- The system shall provide adequate discharge density and coverage to contain and control potential design fire scenarios for the purpose of life safety and/or asset protection;
- The system should be zoned as appropriate to operate effectively with other complementary fire safety management systems where applicable;
- Spray droplet, velocity, trajectory orifice sizing and supply filtration to prevent blockages should be considered as part of the system design; consideration should be given to the corrosive nature of environmental and external contaminant build up, determining material selection, protective coating selection along with any additional maintenance program requirements and or constraints.

Design Requirement:

An automatic suppression system is to be installed throughout the buildings.

The sprinkler heads, locations and pressures and flows are required to be fitted generally in accordance with BCA DTS Provisions E1.5 and AS 2118.1:1999. In the warehouse parts a storage mode system shall be provided in accordance with AS2118.1:1999 with the sprinkler head type/locations and designed flow/pressures in accordance with the Factory Mutual Guidelines FM 2-0 and 8-9.

In the offices, in the cross dock and beneath any awnings attached to the warehouse the system shall comply with BCA Specification E1.5 and AS2118.1:1999.

The work shall at least meet the following requirements:-

- Sprinkler activation temperature no greater than 68°C below the ceiling throughout the office;
- Sprinkler activation temperature no greater than 101°C below the ceiling throughout the warehouse, cross dock and storage areas unless approved by the fire engineer;
- Sprinkler response time index (RTI) shall not be more than $50m^{1/2}s^{1/2}$ (i.e. fast response type) throughout.
- Areas equipped with different sprinkler heads are to be separated from each other by suitable draught curtains in accordance with the relevant sprinkler standard.

8.3.3 Mechanical Smoke Management

General Design Guidance:

Mechanical smoke management should be designed to improve environmental conditions for evacuating occupants and where possible fire fighters as required for life safety and fire brigade intervention during a fire emergency.

Design Requirement:

Due to the different storage configurations two separate smoke hazard management systems are proposed for the buildings. These are separated into the cross dock which has an automatic smoke exhaust system (with rationalised smoke exhaust rates) to address the likelihood of vehicular fires and the high bay storage warehouse which is provided with a manual smoke clearance system with air changes rates one per hour. The specific requirements for each section of the building are detailed below.

Warehouse / High Bay Storage Areas

A manually operated smoke clearance system shall be installed to the warehouse extension in lieu of the DTS required automatic smoke exhaust. The smoke clearance system shall be designed to achieve the following minimum performance requirements.

- Initiation switches shall be located on the main FIP, or an adjacent fan control panel, at the building entry.
- Signs alerting the Fire Brigade to the operation of the smoke clearance system must be provided.
- Fire rated fans and fire rated cabling shall be used and designed to operate at 200°C for a period of 60 minutes.
- System capacity must be capable of one enclosure air change per hour.
- It is recommended that multiple fans be provided and be evenly distributed to otherwise comply with the requirements of Specification E2.2b Clause 5 of the BCA.
- Adequate make-up air shall be provided at low level to facilitate the clearance system's designed operational capacity. The make-up air shall be distributed as equally as possible around the perimeter of the building and shall be provided at low level by:-
  - Permanently open natural ventilation louvers; and/or
  - Mechanically operated louvers that open upon activation of the fans. All motors and cables must be fire rated to operate at 200°C for a period of no less than 60 minutes.
  - If used for general ventilation, the air flow rate at any sprinkler head must be less than 1.5m/s and the system must shut down automatically upon any fire alarm, with manual override available to fire fighters.

Cross Dock

The existing cross dock facility is equipped with six (6) 10,000l/s axial smoke exhaust fans. Given the expansion of the space additional engineering analysis will be completed prior to issue of the relevant building permits (i.e. construction certificates) to determine the extent of any extension to the existing system.

Where that analysis determines that additional exhaust is required two (2) fans extracting at a rate of 10,000l/s (each) shall be installed at the western end of the cross dock. The smoke exhaust system is to be installed in accordance with the prescriptive requirements of BCA Spec E2.2b and AS/NZS 1668.1:1998 with the exception of the exhaust rates prescribed herein.

