

THE  STAR

MODIFICATION 13 PLANNING SUBMISSION

FIRE ENGINEERING
ASSESSMENT

PREPARED BY



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1 EXECUTIVE SUMMARY

SEGL has commenced a five-year redevelopment journey to create a landmark, exemplar integrated resort. This proposed redevelopment will occur through the lodgement of two s75W modification applications to the original Major Project Approval (MP08_0098) with the Department of Planning and Environment (the Department).

Modification 14 (Mod 14) was determined in October 2017 and included approval for a range of upgrades to the existing site. These upgrades included the enclosure of the level 3 terrace to facilitate an expansion in gaming floor area and a new bar and restaurants, expansion of the level 3 pre-function space, changes to the Astral Hotel lobby and retail space, and alterations to internal vertical transportation, services and infrastructure, including the harbour heat rejection system.

Mod 13 is a modification to the development as approved under MP08_0098, up to and including Mod 14. This forms the basis for technical impact assessments.

Mod 14 included enabling works which will allow for the integration of the proposed tower and other new/upgraded areas proposed under Mod 13. The following are examples:

- ◆ Column strengthening from basement levels through to level 1 will provide for the proposed level 5 terrace;
- ◆ The upgraded Harbour Heat Rejection System, which will have enough capacity to provide for the improvements proposed under Mod.13;
- ◆ Alterations to the internal vertical transportation systems will allow for ease of travel for patrons throughout the existing site;
- ◆ Realignment and reconfiguration of the Jones Bay Road porte cochere under Mod 14 will improve efficiency of operations, pedestrian safety and the overall visitor experience to the site; and
- ◆ Relocation of taxi queuing to the service road and the Star's commitment to upgrading the existing parking management system, which will improve ease of access to and from the site.

The proposed Mod 13 development has been assessed against all relevant standards/guidelines, including but not limited to the following:

- ◆ SEARs;
- ◆ Building Code of Australia;
- ◆ Guide to the Building Code of Australia; and
- ◆ International Fire Engineering Guidelines.

This Modification 13 Fire Engineering Assessment has identified that the proposed works will have limited environmental impacts in terms of egress provisions from the existing casino development. This stems from the high level of fire compartmentation which is present within in a high-rise residential/hotel development such as this, along with the limited quantity of occupants who would be occupying each hotel / residential floor at any one time.

The intent of this report is to provide a high level overview of the conceptual building design, the life safety systems it will contain, and the steps needed to progress the fire engineering design from here.

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MODIFICATION 13 PROPOSED WORKS

2 MODIFICATION 13 PROPOSED WORKS

Modification 13 includes the following proposed works:

2.1 NEW RITZ CARLTON HOTEL AND RESIDENTIAL TOWER

- Demolition of part of the existing building in the northern portion of the site, including part of the Pirrama Road façade and part of the Jones Bay Road façade.
- Construction of a new Tower, 237.0 metres AHD (approximate, 234 metres from Pirrama Road);
- Residential uses across 35 levels, comprising:
 - o A residential vehicular drop off lobby on Level B2
 - o A residential lobby on Level 00 to be accessed from Jones Bay Road;
 - o Residential communal space on Level 07 to be accessed via Level 08; and
 - o 204 residential apartments located from Levels 05 to 06 and from Levels 08 to 38, featuring one-bedroom, two-bedroom and three-bedroom unit types (*Note – no Level 13*)
- Hotel uses across 31 levels, comprising:
 - o A hotel arrival lobby on Level B2 to be accessed from the new Ritz-Carlton porte-cochere along Pirrama Road;
 - o A hotel Sky Lobby for guest check-in on Level 39 and 40, featuring a restaurant, bar and lounge;
 - o 220 hotel rooms located from Level 42 to 58 and from Level 60 to 61
 - o A hotel spa and gym on Level 07
 - o A VIP link to the Sovereign Room on Level 04 and 04 Mezzanine
 - o A Ritz-Carlton Club lounge and terrace on Level 59
 - o Hotel staff end-of-trip facilities on Level B3
 - o Hotel staff arrival point on Level 00
 - o Hotel back-of-house and plant on Level B2, 02, 03, 05, 41 and 42
- A Neighbourhood Centre consisting of the following proposed uses including street level cafe, library, learning / innovation hub, multipurpose function centre, practice rooms (functional use to be finalised in conjunction with a neighbourhood panel)
- A new car-parking stacker system below the new porte-cochere of the Ritz-Carlton Hotel, with a total capacity of 221 spaces, to serve the new hotel and apartments
- Vertical transport associated with the tower and podium; and
- A new drop-off / pick up area (short-term parking) on Jones Bay Road for the proposed apartments.

2.2 LEVEL 07

- ◆ A 'Ribbon' at Level 07 connecting the new Hotel and Residential Tower to the existing building along Pirrama Road, comprising:
 - o Two pools and associated pool decks (one for the new Hotel, one for The Star); and
 - o Two food and beverage premises with associated store rooms and facilities;
- ◆ Lift access from the Level 05 Terrace to Level 07;
- ◆ Residential communal open space associated with the new residential apartments, comprising pool and landscaped terrace at the base of the Tower adjacent to Jones Bay Road;
- ◆ Gym and associated change rooms and facilities for the residents;
- ◆ Gym and associated change rooms and facilities for hotel guests; and
- ◆ Landscaping treatments.

2.3 LEVEL 05 SKY TERRACE

- ◆ Three food and beverage outlets with external areas;
- ◆ Completion of the Vertical Transportation drum to connect with Level 05 Sky Terrace;
- ◆ Designated event spaces on the Terrace; and
- ◆ Landscaping treatment.

2.4 LEVEL 05 ASTRAL HOTEL POOL AND SPA RECREATIONAL FACILITY UPGRADE

- ◆ New pool deck, pool, spa, gym and amenities upgrade for Astral Hotel and Residences.

2.5 TOWER TO SOVEREIGN LINK BY ESCALATOR AND LIFT

- ◆ Link from the Tower (across Level 04 and Level 04 Mezzanine) to the Sovereign Resort and MUEF at Level 03, connected via Lift G4, Lift VIP 1 and escalators.
- ◆ Extension of the lift service to stop at Level 00, 01 and 05 in addition to Level 3, 4 and 4M.

2.6 LEVEL 03 SOVEREIGN COLUMN FAÇADE TREATMENT ALONG PIRRAMA ROAD

- ◆ New glazed detail to enclose exposed Level 03 Sovereign columns along the Pirrama Road façade.

2.7 VARIOUS RECONFIGURATION WORKS AROUND VERTICAL DRUM LEVEL 00 TO L5

- ◆ Revolving door at L00 main entrance landing Pirrama Road end
- ◆ Sliding door at L00 landing at stairs from Light Rail
- ◆ Reconfiguring of existing L1 and 2 void edge
- ◆ New escalators from L2 to L3 due to revised landing at Level 3
- ◆ Infill of L2 atrium void to main entrance at Pirrama Road

2.8 FAÇADE INTEGRATION WORKS

Façade integration works includes:

- ◆ Upgrades to the Pirrama Road and Jones Bay Road, façades to integrate the new Ritz Carlton Hotel and Residential Tower with the existing building.

2.9 INFRASTRUCTURE UPGRADES

- ◆ A new plant room located within the podium over Levels 03, 04, 05 and 06 of the proposed Hotel and Residential Tower;
- ◆ Relocation of the current Level 03 cooling towers (adjacent to the MUEF) to the Level 09 plant room above the Level 06 plantroom adjacent to the Astral Hotel;
- ◆ New capstone microturbine units and associated flues in the proposed plant room at Level 03 between the Darling Hotel and the Astral Residence Tower;
- ◆ New capstone microturbine units and associated flues in the new Level 03 plant room at the base of the Tower;
- ◆ Relocation of the existing main switch-room to the new plant room on Level 02, south of the demolition cut line;
- ◆ Relocation of the existing data recovery centre to the new plant room on Level B1 of the Darling Hotel;
- ◆ Relocation of diesel generator flues to the side of the new Level 09 plantroom, adjacent to Astral Hotel.

2.10 LEVEL B2 TRANSPORT INTERCHANGE

- ◆ Reconfiguration of existing median strips on Jones Bay Road and addition of new median strip on Pymont Street, with associated line-marking to enable a new right-hand turning lane into the Astral Hotel Porte-Cochere;
- ◆ New Pymont Street carpark entry and exit, associated line marking, changes to internal circulation, and reconstruction of the pedestrian footpath along Pymont Street; and
- ◆ Relocation of existing feeder taxi-rank from Jones Bay Road to the Level B2 transport interchange.

2.11 TRANSPORT IMPROVEMENTS- OTHER LOCATIONS

- ◆ Reconfiguration of existing median strips on Jones Bay Road and addition of new median strip on Pymont Street, with associated line-marking to enable a new right-hand turning lane into the Astral Hotel Porte-Cochere;
- ◆ New Pymont Street carpark entry and exit, associated line marking, changes to internal circulation, and reconstruction of the pedestrian footpath along Pymont Street; and
- ◆ Relocation of existing feeder taxi-rank from Jones Bay Road to the Level B2 transport interchange.

2.12 SITE WIDE LANDSCAPE AND PUBLIC DOMAIN UPGRADES

- ◆ Upgrades to street frontages along Pirrama Road (for the Hotel Porte Cochere) and Jones Bay Road (for the residential entry);
- ◆ Upgrades to street frontage to Pymont Street, due to new car parking entry; and
- ◆ Upgrade to the entry forecourt of SELS building at the corner of Jones Bay Road and Pymont Street. (Note: no works within SELS building is proposed)

2.13 LEVEL 00-RESTAURANT STREET

- ◆ Creation of a new destination Restaurant Street by:
 - Incorporating existing Balla & Black Food and Beverage premises on Level 00; and
 - Converting existing retail shops into new Food and Beverage tenancies

2.14 PIRRAMA ROAD AND JONES BAY ROAD - FOOD AND BEVERAGE TENANCIES

- ◆ A revised food and beverage tenancy at the existing Pizzaperta outlet along Pirrama Road;
- ◆ A new food & beverage tenancy at the Marquee street entry; and
- ◆ A small café outlet adjacent to the residential lift lobby at Jones Bay Road.
- ◆ A new food & beverage tenancy accessed off existing walkway from Jones Bay Road

2.15 FOOD AND BEVERAGE – OTHER LOCATIONS

- ◆ Reconfiguration of Harvest Buffet, including new escalators from Level 00 Food Court to Level 01; and
- ◆ Refurbishment of Bistro 80 into the interim Century tenancy. (Note: The Century tenancy post construction is proposed to be at the Jones Bay end of L00 – Restaurant Street

2.16 DARLING HOTEL CORNERS

- ◆ Upgrade of the corner plaza at the Union/Edward Street property entry to accommodate:
 - A new food and Beverage premises on Level 01 and 02;
 - A new entry foyer leading to the Food Court;
 - A relocated awning enclosure at street level;
- ◆ Upgrade of the corner plaza at the Union/Pymont Street property entry to accommodate:
 - A new awning enclosure at for the existing café;
 - New revolving door at entry to Darling Hotel

- o Eight (8) luxury display cases at Darling Hotel car park entry; and
- o Two car display areas at Darling Hotel car park entry.

2.17 SITE-WIDE ACOUSTIC STRATEGY

- ◆ A site-wide acoustic monitoring strategy applied to assess impact of potential noise generating sources in Mod13.

2.18 SITE-WIDE LIGHTING STRATEGY

- ◆ A site-wide lighting strategy integrating and improving the existing lighting across the precinct, with new lighting the proposed Tower, Podium and Ribbon, including:
 - o Internal lighting of Hotel and Residential spaces;
 - o Illuminated highlights at the Sky Lobby and Club Lounge levels;
 - o Integrated lighting on the eastern and western vertical façade slots and angled roof profile;
 - o Podium external illumination from awnings, and under retail and lobby colonnades;
 - o Landscape lighting on Level 07 open terraces and pool decks;
 - o Feature lighting accentuating the wing-like profile of the Ribbon and vertical element;
 - o Internal and external lighting to Food and Beverage outlet at Union/Edward Street corner;
 - o Façade LED lighting to the heritage SELS Building

2.19 SPECIAL LIGHTING EVENTS

- ◆ Approval for fifty three (53) Special Lighting Event nights per year for the use of permanent installation of moving projector lights on the rooftop of the Astral Hotel.