Make up air shall be provided as required by BCA Spec E2.2b and AS/NZS 1668.1:1998, beneath the smoke layer. Make up locations are to be equally distributed around the perimeter of the enclosure to as to minimise 'dead spots'. Make up air shall not be drawn from a single location.

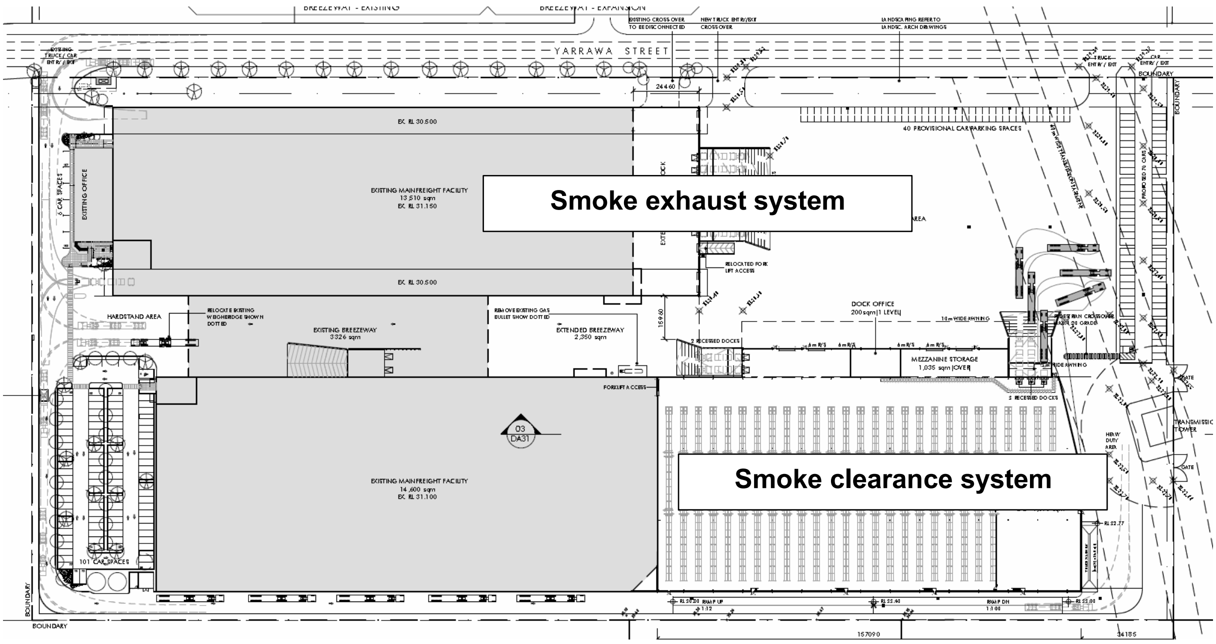


Figure 8-3: Smoke Hazard Management Requirements

8.3.4 Building Occupant Warning System

General Design Guidance:

The system should exhibit the following general design principles:-

- It must be sufficiently audible and intelligible so that it is appropriate to the particular enclosure within which it is installed;
- The speakers shall be spaced appropriately;
- Where messages are delivered by the system they should be simple, clear and informative to encourage appropriate occupant behaviour and response;
- Full coverage of evacuation paths and routes need be provided;
- Messaging should be appropriate for the incident and location.

Design Requirement:

In accordance with the prescriptive requirements of the BCA the occupant warning system is required to be extended throughout the refurbished parts of the building in accordance with Specification E1.5 and Clause 6 of Specification E2.2a and is to be interfaced with the sprinkler system and smoke detection system such that the activation of any sprinkler head or detector will initiate the Building Occupant Warning System.

8.3.5 Emergency Lighting & Exit Signage

General Design Guidance:

Emergency lighting and exit signage should be provided in accordance with the Australian Standard and take into account the familiarity (or lack thereof) of the occupants within the building. Lighting need take into consideration any unique design elements.