2.20 SIGNAGE UPGRADES

- ◆ Consolidation of existing signage approvals and new signage, including:
 - o Approved signs
 - o Wayfinding signs;
 - o Business identification (including for Food and Beverage outlets); and
 - o Signage on the Tower and Podium.

2.21 STORMWATER UPGRADES

- ◆ Stormwater upgrade works, including increased pit inlets and pipe capacities at the low points along Pymont Street and Edward Street.

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BUILDING OVERVIEW

3 BUILDING OVERVIEW

3.1 PRINCIPAL BUILDING CHARACTERISTICS

3.1.1 Description

The Ritz Carlton Hotel Tower is to be located on the corner of Pirrama Road and Jones Bay Road, and will be part of The Star, Sydney redevelopment which is currently underway.

The hotel tower consists of 30 floors of residential apartments (Level 08 to 38) below 22 storeys of hotel. Levels 1 to 7 consist of community spaces and the 'Ribbon' part of the development that connects the hotel tower with the main building over an extended structure accommodating a restaurant and bar.

3.1.2 Building Characteristics

The BCA building characteristics are listed in table 1 below. The below are in line with the BCA report prepared by McKenzie (Revision G dated 14/09/2017).

TABLE 1: BUILDING CHARACTERISTICS

BCA Clause	Building Characteristic	Description or Requirements		
A1.1	Effective Height	Greater than 50 m in effective height (Approx. 209 m).		
A3.2	Occupancy Use and BCA Classification*	Basement 04 and lower	Carstackers Hotel BoH	Class 7a Class 3
		Basement 03	Residential / hotel storage Parking areas	Class 2 / 3 / 7b Class 7a
		Basement 02	Hotel Lobby Retail	Class 3 Class 6
		Level 00	Residential Lobby Retail	Class 2 Class 6
		Level 02-Level 05	Plant Neighbourhood Spaces	Class 7b Class 9b
		Level 05	Rooftop function space / restaurant	Class 6 / 9b
		Level 07	Ribbon – Function Spaces Restaurant and Bar	Class 9b Class 6
		Level 09 – Level 10	Residential Gym Hotel Change Facilities	Class 2 Class 3
		Level 11 – Level 38	Residential apartments	Class 2
		Level 39	Residential apartments Hotel BoH	Class 2 Class 3

BCA Clause	Building Characteristic	Description or Requirements		
		Level 40 – Level 41	Hotel Restaurant and Sky Lobby	Class 9b
		Level 42	Plant	Class 3 ancillary
		Level 43 – Level 58	Hotel Suites	Class 3
		Level 59	Club Lounge	Class 9b
		Level 60 – Level 61	Presidential Suites	Class 3
		Level 61 and Roof	Plant	Class 7b
C1.1	Construction	Type A		
C1.2	Rise in Storeys (RIS)	63		
	Number of Storeys	64		
Table C2.2	Fire Compartment Floor Area and Volume	Class 2	The Class 2 portions of the building are not subject to floor and volume limitations of Table C2.2.	
		Class 3	The Class 3 portions of the building are not subject to floor and volume limitations of Table C2.2.	
		Class 6	Does not apply as this is deemed a Large Isolated Building	
		Class 7a	The carpark is to be sprinkler protected and as such there are no maximum floor area or volume limitations for this area	
		Class 7b	Does not apply as this is deemed a Large Isolated Building	
		Class 9b		

3.2 FIRE BRIGADE INTERVENTION

3.2.1 Proximity to Fire & Rescue NSW Fire Stations

The site is located approximately 400 m (as determined by Google Maps) from the Pyrmont Fire Station at 147 Pyrmont St, Pyrmont NSW 2009. The building is also in close proximity to Glebe Fire Station, City of Sydney Fire Station and The Rocks Fire Station as detailed in table 2, which also lists the resources available at each station.

TABLE 2: FIRE STATIONS IN CLOSE PROXIMITY TO THE STAR BUILDING

Station Name	Address	Station Resources	Distance from The Star
Pymont Fire Station	147 Pymont St, Pymont NSW 2009	1 x Class 3 Pumper 1 x Hazmat	0.4 Km
Glebe Fire Station	75 St Johns Rd, Glebe NSW 2037	1 x Class 3 Pumper 1 x Bronto F27 Ladder Platform	2.0 Km
City of Sydney Fire Station	211-217 Castlereagh St, Sydney NSW 2000	3 x Class 3 Pumper 1 x Bronto F44 Ladder Platform 1 x Rescue	2.6 Km
The Rocks Fire Station	166 Kent Street, The Rocks NSW 2000	1 x Class 3 Pumper	2.9 Km

3.3 EVACUATION PROVISIONS

3.3.1 Residential and Hotel Tower

Egress from the residential and hotel tower is indicatively shown in Figure 1 below. The fire isolated stair serving the tower is not fitted with air pressurisation system; a bespoke corridor smoke exhaust system will be provided in lieu and will be subject to a Performance Solution.

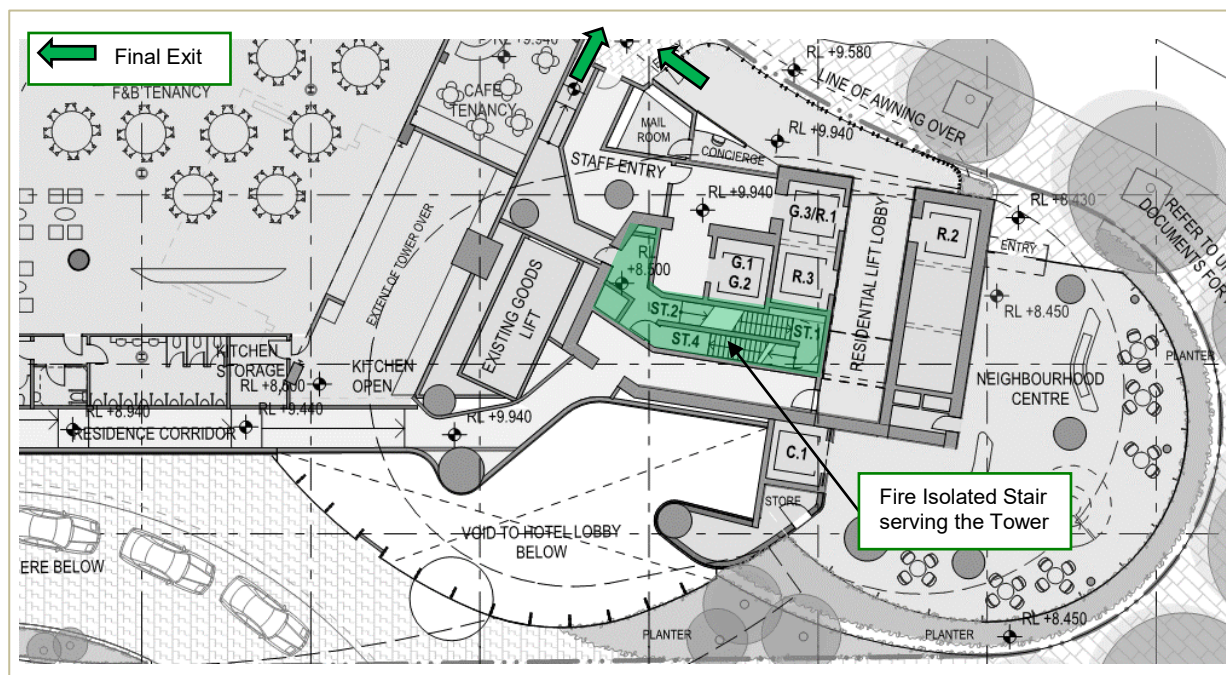


FIGURE 1: EGRESS PROVISIONS FOR THE HOTEL AND RESIDENTIAL TOWER ON GROUND

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3.3.3 Restaurant Street (Ground Level)

Egress from the restaurant street is indicatively shown in FIGURE 4 below.

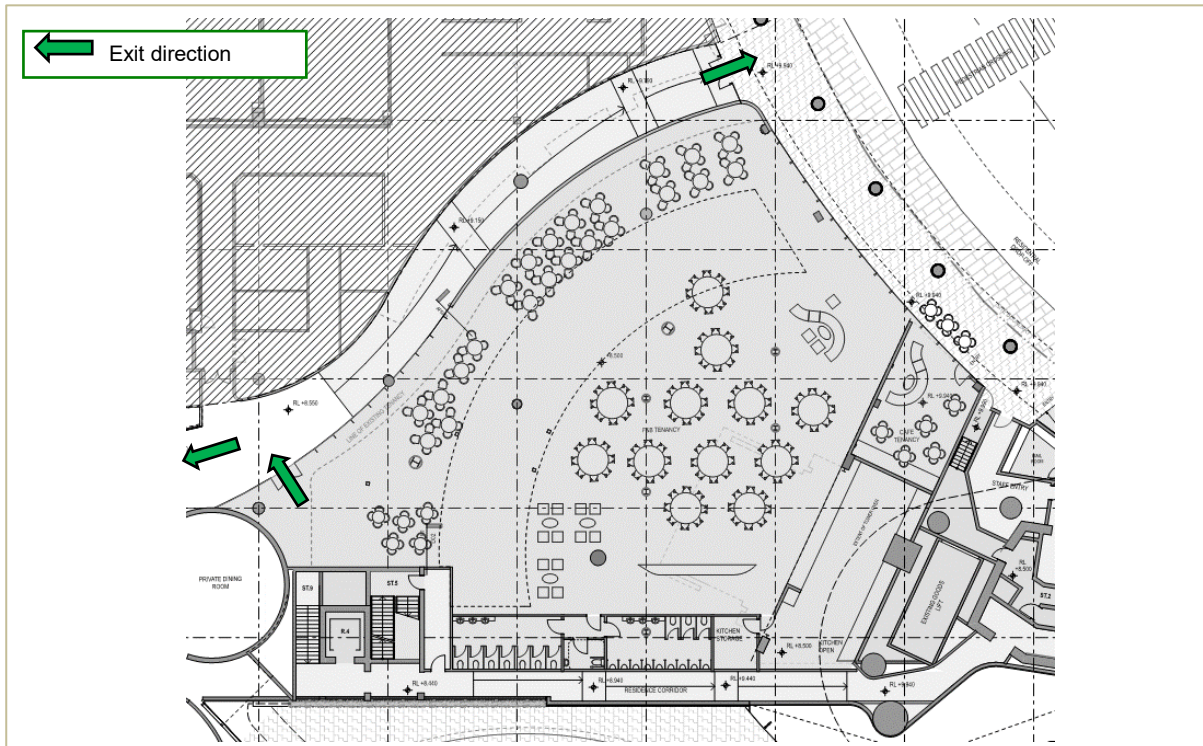


FIGURE 4: RESTAURANT STREET - EGRESS

3.3.4 Neighbourhood Centre (Ground – Level 04)

The lower levels of the Tower serving Ground to Level 04 will form the Neighbourhood building. The levels will be interconnected with an open spiral stair. A cafeteria will be present at ground level and the upper levels will be forming the community hub / tech space. Two means of escape will be provided from each of these levels, as indicatively shown below.



FIGURE 5: LEVEL 2 COMMUNITY BUILDING

3.3.5 The Ribbon and Level 5 Sky Terrace

The Ribbon is considered an open space with the two restaurant tenancies discharging in open air. The Ribbon is connected to the Level 5 Sky Terrace as illustrated in FIGURE 6.

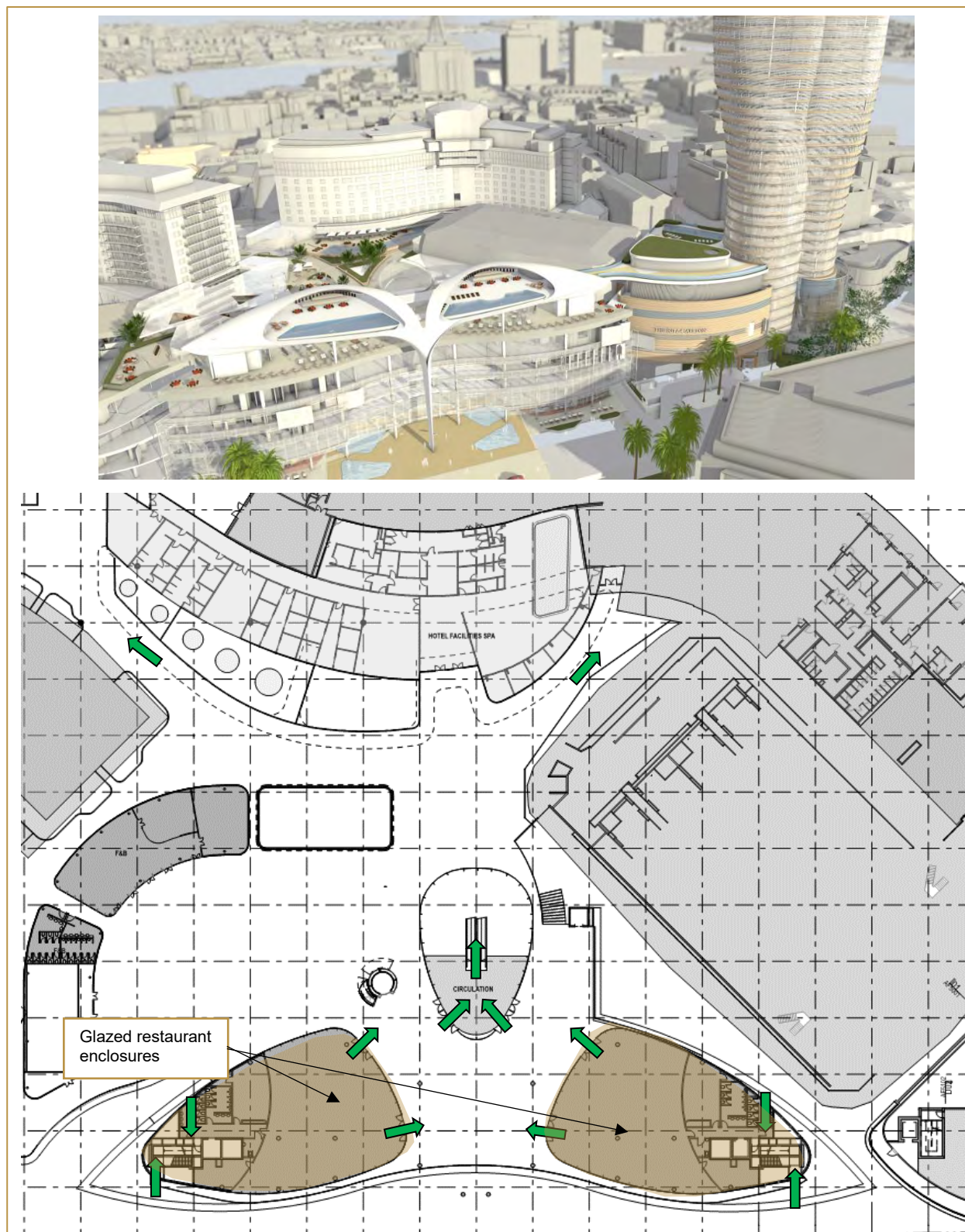


FIGURE 6: EGRESS PROVISIONS FROM THE RIBBON AND SKY TERRACE

3.3.6 Level 07 Pool Terrace

As illustrated in the 3D render in Figure 6, Level 7 forms a canopy over the Level 5 Ribbon structure. The pool terrace is essentially open to atmosphere. On the Tower side, there is the residents’ pool as well as the hotel and residential gym facilities at the northern end of the floorplate. Escape provisions from this level are shown in FIGURE 7.

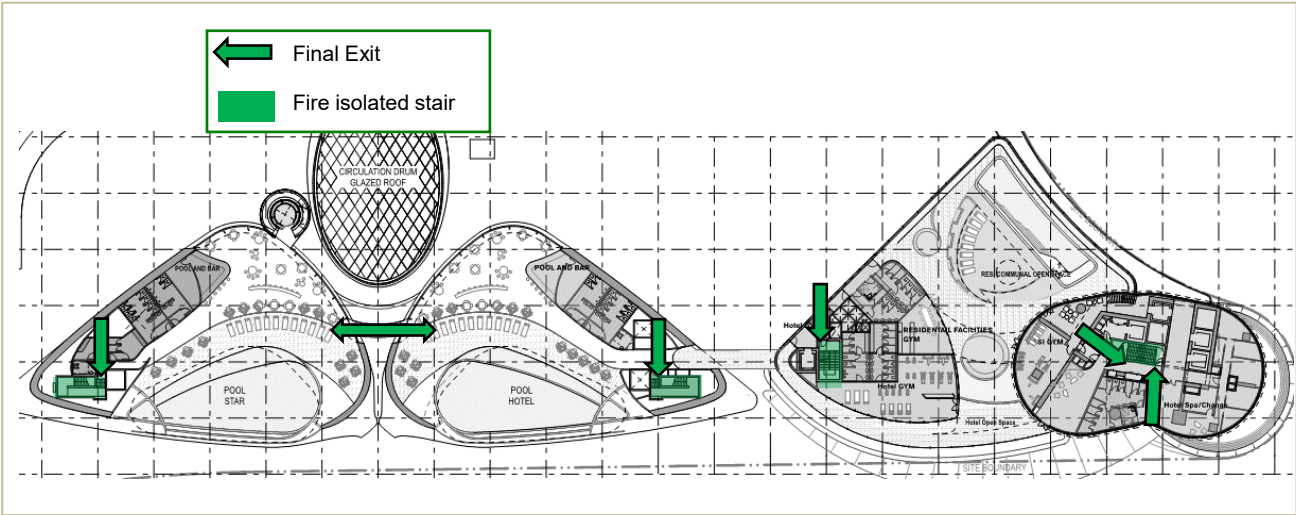


FIGURE 7: EGRESS PROVISIONS FROM LEVEL 7

3.3.7 Vertical Drum

The existing Vertical Transportation drum is being extended to connect with Level 5 Sky Terrace. It is noted that preliminary CFD modelling was carried out by WSP Fire to determine the smoke exhaust requirements for the space. Natural ventilation openings of a minimum of 60 m² of area are required at Level 5 to maintain tenable conditions in a fire scenario subject to supplementary smoke exhaust provided on each floor and to limited fire load within the drum area itself.

3.4 PREVENTATIVE AND PROTECTIVE MEASURES

3.4.1 DtS Requirements

All building work must comply with the prescriptive requirements of the BCA unless it has been specifically varied through performance based fire engineering assessment, or by the Principal Certifying Authority (PCA). A general overview of the standards of construction and maintenance are tabulated below for ease of reference. Standards referenced are those mandated by the BCA 2016, or in place at the time of this report being written.

The required standards of construction, commissioning, management, use and maintenance requirements are presented below.

TABLE 3: STANDARDS OF CONSTRUCTION AND MAINTENANCE

Fire Life Safety Provision	Standard of Construction	Standard of Maintenance
Air handling systems	Comply with [AS 1668.1] and Fire Engineering Requirements	Comply with [AS 1851]
Construction	Comply with BCA Spec C1.1 and Fire Engineering Requirements	Comply with [AS 1851]
Emergency lifts	Comply with BCA Part E3 and Fire Engineering Requirements	EN 81.1 Annexure D

Fire Life Safety Provision	Standard of Construction	Standard of Maintenance
Emergency vehicular access	Comply with BCA Clause C2.4 and Fire Engineering Requirements	Comply with Fire Engineering Requirements.
Exit and emergency lighting	Comply with BCA Part E4, [AS 2293.1]	Comply with [AS 2293.2]
Fire and smoke doors	Comply with BCA Spec. C3.4, [AS 1905.1] and Fire Engineering Requirements	Comply with [AS 1851]
Fire detection and alarm systems	Comply with [AS 1668.1], [AS 1670.1] and Fire Engineering Requirements	Comply with [AS 1851]
Fire extinguishers	Comply with BCA Clause E1.6 and [AS 2444]	Comply with [AS 1851]
Fire hydrants (including boosters)	Comply with BCA Clause E1.3 and [AS 2419.1]	Comply with [AS 1851]
Fire hose reels	Comply with BCA Clause E1.4, [AS 2441] and Fire Engineering Requirements.	Comply with [AS 1851]
Fire mains	Comply with BCA Spec. E1.5, [AS 2118.1] and [AS 2419.1]	Comply with [AS 1851]
Penetrations in fire rated construction	Comply with BCA Spec C3.15 – Penetrations of walls, floors and ceilings by services	Comply with [AS 1851]
Smoke exhaust systems	Comply with AS 1668.1 and Fire Engineering Requirements	Comply with [AS 1851]
Sound System and Intercom System for Emergency Purposes (SSISEP)	Comply with [AS 1670.4] and Fire Engineering Requirements	Comply with [AS 1851]
Sprinklers	Comply with AS 2118.1 and Fire Engineering Requirements	Comply with [AS 1851]

3.5 FIRE AND SMOKE COMPARTMENTATION

Residential parts of the Tower are to have Type A construction achieving an FRL in accordance with BCA Specification C1.1 Table 3 for Class 2 (FRL 90 minutes). Non-residential parts of the building to have Type A construction achieving an FRL in accordance with BCA Specification C1.1 Table 3 for Class 7a (FRL 120 minutes), Class 6 retail (FRL 180 minutes), Class 9b pool areas and the Ribbon part of the building (FRL 120 minutes) and Class 7b storage areas (FRL 240 minutes). The stated values can be subject to reduction following PCA confirmation and further assessment as part of a Performance Solution where believed to be of benefit to the project.

The fire-isolated egress stair in the Tower is required under the DtS Provisions of the BCA to be provided with a mechanical pressurisation system. However, it is proposed to only pressurise the portion serving the basement levels whilst the residential levels of the Tower will be served by a mechanical smoke exhaust system within the common corridor. The justification of the omission of stair pressurisation will be the provision of a corridor exhaust system on each floor of the tower, as indicatively shown in FIGURE 8 below.