Design Requirement:

Emergency lighting is to be provided throughout the area of the new works in accordance with BCA DTS Provisions E4.2 and E4.4 and AS 2293.1:2005. Exit signage is to be provided throughout in accordance with the BCA DTS Provisions E4.5, E4.6 and E4.8 and AS 2293.1:2005.

Throughout existing parts of the building existing text ‘EXIT’ signage should be replaced with ‘running man’ pictograph signage.

8.4 FIRST AID FIRE FIGHTING FACILITIES

8.4.1 Fire Hose Reels & Portable Fire Extinguishers

General Design Guidance:

Equipment should be provided based on the potential storage hazards to be installed within the building. Locations should be signposted and readily accessible to occupants. Use of facilities should be monitored for abuse, mistreatment and servicing.

Design Requirement:

- Fire Hose Reels are to be installed in accordance with the provisions within the BCA and AS 2441:2005. Locations should be signposted and readily accessible to occupants. Use of facilities should be monitored for abuse, mistreatment and servicing. The fire hose reels shall be located within 4m of an exit and provide coverage to all areas of the building based on a 36m hose length with a 4m water stream (i.e. maximum 40m coverage from the hose location).
- Portable fire extinguishers are to be provided throughout in accordance with BCA Table E1.6 and selected, located and distributed in accordance with AS 2444:2001. Sufficient extinguishers of an appropriate type should be provided throughout the building with regard to the hazards that can be expected in the various areas. Typically the following extinguishers should be used for standardization and shall be provided.

General office areas	Dry Powder (ABE type)	2.5 Kg
Plant Rooms	Dry Powder (ABE)	2.5 Kg
Designated Exits	Dry Powder (ABE)	4.5 Kg
Adjacent to each fire hose reel cabinet	Dry Powder (ABE)	4.5 Kg

8.5 FIRE BRIGADE INTERVENTION

General Design Guidance:

Fire brigade access points should be provided and located to facilitate emergency response and the buildings fire safety systems should consider the fire brigades response times.

Design Requirement:

- A fire hydrant system (incorporating external hydrant connections and ring main) must be installed to serve the building in accordance with the Fire & Rescue New South Wales requirements, AS 2419.1:2005 and BCA Clause E1.3.
- Fire hydrant booster assembly connections and all fire hydrant valves shall be fitted with Storz aluminium alloy delivery couplings manufactured and installed in accordance with Clauses 7.1 and 8.5.11.1 of AS 2419.1:2005 to meet FRNSW requirements. Further information is available from the FRNSW Guide Sheet No.4 ‘*Hydrant system connectors*’ available at www.fire.nsw.gov.au. The pressures and flows of the existing
- Clear block plans (not less than A3 in size) shall be provided at the fire hydrant booster assembly and in the fire control centre.
- The sprinkler system is to be interfaced with the Fire Indicator Panel (FIP) and connected to a monitoring station via alarm signalling equipment.
- The fire brigade rendezvous point shall be at the FIP in a separate enclosure adjacent to the pump room (or in the main office).
- The vehicular access paths around the building are to be provided with an all weather surface capable of supporting general Fire and Rescue NSW appliances (maximum weight of 15,000kgs) in accordance with ‘*Guidelines for emergency vehicle access*’, available from www.fire.nsw.gov.au
- Perimeter access is to be maintained to the existing parts of the building and extended around the perimeter of the new part of the building as depicted below.