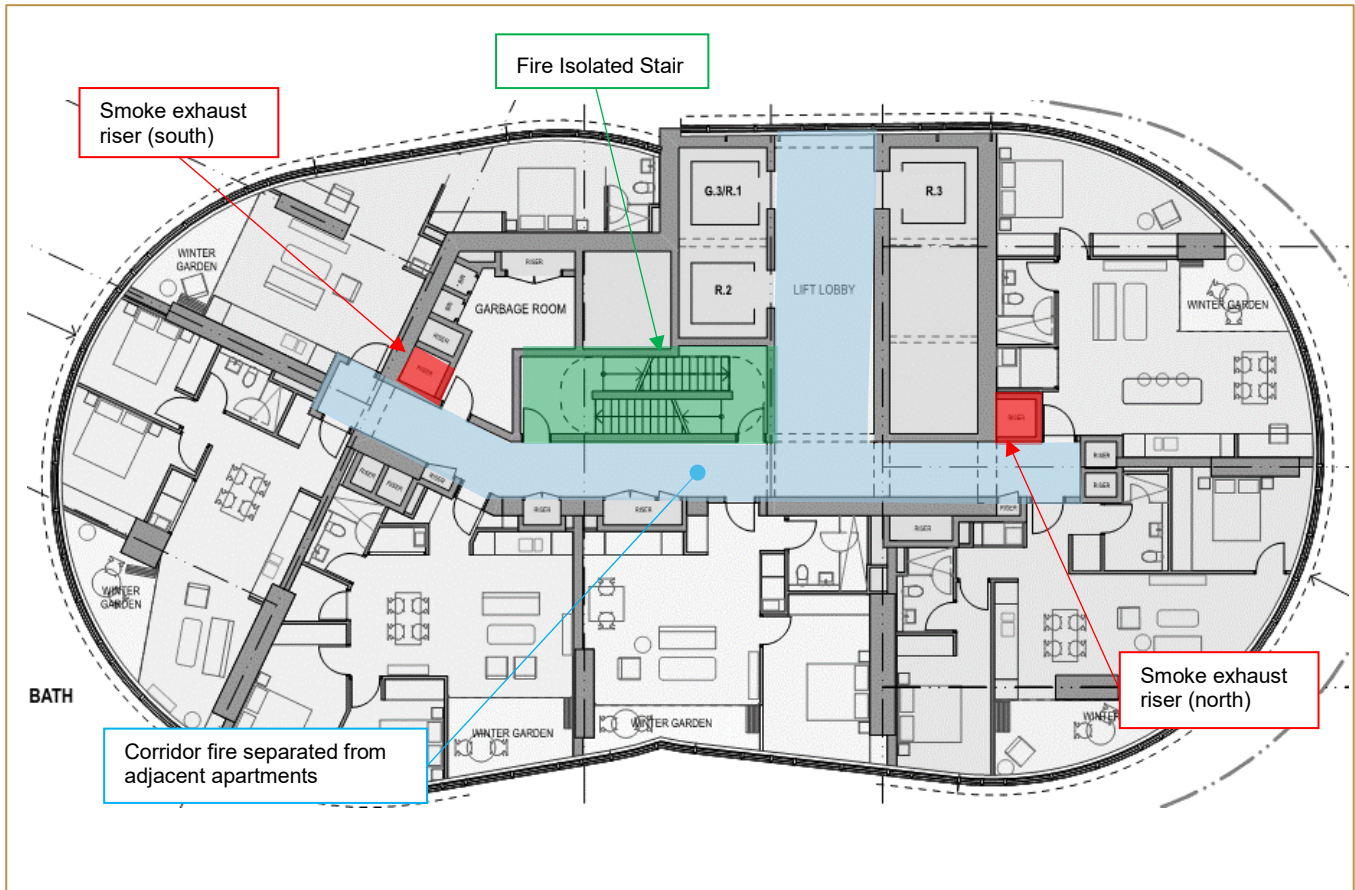


FIGURE 8: TYPICAL RESIDENTIAL LEVEL SHOWING PROPOSED MECHANICAL EXHAUST SYSTEM

Each shaft will be fitted with a smoke exhaust fan. Both shafts will be provided with sub-ducts in addition to smoke dampers to alleviate FRNSW review risk. The corridor itself will then be zoned into north and south portions. Which fan operates will be determined by the location of the zone which the actuated smoke detector sits within. The fan within the shaft closest to the detector will then run, and the fan within the other shaft will remain idle to allow fresh air to pass down through it. The corridor itself can then serve as a refuge for occupants should they be unable to evacuate via the fire stair themselves. The shortfall in this option would be that limitations would need to be placed on the types of finishes which can be used within the corridor itself (likely to be BCA Spec. C1.10 Table 3 - Group 2).

Where the fire isolated stair is being accessed directly from the occupied floor in the current design, the corridor exhaust system will not be able to serve these levels. It is proposed to either introduce a lobby to the stair in order for the exhaust system to serve these levels, or alternatively, provide air lock access to the stair entries to form an additional smoke barrier between the occupied space and the stairwell.

3.6 ANTICIPATED PERFORMANCE SOLUTIONS

The following Performance Solutions have been identified by the PCA following a preliminary review of the design in June 2017.

- ◆ Assess the provision of the fire-isolated stair serving the Tower to be protected by a bespoke smoke exhaust system in lieu of stair pressurisation.
- ◆ Protection of openings in adjoining compartments to be assessed on a performance basis.
- ◆ The egress strategy, including utilising lifts for egress, access to exits, travel distances, aggregate egress widths, continuous egress paths and fire isolated exits are proposed to be assessed on a performance basis.
- ◆ Assess the allowance for extended travel distances throughout the development.

- ◆ Assess the discharge of final exits to be within The Star main building from the retail units and F&B tenancy on the Southern end of the site (in lieu of to a road or open space).
- ◆ Public corridors exceeding 40 m in length not to be divided into intervals with smoke proof walls.
- ◆ Assess the aggregate egress width from Level 7 and 8 under the performance provisions of the BCA.
- ◆ Allow for the car stacker area not to be fully accessible
- ◆ The smoke hazard management and atrium to the community levels is proposed to be assessed on a performance basis in lieu of complying with the deemed to satisfy provisions of Clauses E2.2, Parts G3, G3.8 and Specification G3.8.
- ◆ Due to there being several entrances to the building, the access to the fire control room is to be documented as part of the alternative solution.
- ◆ Due to there being several entrances to the building, the location of the FIP and mimic panels are to be assessed under the performance requirements.
- ◆ Non-fire isolated stairs connecting four (4) levels directly and five (5) indirectly in the community spaces.
- ◆ Assess the rationalisation of FRLs to the Class 6 (retail) and 7b (storage) areas of the works.
- ◆ Assess the retail units being served by a single exit (within the Tower development).
- ◆ Assess the provision of performance based fire protection systems (water mist) within the new basement car stacker system.
- ◆ Assess the omission of a zone smoke control system in Class 6, 7b and 9b parts of the Ribbon and Tower.

A more detailed overview of the Performance Solutions being put forward as part of these works can be found in the Fire Engineering Brief Questionnaire (FEBQ) found in Appendix A of this report.

THE  STAR

FIRE LIFE SAFETY

4 FIRE AND LIFE SAFETY

4.1 BACKGROUND ON FIRE LIFE SAFETY AT THE STAR

The design for The Star, Sydney took place pre-1996, before the development of a performance based building code here in Australia. The building was designed in accordance with the prescriptive requirements of NSW Ordinance 70 and BCA (1990) with minimal fire engineering design incorporated within the building at project completion.

Since that time a considerable amount of redevelopment has taken place on site, which has resulted in numerous fire engineering reports being provided for the site over the last 10-15 years. Such an approach has resulted in a rather piecemeal life safety strategy, created by conflicting approaches and unnecessary complexities in systems operation and building functionality. WSP believe this can be improved upon considerably as part of the site-wide works.

4.2 FUTURE APPROACH TO FIRE LIFE SAFETY AT THE STAR

WSP are in the process of undertaking a thorough investigation of all fire engineering elements previously performed at The Star, which includes a review of the existing fire systems, evacuation management plans and operational procedures on site.

Part of this process is to understand exactly how the current essential services systems interface and perform to gain a holistic understanding of the building's fire performance. Following this review, we can then identify which of these systems would offer the greatest benefit to life safety as part of pinpointing key infrastructure which should be upgraded during this project. This review has identified an upgrade of the fire detection and alarm system as being the primary recommendation in this regard, which is in the initial design planning stage at this point in time.

In parallel with this services review process, we have collated copies of all existing Fire Engineering Reports (FERs) applicable to the site for the purposes of understanding the strategies which they propose. We are currently developing a holistic approach to fire life safety for The Star which enables an easy transition to the "end game" development. It will include a review and amalgamation of new and old fire engineering approaches in a seamless manner with a focus on maximising operational flexibility.

Given the significant nature of the proposed redevelopment, it is considered appropriate that consideration be given to amalgamating the existing fire life safety approaches with the proposed new development to develop a single holistic fire life safety strategy. This was the strategy agreed with SEGL upon first commencing these works on site. The aim would be to de-risk the project and the asset as a whole such that the facility operates as a single operation to enable business continuity throughout works, in addition to promoting the life safety of occupants and Brigade personnel as per standard fire engineering practice.

The scale of the works taking place on site adds additional design challenges to the engineering process. It is proposed that the fire engineering for each portion of works will be undertaken as an individual sub-project design report in the first instance. These reports are written with the existing fire engineering strategies in mind to minimise interruption to site operations as construction works take place. At completion of the works taking place across the site, each of these sub-project FERs will then be amalgamated into a single FER. This approach is discussed in more detail later in this report (refer to Section 4.6).

4.3 NATIONAL CONSTRUCTION CODE: BUILDING CODE OF AUSTRALIA

The primary legislation applicable to the development is the EP&A Regulations 2000, which require any new building to comply with the NCC Vol. 1: Building Code of Australia. The BCA provides a set of prescriptive Deemed to Satisfy (DtS) Provisions that, if adhered to, are considered to provide an acceptable level of safety, and achieve compliance with the Performance Requirements of the BCA. Deviations from the DtS Provisions must be shown to comply with the Performance Requirements of the BCA. The analysis of such a deviation is referred to as an Alternative Solution.

4.4 STAKEHOLDER ENGAGEMENT

4.4.1 Principal Certifying Authority

WSP have been working closely with the PCA on these works (McKenzie Group) since the site-wide masterplan works commenced in mid-2015. All performance based designs which are developed by our team are first accepted in principle by the PCA prior to submission to FRNSW for review and comment. This level of design collaboration will be continued throughout the Modification 13 works, to enable design outcomes to meet the approval of all stakeholders on the project.

4.4.2 FRNSW

WSP have engaged with Fire and Rescue NSW (FRNSW) throughout the project works taking place at The Star since 2015 (North West Gaming, Darling VIP, etc.). To enable early feedback to be sought, it was deemed beneficial for a Fire Engineering Brief Questionnaire (FEBQ) to be submitted to FRNSW. The FEBQ contains a high-level summary of the identified Performance Solutions which are proposed on the project for review and comment by the Brigade. The feedback received is then used to create robust solutions in the final Fire Engineering Report (FER).

The Modification 13 FEBQ has been submitted to FRNSW on Monday 18th September 2017. WSP received feedback from FRNSW on this document on 16th October 2017. The full document, including FRNSW's responses, has been attached as 'APPENDIX A – FRNSW FEBQ Submission' here for the review team's information. We have also provided a summary of FRNSW's comments and how WSP will address each of these at the Detailed Design stage of works in 'APPENDIX B – Summary of FRNSW comments and WSP responses'.

4.5 FIRE LIFE SAFETY OUTCOMES AT THE STAR

The design(s) developed as part of the Modification 13 works will adhere to the requirements of the NCC in full. Our assessment will incorporate fire compartmentation, evacuation principles and essential services which form part of a holistic assessment of the subject building to ensure life safety is upheld throughout. Compliance will be achieved through a mixture of both prescriptive and performance based design.

4.6 THE FIRE ENGINEERING PROCESS

In accordance with the International Fire Engineering Guidelines [IFEG], WSP's fire engineering for The Star will consist of preparing a Fire Engineering Brief (FEB) for every sub-project that is subject to Alternative Solution(s) to the BCA Deemed to Satisfy (DtS) Provisions. The FEB will include the objectives, proposed trial designs, methods of analysis and acceptance criteria for any Alternative Solutions proposed in the scheme.

Following approval of each FEB by project stakeholders, the IFEG stipulates that a detailed Fire Engineering Report (FER) can be prepared. The FER will contain all the relevant design calculations and justification to show that the Alternative Solutions contained within the FER comply with the Performance Requirements of the BCA.

Given the staging of the works on site, it will not be possible to supply an all-encompassing FEB or FER until all the sub-projects are designed and underway. It is therefore proposed that this process will take place on a project by project basis, with all of these reports being amalgamated into a single FER report as works near completion across site.

The existing AECOM FERs which are currently applicable to the site will be superseded once the WSP fire engineering strategy and final FER is complete.

The fire engineering process for each sub-project shall be undertaken as follows (subject to the scale of the sub-project in question):

TABLE 4: FIRE ENGINEERING PROCESS STATUS

Stage	Approximate Programme Schedule
Concept design development	Week 1 - 2
Draft Fire Engineering Brief Questionnaire (FEBQ) issued to team for comment	Week 3 - 5

Stage	Approximate Programme Schedule
FEBQ revised and issued to FRNSW	Week 8 (<i>FEBQ submitted 18th Sept 2017</i>)
Computational Fluid Dynamics (CFD) modelling undertaken (where applicable)	Week 8 - 12
Evacuation modelling undertaken (where applicable)	Week 8 - 12
Draft FER issued to team for comment	Week 13
FRNSW comments received back on FEBQ	Week 18 (<i>approximately</i>)
FER revised to suit FRNSW feedback application	Week 18 - 19 (subject to timing of FRNSW feedback)
FER issued as final for construction documentation	Week 20

4.7 FIRE ENGINEERING METHODOLOGY

4.7.1 ASET vs. RSET Assessment Methodology

For large and complex buildings, it is at times difficult to design the building against the prescriptive requirements of the Building Code of Australia. Performance based fire engineering design is adopted where complex scenarios are required to be addressed, which impact upon occupant evacuation. Such techniques make use of the life safety systems installed within a building, as well as taking into consideration its occupant behaviour, layout of the building, egress provisions and fire hazards to ensure occupants can evacuate safely.