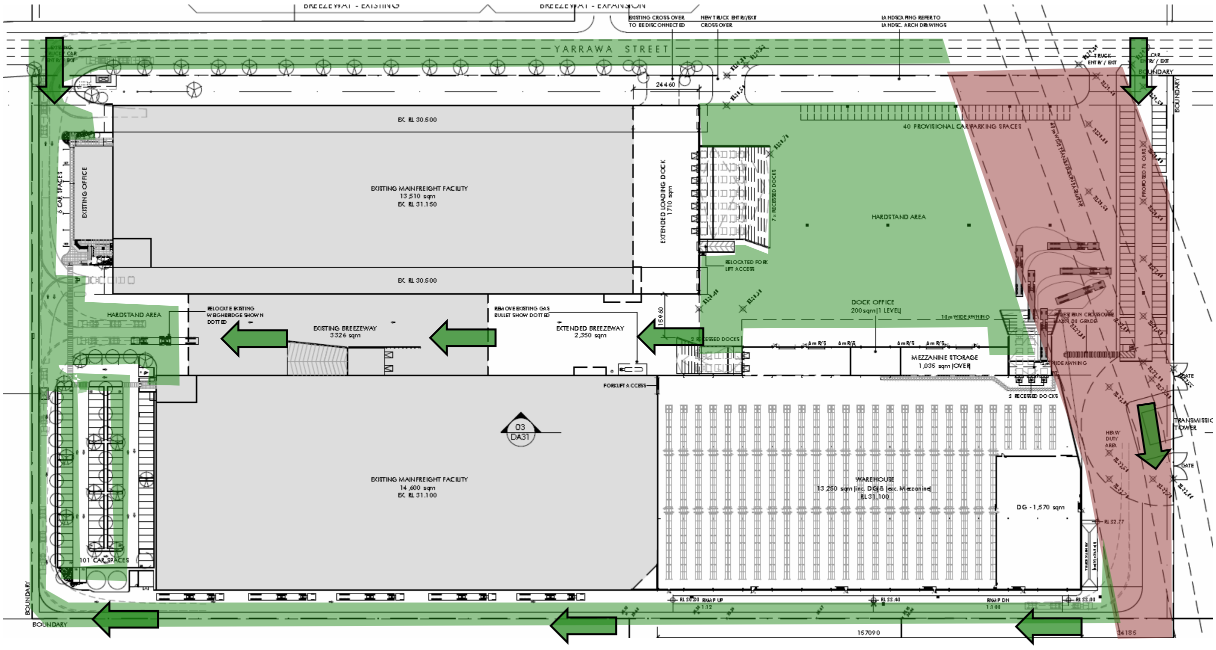


Figure 8-4: Emergency services staging areas

Due to the proximity of the transmission line to the east of the site the staging of fire brigade operations shall be restricted to areas that fall outside the transmission zone. Vehicle movement shall not be obstructed however safe working clearances need to comply with the requirements of the energy provider and as recommended by the WorkCover Authority.

Contact with overhead power lines is a serious risk that can result in electrocution, electric shock or burns. Other risks include fires and explosions that may immobilise mobile plant involved in work. It is recommended that consultation with the relevant electricity supply authority occur in relation to the activities proposed to be undertaken so as to comply with any special conditions imposed by them.

Figure 8-5: Transmission line passing through property (Source: googlemaps.com.au)

Operational setback distances as defined in the WorkCover guideline documentation are provided below. When applying the separation and approach distances depicted in Figure 8-6, it is important to take into account the 'sag and swing' of the power lines, the movement of the mobile plant and the strength of the wind, as well as possible operator error or equipment malfunction.