By evaluating these systems and the level of safety and early warning afforded to occupants evacuating, it is possible to carry out a time based comparison of the time available for occupants to escape (the Available Safe Egress Time – ASET) against the required time for occupants to escape (Required Safe Escape Time – RSET).

4.7.2 FRL Reduction Assessment Methodology

Fire Resistance Level (FRL) reduction assessments will be undertaken using equivalent fire severity calculations. This should demonstrate that even with sprinkler failure within the subject area, the ventilation afforded to this space from glazing failure and other ventilation openings will keep temperatures below the level at which structural failure may occur. This assessment will be used as a sensitivity analysis, with the base case being a sprinkler controlled fire which will not reach the temperatures at which structural failure may ensue. This will be reviewed on a case by case basis.

4.7.3 Evacuation Principles

Egress provisions on site will achieve compliance through either a prescriptive DtS compliant design (20 m to a point of choice and 40 m to the nearest exit in public areas), hotel/residential corridor exit travel distance 6 m required by NCC or through performance based design. Where performance based design is used, the smoke exhaust system will be designed to maintain tenable conditions for the duration of the evacuation period including a 1.5 safety factor (as per IFEG).

The key principles behind the design (in terms of life safety) shall be as follows:

- ◆ Strategy shall be based upon the BCA's guiding principles: protection of life, protection of Brigade, protection of property;
- ◆ Egress philosophy will provide flexibility by utilising horizontal evacuation strategies to adjacent quasi-safe zones;
- ◆ Alternatively, in the hotel/tower by utilising the fire safety provisions proposed in place;
- ◆ Rationalised egress points shall be quantified holistically;
- ◆ Fire strategy will utilise qualitative and quantitative studies to determine most pragmatic approach; and
- ◆ Management of staging works crucial as transition from AECOM (existing) to WSP (proposed) FER takes

place if applicable.

Any rationalisation of egress routes, while maximising population numbers, will be subject to the outcomes of Computational Fluid Dynamics (CFD) and egress modelling that is undertaken. Full details on evacuation principles and occupant loading for each area will be carried out once detailed internal fitout plans are available for this development. This process will be carried out at Detailed Design stage of the project prior to the Construction Certificate (CC) being issued.

The anticipated population loads for each type of area can be found as follows:

TABLE 5: OCCUPANT DENSITY PER AREA (AS PROVIDED BY THE STAR)

Area Usage	Occupant Density (persons per m ²)
Function / bar space	1 : 1
Main gaming space	1 : 2
Food and beverage	1 : 2.5
VIP gaming space	1 : 3

4.7.4 CFD Assessment

Given the complexity of The Star site and the high population numbers within, it is deemed beneficial to conduct detailed fire and smoke modelling to quantify the level of life safety which the proposed design(s) will provide. Computational Fluid Dynamic (CFD) will be used to simulate fire development and smoke spread, with these results then used in an ASET/RSET analysis.

CFD assessment will also be utilised for the omission of stair pressurisation in the hotel and tower levels. A corridor exhaust system is being proposed in lieu to achieve an equal or greater level of life safety to the Deemed to Satisfy (DtS) Provisions of the BCA.

THE  STAR

CONCLUSION

5 CONCLUSION

WSP have reviewed the proposed design and can confirm that it is capable of compliance with the Building Code of Australia (BCA) requirements in relation to fire and life safety. Compliance with the BCA report for Modification 13 has been detailed in the Fire Engineering Brief Questionnaire (FEBQ) found in Appendix A. Although there are some design features that do not meet the Deemed-to-Satisfy (DtS) Provisions of the BCA, WSP have demonstrated that the design can meet the Performance Requirements of the BCA through fire engineering analysis and performance based solutions in relation to those matters. Our early engagement with FRNSW through the provision of this FEBQ will enable robust solutions to be developed to ensure stakeholder approval is in place prior to any further design works taking place.

Although egress provisions for the existing building will be affected by the proposed works, this will only involve a modification to the existing configuration which will work in tandem with the existing building envelope. The result of this is that the Modification 13 works will have a negligible impact on the life safety provisions on site and will be demonstrated to comply with the relevant building code and standards in full as part of these works.

In summary; the proposed Modification 13 works will have minimal impact on the existing building, and no impact on the surrounding environment in relation to fire and life safety.

THE  STAR

REFERENCES

6 REFERENCES

- [AS 1530.1] AS 1530.1 (1994), *Methods for fire tests on building materials, components and structures: Combustibility tests for materials*, Standards Australia
- [AS 1530.3] AS 1530.3 (1999), *Methods for fire tests on building materials, components and structures: Simultaneous determination of ignitability, flame propagation, heat release and smoke release*, Standards Australia
- [AS 1530.4] AS 1530.4 (2004), *Methods for fire tests on building materials, components and structures: Fire-resistance tests on elements of construction*, Standards Australia
- [AS1668.1] AS 1668.1 (1998), *The use of ventilation and air-conditioning in buildings; Fire and smoke control in multi-compartment buildings*, Standards Australia
- [AS 1670.1] AS 1670.1 (2004), *Fire detection, warning, control and intercom systems, system design, installation and commissioning – Fire*, Standards Australia
- [AS 1670.3] AS 1670.3 (2004), *Fire detection, warning, control and intercom systems, system design, installation and commissioning – Fire alarm monitoring*, Standards Australia
- [AS 1670.4] AS 1670.4 (2004), *Fire detection, warning, control and intercom systems, system design, installation and commissioning – Sound Systems and intercom systems for emergency purposes*, Standards Australia
- [AS1851] AS 1851 (2012), *Routine Service of Fire Protection Systems and Equipment*, Standards Australia
- [AS1905.1] AS1905.1 (2005), *Components for the protection of openings in fire-resistant walls: Fire-resistant doorsets*, Standards Australia
- [AS1905.2] AS1905.2 (2005), *Components for the protection of openings in fire-resistant walls: Fire-resistant roller shutters*, Standards Australia
- [AS2118.1] AS 2118.1 (1999), *Automatic fire sprinkler systems: General requirements*, Standards Australia
- [AS2293.1] AS 2293.1 (2005), *Emergency escape lighting and exit signs for buildings - System design, installation and commissioning*, Standards Australia
- [AS2293.2] AS 2293.2 (1995), *Emergency escape lighting and exit signs for buildings - System design, installation and commissioning*, Standards Australia
- [AS2419.1] AS 2419.1 (2005), *Fire hydrant installations - System design, installation and commissioning*, Standards Australia
- [AS2441] AS 2441 (2005), *Installation of hose reels*, Standards Australia
- [AS2444] AS 2444 (2001), *Portable fire extinguishers and fire blankets – Selection and location*, Standards Australia
- [AS 3745] AS 3745 (2010), *Planning for emergencies in facilities*, Standards Australia
- [BCA] ABCB (2015), *National Construction Code Series, Volume 1, Building Code of Australia 2015, Class 2 to Class 9 Buildings*, Australian Building Codes Board, Canberra.
- [BCA Guide] ABCB (2015), *Guide to the Building Code of Australia*, Australian Building Codes Board.

- [BRE] Annable, K (2006), *Effectiveness of sprinklers in residential premises – an evaluation of concealed and recessed pattern sprinkler products*, Building Research Establishment Ltd, United Kingdom
- [BS 7346-4] BS 7346-4, Components for smoke and heat control systems. Functional recommendations and calculation methods for smoke and heat exhaust ventilation systems, employing steady-state design fires, British Standards
- [FBIM] AFAC, Fire Brigade Intervention Model, Australasian Fire and Emergency Services Authorities Council August 2008.
- [IFEG] ABCB (2005), *International Fire Engineering Guidelines*, Australian Building Codes Board, Canberra
- [PD 7974-6] PD7974-6 (2004), *The application of fire safety engineering principles to fire safety design of buildings – Part 6: Human factors: Life safety strategies – Occupant evacuation, behaviour and condition (Sub-system 6)*, BSI British Standards.

7 APPENDIX A – FRNSW FEBQ SUBMISSION

The following pages contain the Fire Engineering Brief Questionnaire which WSP have submitted on Monday 18th September 2017 for their review and comment in relation to the Modification 13 works, along with FRNSW's responses received 16th October 2017 (refer red text within the same document).

1 Document control

Applicant reference number

FRNSW reference number NFB/02439-2-5

Ver.	Author	Organisation	Status	Date
01	Dan Kirk (NSW C10 BPB2952)	WSP	Initial submission	15/09/2017
02	Ben Hamilton	FRNSW (ref BFS17/2198 #1495)	Response to V01	16/10/2017

2 Applicant

2.1 Role of applicant

- ☐ Local government authority
 ☐ Certifying authority
 ☒ Fire safety engineer
 ☐ Development owner
 ☐ Other

Note: The applicant is expected to have the consent of the development owner to act on their behalf.

2.2 Agreement

As the applicant, I confirm the following:

- I agree to pay Fire & Rescue NSW (FRNSW) the charges set out in [Clause 46](#) of the *Fire Brigades Regulation 2014* (see Section **Error! Reference source not found.**).
- I agree to forward with this application the following documentation for FRNSW to review and provide advice on the assessment methods and acceptance criteria proposed for the given alternative solution:

- ☒ Copy of proposed building plans and specifications (e.g. relevant floor plans, elevations, site plan, section views, hydrant plan and schematic)
- ☒ BCA report or letter from an accredited certifier that identifies all non-compliances (if available)
- ☒ CFD/zone modelling inputs form (if applicable)
- ☒ Report extract of the trial design requirements/proposed fire safety measures (optional).

Name of applicant	Raymond Yeo
Applicant phone number	0414 496 514
Applicant email address	Raymond.Yeo@star.com.au

2.3 Remittance advice information

Invoices will be issued based on the information provided below:

Company / vendor name	The Star Entertainment Group		
Australian business number	85 149 629 023	Trading name	The Star Entertainment Group Limited
Remittance contact name	Raymond Yeo		
Remittance street address	80 Pyrmont Street, Pyrmont, NSW 2009		
Remittance postal address	PO box Q 192 QVB Post Office, NSW 1230 Australia		
Remittance email address	Raymond.Yeo@star.com.au		
Remittance phone number		Remittance fax number	

3 Consultation

3.1 Stakeholders

Role	Name and BPB number	Organisation and phone	Email address
Fire safety engineer	Dan Kirk	WSP 04 1531 4412	Dan.kirk@wsp.com
BCA consultant	Lindsay Beard	McKenzie Group +61 4 0787 0612	lbeard@mckenzie-group.com.au
Certifying authority	Lindsay Beard	McKenzie Group +61 4 0787 0612	lbeard@mckenzie-group.com.au
FRNSW reviewers	SO Darren Bofinger Ben Hamilton	Fire & Rescue NSW 02 9742 7434	firesafety@fire.nsw.gov.au

3.2 Meeting details

In conjunction with the written comments provided in response to this FEBQ, FRNSW may hold a meeting with the applicant to discuss aspects of the proposed alternative solution. The meeting will be at the discretion of FRNSW.

Type of meeting preferred ☐ No meeting ☐ Telephone meeting ☒ Face-to-face meeting

4 Project details

4.1 Premises

Premises name	The Star – Modification 13 project
Primary street address	80 Pyrmont Street, Pyrmont, NSW
Secondary street address	Secondary street address (if applicable)
Premises suburb	Pyrmont
Lot and DP numbers	TBC

4.2 Proposed works

☐ New building **Applicable NCC:** NCC 2016

☐ Refurbishment of an existing building

☒ Extension of an existing building **For existing buildings:**

☐ Change in use within an existing building Approximate year of construction: 1994

☐ Other: (provide details) Building code when constructed: Ordinance 70

In relation to this matter where FRNSW comments contradict or are not consistent with any condition of development consent, further consultation with FRNSW is required to refine the proposed fire safety strategy

How many alternative solution issues are proposed in this FEBQ? 14

Note: The number of alternative solution issues must address all identified non-compliances.

Have all departures from the deemed-to-satisfy (DtS) provisions of the *National Construction Code (NCC)* been identified for this proposed design (i.e. a BCA report or letter from an accredited certifier)? Yes

Note: Any advice given is subject to all non-compliances being identified. Any new DtS departures identified, including any from the certifying authority determining the application for construction certificate, may affect FRNSW advice in respect to this alternative solution.

Identify if any previous alternative solution applies to the building:

Overall Casino:

Refer AECOM FER ref. 60103570 (Part A, B and Appendix Report) issued on the 1st of December 2010

Astral Club Lounge (under construction)

No.	Description of Alternative Solution	BCA Clause	Performance Requirement	BCA (0.5)	BCA (0.9)
AS 1	To rationalise FRLs in Class 6 portions of Level 05 to 120/120/120 in lieu of 180/180/180	C1.1 and Specification C1.1	CP1 & CP2	(b)(i)	(b)(ii)
	To permit the omission of required fire separation between the Class 5 & 6 areas at Level 05	C2.8			
AS 2	To permit the omission of a Zone Smoke Control System (ZSCS) to the newly created Class 5 and 6 areas at Level 05.	E2.2(a)(i) & Table E2.2a	EP2.2	(b)(i)	b(c)
AS 3	To review the available 6 m egress width capabilities on Level 05 in terms of acceptance.	D1.6 (d)	DP2, DP4 & EP2.2	(b)(ii)	(c)
	To permit a required egress door not to swing in the direction of egress.	D2.20 (b)			
AS 4	Permit partially non-compliant sprinkler coverage across the Club Lounge Deck (external covered area) on Level 05, Astral Hotel.	Clause E1.5, Spec E1.5 & Clause 5.5 of AS 2118.1	EP1.4 & CP2	(b)(ii)	(b)(i)
AS 5	To permit glazed walls and doors to form part of a required fire wall through the provision of a Tyco drencher system	C2.8	CP2	(b)(ii)	(c)

Astral Lobby and Bar (under construction)

No.	Description of Alternative Solution	BCA Clause	Performance Requirement	BCA (0.5)	BCA (0.9)
AS 1	Rationalise FRLs in retail space on Level 00 to 120 minutes from 180 minutes	C2.7, C2.8 & Spec C1.1 (Table 3)	CP1 CP2	(b)(i) (b)(ii)	(b)(ii)
AS 2	Permit the Porte Cochere area to be treated as 'open space' for the purposes of occupants reaching an exit within 40 m from the internal Astral Lobby space	D1.4	DP4, EP2.2(a)	(b)(i)	(b)(ii)
AS 3	Rationalised smoke exhaust rates and extended travel distances within Astral Lobby space on Level 00	D1.4, D1.6, E2.2 and Specification E2.2	DP4 DP6 EP2.2	(b)(i) (b)(ii)	(b)(ii)
AS 4	Omission of hose reel coverage to Class 6 retail and Class 7a porte cochere areas	E1.4	EP1.1	(b)(i)	(b)(ii)
AS 5	Justification of porte cochere fire hydrant valves to be deemed 'external' for compliant coverage purposes	E1.3	EP1.3	(b)(i)	(b)(ii) (c)

Lyric Theatre

No.	Description of Alternative Solution	BCA Clause	Performance Requirement	BCA (0.5)	BCA (0.9)
AS 1	To Permit the auditorium seating spacing of the Grand Circle area only to deviate from guidance given in Table H101.12 as follows; - For no. of seats between 31-45, the depth of rows to be 980 mm in lieu of 1000 mm - For no. of seats between 46-60, the depth of rows to be 980 mm in lieu of 1025 mm	NSW H101.12.3 & Table H101.12	DP4 & DP6	(b)(i)	(c)
	To permit egress doorways through the walls of the auditorium to serve six (6) rows (located at front of auditorium at the Stalls Level) in lieu of the permissible five (5) rows.	NSW H101.12.6(b)			
	To permit the path of travel in parts of the auditorium seating areas to an exit to be reduced (in part only) from the required 1 m.	D1.6(b)			(b)(ii) (c)
AS 2	To permit the use of performance based illuminated exit signage (for the Lyric Theatre Auditorium space only) which shall not be illuminated at all times.	E4.5, E4.8 & Clause 6.7 of AS 2293.1	EP4.1 & EP4.2	(b)(i)	(b)(ii)
AS 3	To permit the omission of sprinkler heads from the concealed underfloor space of the Dress and Grand Circle.	Spec. E1.5 & Clause 5.6.1 of AS 2118.1	CP2 & EP1.4	(b)(i)	(b)(ii)

North West Gaming

No.	Description of Alternative Solution	BCA Clause	Performance Requirement	BCA (0.5)	BCA (0.9)
AS 1	Permit 60 m hydrant hose lengths to be used on the Main Gaming Floor, in lieu of 30 m lengths in accordance with AS 2419.1	E1.3, and AS 2419.1	EP1.3	(b)(ii)	(c)
AS 2	Permit the omission of fire hose reels from the North West Gaming area	E1.4	EP1.1	(b)(ii)	(b)(i)
AS 3	Permit performance based smoke exhaust, evacuation and egress provisions within NW Gaming area and mezzanine areas around the North West Gaming space.	D1.6, E2.2, and Spec. E2.2	DP4, DP6, and EP2.2	(b)(i)	(b)(ii)
AS 4	Permit extended travel distances of 41 m in lieu of 20 m from the front of house Cashier area.	D1.4 and D1.5	DP4, EP2.2	(b)(ii)	(b)(ii)

Sovereign Gaming (Stage 1 works) – under construction

No.	Description of Alternative Solution	BCA Clause	Performance Requirement	BCA (0.3)	BCA (0.5)
PS 1	Assess the provision of a reduced FRL to the Class 6 areas (120/120/120 in lieu of 180/180/180 FRL)	Clause C1.1 & Specification C1.1 Table 3	CP1 & CP2	(b)(i)	(b)(ii)
PS 2	Assess the use of escalators as part of the egress strategy for the building	D1.2, D1.9 & Spec D1.12	DP2, DP4, DP6 & EP2.2	(b)(i)	(b)(ii)
PS 3	To permit the following extended travel distances; — Travel to a point-of-choice of 27 m in lieu of 20 m — Travel to the nearest exit of 67 m in lieu of 40 m To permit a distance between alternative exits of up to 98 m in lieu of 60 m	D1.4 & D1.5	DP4 & EP2.2	(b)(ii)	(b)(ii)
PS 4	Assess the omission of fire hose reels from the Sovereign Gaming areas	E1.4	EP1.1	(b)(i)	(b)(ii)

Identify if any application has been/will be submitted under [Clause 188](#) of the *Environmental Planning and Assessment Regulation 2000*:

N/A

Identify if the premises is or will be subject to any development application (DA) conditions or special regulatory approvals (e.g. BPB conditions, ministerial conditions, crown building works):

Note: FRNSW will not comment on existing buildings subject to voluntary upgrade or change of use prior to the issue of any DA conditions of consent or Section 96 amendments. Comment will also not be provided if an order has been issued unless the Council agrees. The Council may seek advice during the DA review.

None at present, although SEARs application is currently with Council for review.

Will the premises be subject to a fire safety study, risk assessment or dangerous goods study? No

Note: Any study/risk assessment should be completed prior to submitting this FEBQ, and should be attached to this application.

4.3 Description of building occupancy

Main occupancy class	3	Other occupancy classes	2, 5, 6, 7a, 7b, 9b
Type of construction	A	Largest fire compartment (m ²)	TBC
Effective height	209 m	Ground floor area (m ²)	~25,000m ²
Rise in storeys	63	Total floor area (m ²)	>150,000 m ²
Levels contained	64	Total volume (m ³)	TBC

Note: The definition of effective height has changed in *NCC 2016*. For any other applicable *NCC*, consideration must be given to the NSW Supreme Court case [\[2012\] NSWSC 1244](#).

Outline any additional building characteristics:

BCA Clause	Building Characteristic	Description or requirements		
A1.1	Effective Height	Greater than 50 m in effective height (Approx. 209 m).		
A3.2	Occupancy Use and BCA Classification*	Basement 04 and lower	Carstackers Hotel BoH	Class 7a Class 3
		Basement 03	Residential / hotel storage Parking areas	Class 2 / 3 / 7b Class 7a
		Basement 02	Hotel Lobby Retail	Class 3 Class 6
		Level 00	Residential Lobby Retail	Class 2 Class 6 / 9b
		Level 02-Level 05	Plant Community Spaces	Class 7b Class 9b
		Level 05 Sky Terrace	Rooftop function space / restaurant	Class 6 / 9b
		Level 07	Ribbon – Function Spaces Restaurant and Bar	Class 9b Class 6
		Level 09 – Level 10	Residential Gym Hotel Change Facilities	Class 2 Class 3
		Level 11 – Level 38	Residential apartments	Class 2
		Level 39	Residential apartments Hotel BoH	Class 2 Class 3
		Level 40 – Level 41	Hotel Restaurant and Sky Lobby	Class 9b
		Level 42	Plant	Class 2/3 ancillary
		Level 43 – Level 58	Hotel Suites	Class 3
		Level 59	Club Lounge	Class 9b
		Level 60 – Level 61	Presidential Suites	Class 3
		Level 61 and Roof	Plant	Class 7b
C1.1	Construction	Type A		
C1.2	Rise in Storeys (RIS)	63		
	Number of Storeys	64		
Table C2.2	Fire Compartment Floor Area and Volume	Class 2	The Class 2 portions of the building are not subject to floor and volume limitations of Table C2.2.	
		Class 3	The Class 3 portions of the building are not subject to floor and volume limitations of Table C2.2.	
		Class 6	Does not apply as this is a Large Isolated Building	
		Class 7a	The carpark is to be sprinkler protected and as such there are no maximum floor area or volume limitations for this area	
		Class 7b	Does not apply as this is a Large Isolated Building	
		Class 9b		

Overview

SEGL has commenced a five-year redevelopment journey to create a landmark, exemplar integrated resort. This proposed redevelopment will occur through the lodgment of two s75W modification applications to the original Major Project Approval (MP08_0098) with the Department of Planning and Environment (the Department).

Modification 14 was lodged with the Department in October 2016 and is currently under assessment as a stand-alone modification application. Modification 14 proposes works and improvements across the site including improvements to access and circulation to and within the site and to generally improve the functioning, circulation and amenity of The Star. The proposed works will deliver an expansion of the Sovereign Resort and ancillary works, provide additional pre-function space to the Multi Use Events Facility, improve the arrival experience on Pirrama

Road and a number of associated internal upgrade works. These works seek to enhance the attractiveness and functioning of The Star.

Modification 13, proposes the development of a new Ritz-Carlton Hotel and Residential Tower in the northern portion of the site with associated podium treatment, as well as other transport, retail, food and beverage improvements across the site. It is Modification 13 that is the subject of this report. The proposed development has been assessed against all relevant standards/guidelines, including but not limited to the following:

- SEARs;
- Building Code of Australia;
- Guide to the Building Code of Australia; and
- International Fire Engineering Guidelines.

The Secretary's Environmental Assessment Requirements (SEARs) have been reviewed and it is noted that the proposed design has no potential fire engineering impacts on Modification 13 nor cumulative impacts. This Modification 13 Fire Engineering Assessment, has limited environmental impacts.