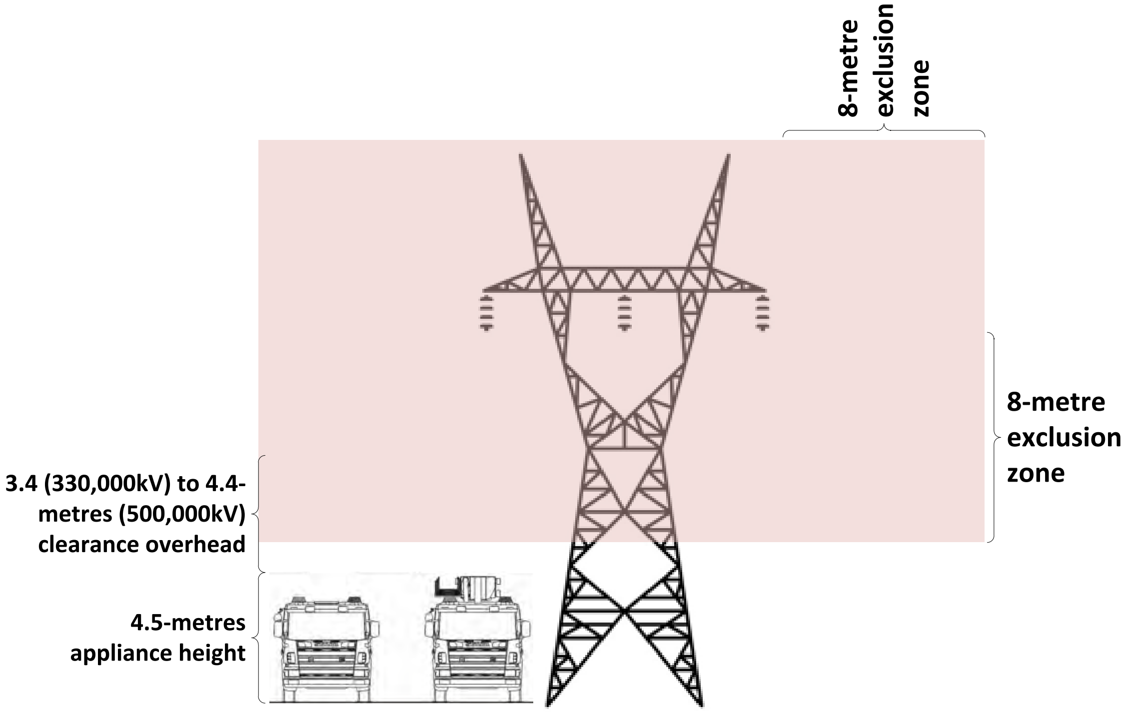


Figure 8-6: Clearance to transmission lines (not to scale)

The FIP shall be installed in accordance with BCA Specification E2.2a and AS1670.1:2004 and must be capable of isolating, resetting, and determining the fire location within the development.

- The red strobe shall be maintained (replaced where necessary) at the entry to the FIP in a visible location to alert arriving fire brigade of the FIP location.
- The FIP must be connected to a direct brigade notification alarm and building occupant warning systems that shall both initiate upon fire detection by the sprinkler and/or smoke detection systems.
- The fire fan control panel shall include a display to indicate the operation or otherwise of exhaust and supply fans in each zone. The panel shall include clear signalling of the operational status of the fans with manual override controls for use by firefighters.

8.6 MANAGEMENT CONTROLS AND PROCEDURES

General Design Guidance:

Emergency and operational management plans should be prepared and developed in conjunction with emergency response agencies and centre operators. Regulator training exercises should be conducted to reflect the most likely fire incidents.

Design Requirement:

- No smoking policy throughout all public areas of the building.
- A hot work permitting system shall be established for works undertaken within the building during occupation.
- Keep unnecessary combustible loads to a minimum in public areas via regular housekeeping, including the removal of random storage and accumulated debris.
- The recommended fire safety systems must be replaced with equivalent systems in all future works and the recommended fire safety systems must be applied to any renovations or new works.
- Periodic inspection, testing and maintenance of all fire safety systems, fire hydrants, fire hose reels, emergency lighting, exit signage, doors, fire resistance, portable fire extinguishers, etc. should be implemented. Under all circumstances it is important to keep as much of the system

fully operational as is practical. Should any building works extend over a number of days, the system must be re-instated as far as practical at the end of each day.

- Scaffolding, wire fencing, barricades and the like must not prevent fire brigade access for vehicles or personnel to essential fire safety components (hydrants, boosters, FIP, etc.) or prevent fire brigade personnel from intervening in the event of a fire.
- A building emergency management plan including relevant elements such as occupant evacuation plans, occupant muster points, fire warden training is to be provided in accordance with AS 3745:2010. The plan must accommodate any staged construction and hand over of the premises.

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