Proposed Works

New RITZ Carlton Hotel and Residential Tower includes

- Demolition of part of the existing building in the northern portion of the site;
- Construction of a new 237 m AHD (approximate) tall hotel and residential tower including
 - o 198 residential apartments located from Level 08 to 38 featuring a variety of one-bedroom, two-bedroom and three-bedroom unit types. A residential lobby at Level 00 that is accessed from Jones Bay Road; 220 hotel rooms located from Level 43 to 58 and Level 60 to 62; Hotel lobby at Level B2 to be accessed from the new Ritz-Carlton
 - o Porte-Cochere along Pirrama Road, which will provide access to the Sky Lobby at Level 40; Hotel Sky Lobby located at Level 40 and 41 for Ritz-Carlton hotel guests to check-in, featuring a bar, restaurant and lounge; and
 - o A Ritz-Carlton Club Lounge located at Level 59.
- A neighbourhood centre consisting of a café, reading room, collaborative, Pyrmont forum and terrace area.
- A new car-parking stacker system below the new porte-cochere of the Ritz Hotel, with a capacity of 225 spaces) to serve the new hotel and apartments; and
- A new drop-off/pick up area (short-term parking) on Jones Bay Road for the proposed apartments.

New Level 05 Terrace

- Food and drink premises with external areas;
- Completion of the Vertical Transportation drum to connect with Level 05 Terrace;
- Landscaping treatment; and
- New pool and pool deck upgrades for Astral Hotel and Residences.

New level 7 includes:

- A 'ribbon' at Level 07 connecting the new hotel and residential tower to the existing Star complex along the Pirrama Road frontage, comprising two pools (one for new hotel, one for The Star), associated pool decks and two food and drink premises with associated store rooms and facilities;
- Residential communal open space associated with the new residential apartments, comprising pool and landscaped terrace adjacent to Jones Bay Road;
- Gymnasium and associated change rooms and facilities for the residents;
- Gymnasium and associated change rooms and facilities for hotel guests; and
- Landscaping treatments

Evacuation Provisions

Egress from the residential and hotel tower is indicatively shown in Figure 1 below. The fire isolated stair serving the tower is not fitted with air pressurisation system; a bespoke corridor smoke exhaust system will be provided in lieu which will be subject to a Performance Solution.

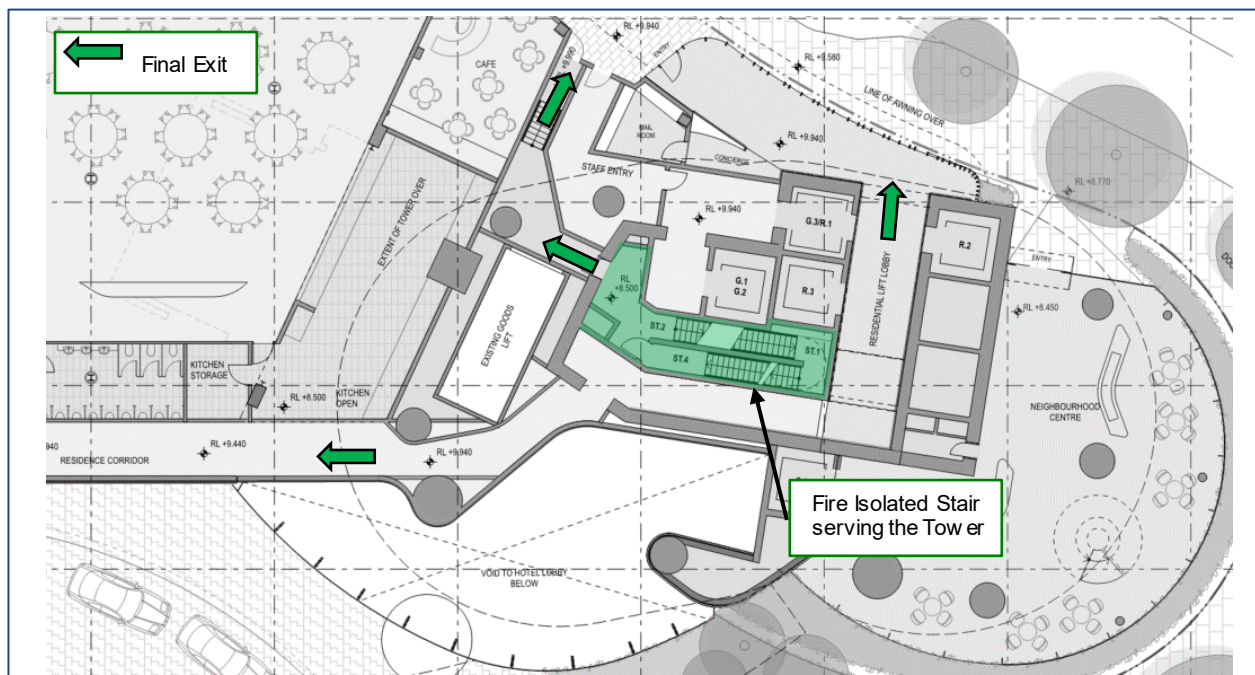


Figure 1: Egress provisions for the hotel and residential on Ground

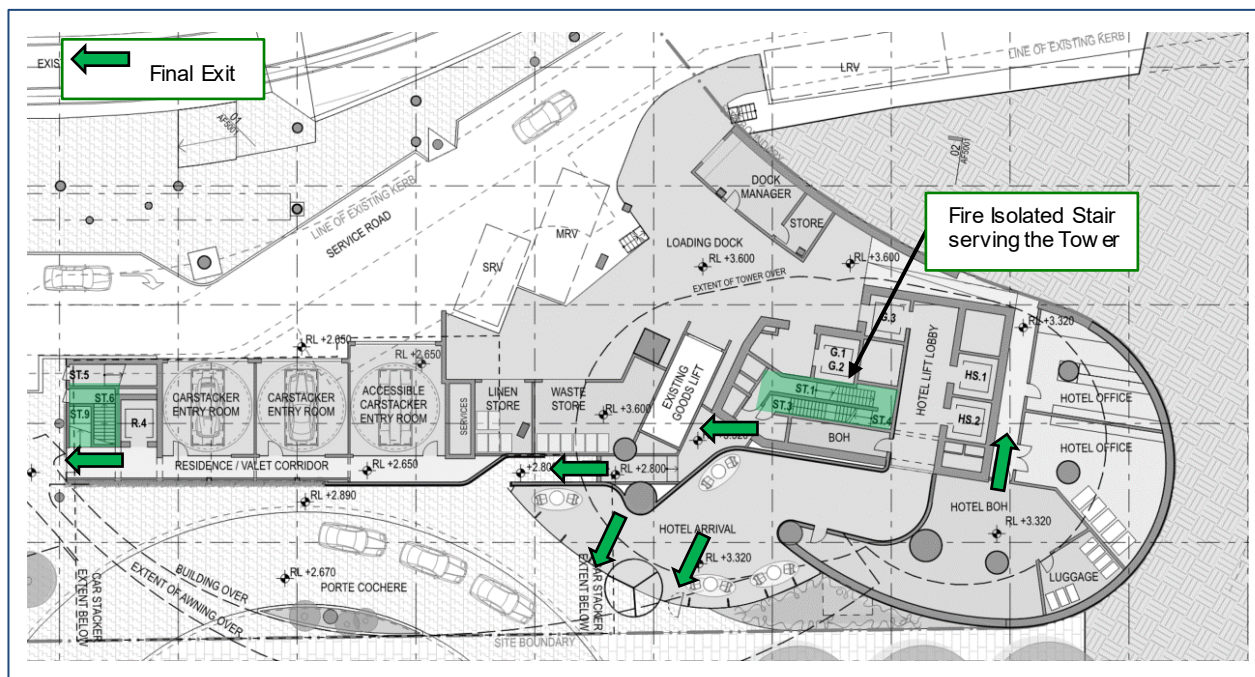


Figure 2: Egress provisions for the hotel and residential tower on B2 Level

The southern retail units and gastro pub forming part of the Modification 13 submission with the exception of the retail units located within the Astral Lobby premises - discharge to Union, Pyrmont and Edward Streets via The Star premises. Means of escape from the pub and retail units, and the exits which discharge from above into this space have been identified below.

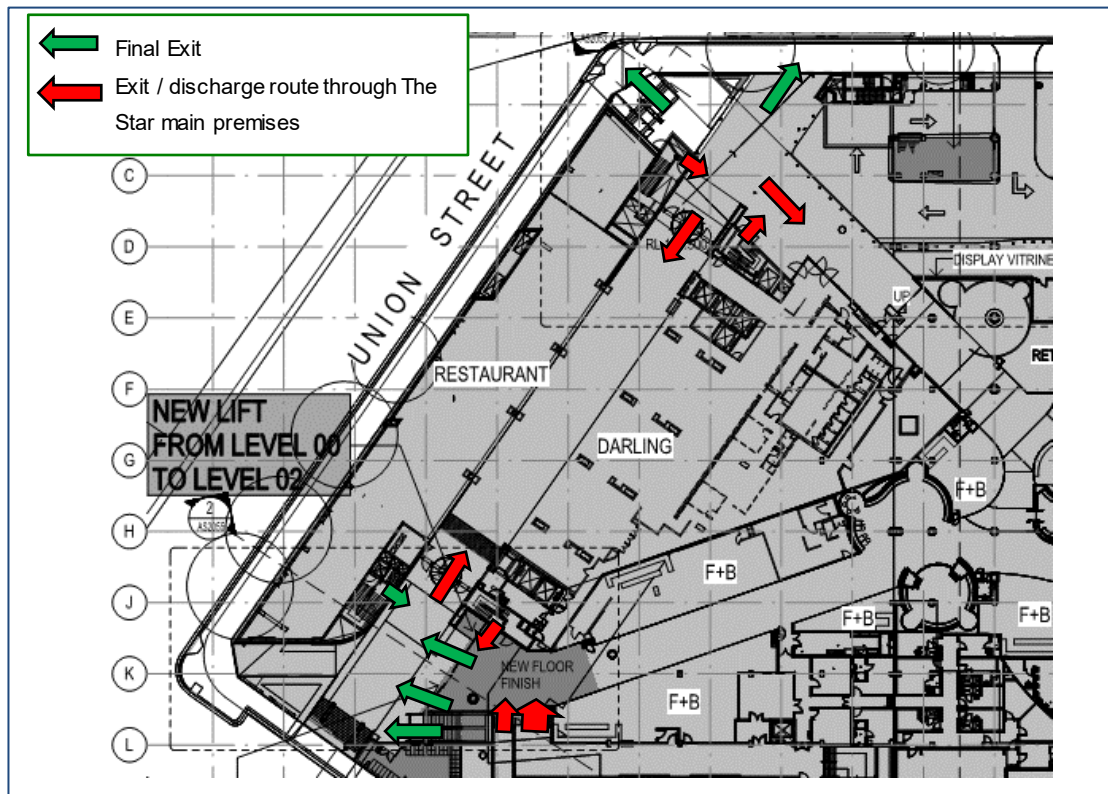


Figure 3: Egress provisions for the retail units and Gastro Pub

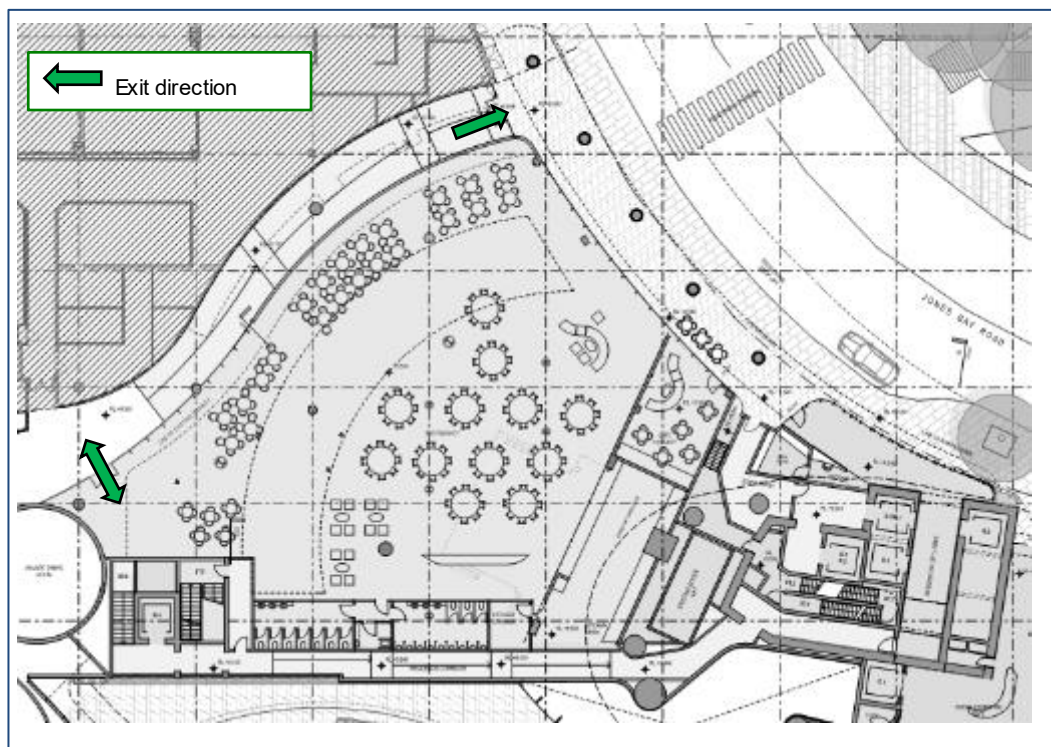


Figure 4: Restaurant Street egress

Neighbourhood Centre

The lower levels of the Tower serving Ground to Level 04 will form the Neighbourhood Centre. The levels will be interconnected with two separate open spiral stair. A cafeteria will be present at ground level and the upper levels will be forming the neighbourhood centre / tech space. Two means of escape will be provided from each of these levels, as indicatively shown below.



Figure 5: Level 2 Community/Neighbourhood Centre

The Ribbon & Sky Terrace at Level 05 and 07

The Ribbon is considered an open space with the two restaurant tenancies discharging in open air. The Ribbon is connected to the Level 5 Sky Terrace as illustrated in below.

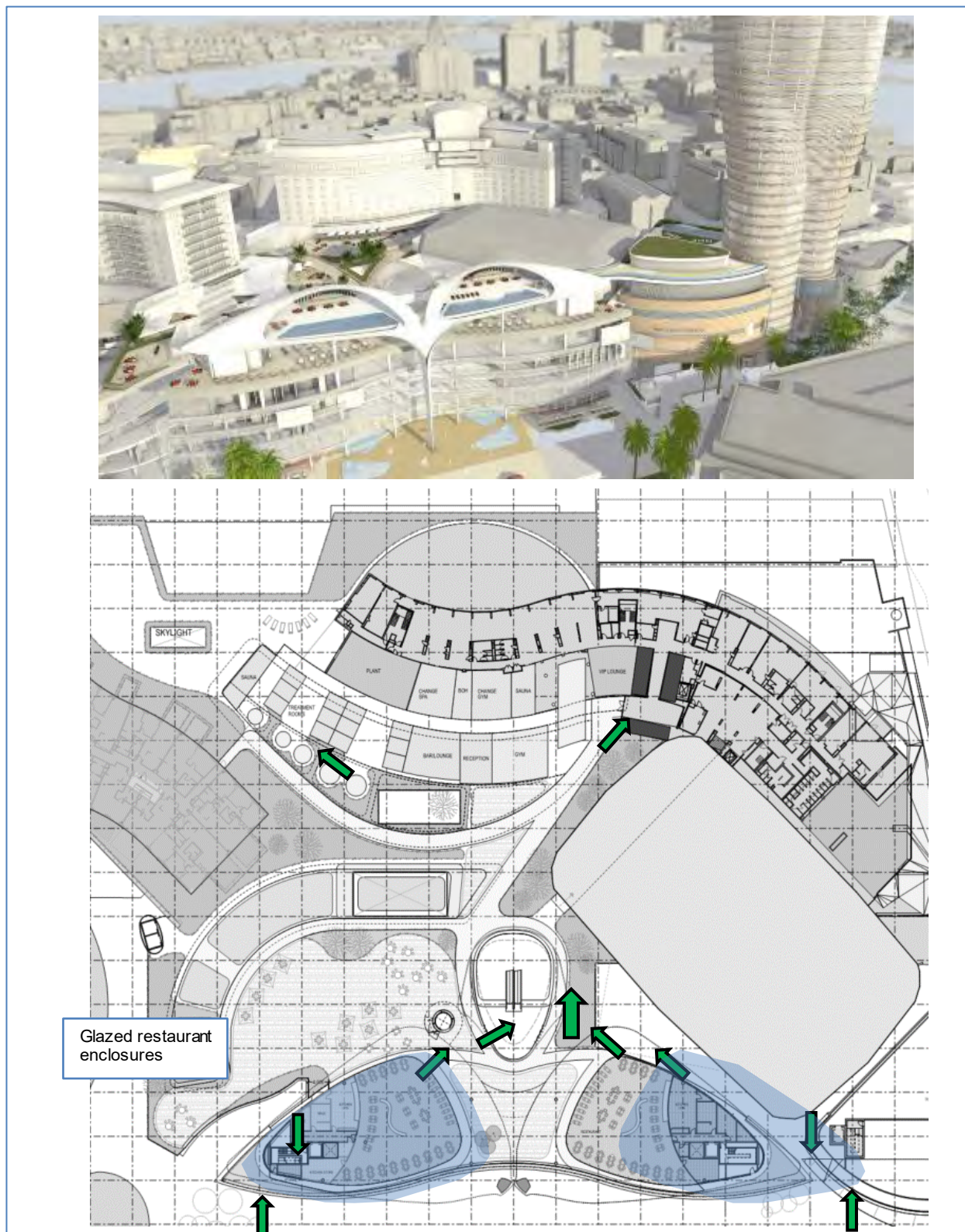


Figure 6: Egress Provisions from the Ribbon and Sky Terrace

Level 07 Pool Terrace

As illustrated in the 3D render in the figure below, Level 6 and Level 7 forms a canopy over the Level 5 Ribbon structure. The pool terrace is essentially open to atmosphere. On the Tower side there's the residents' pool as well as the hotel and residential gym facilities at the northern end of the floorplate. Escape provisions from this level are shown in figure below.

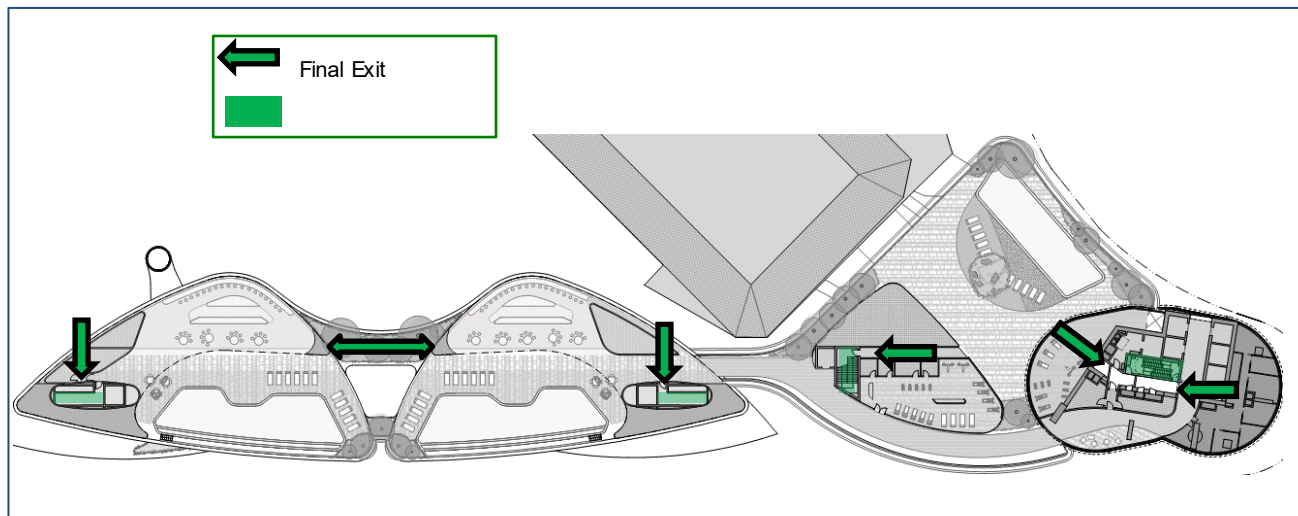


Figure 7: Egress Provisions from Level 7



Figure 8: Mod 13 Tower Section Drawing

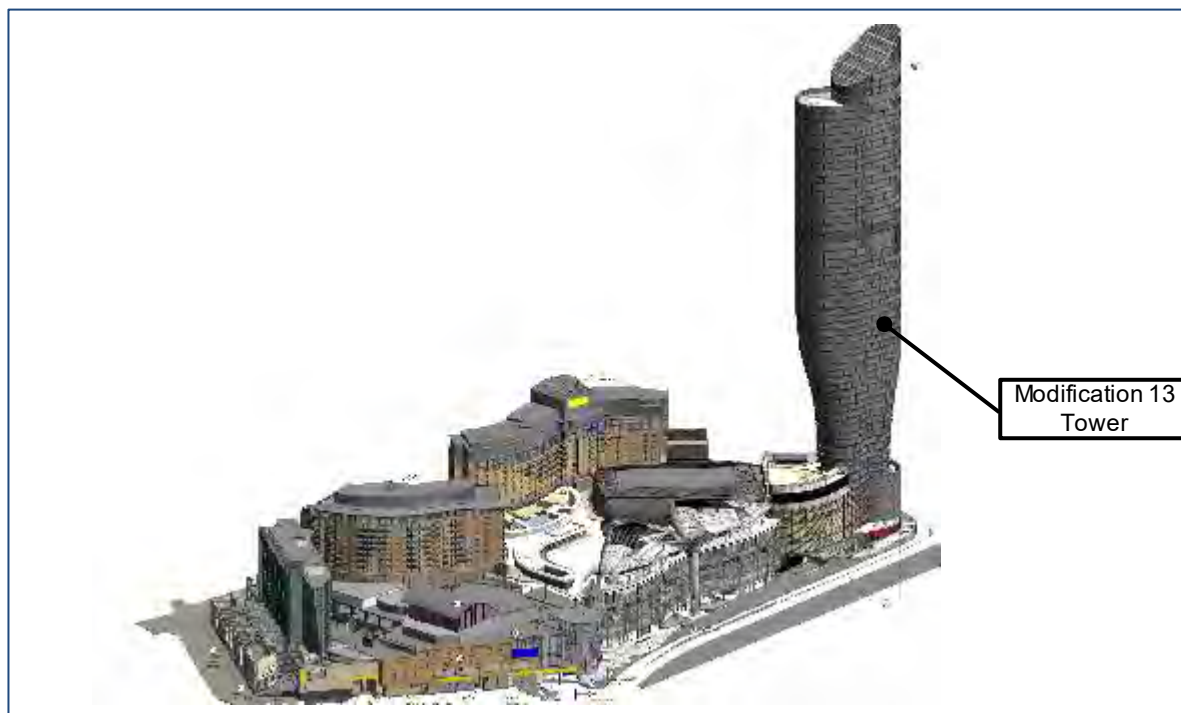


Figure 9: Location of the tower in relation to existing portions of the building

Proximity to Fire & Rescue NSW fire stations

The site is located approximately 400 m (as determined by Google Maps) from the Pyrmont Fire Station at 147 Pyrmont St, Pyrmont NSW 2009, as depicted in Figure 10. The building is also in close proximity to Glebe Fire Station, City of Sydney Fire Station and The Rocks Fire Station as detailed in Table 1, which also lists the resources available at each station.

Table 1: Fire Stations in close proximity to The Star Casino building

Station Name	Address	Station resources	Distance from The Star
Pyrmont Fire Station	147 Pyrmont St, Pyrmont NSW 2009	1 x Class 3 Pumper 1 x Hazmat	0.4 Km
Glebe Fire Station	75 St Johns Rd, Glebe NSW 2037	1 x Class 3 Pumper 1 x Bronto F27 Ladder Platform	2.0 Km
City of Sydney Fire Station	211-217 Castlereagh St, Sydney NSW 2000	3 x Class 3 Pumper 1 x Bronto F44 Ladder Platform 1 x Rescue	2.6 Km
The Rocks Fire Station	166 Kent Street, The Rocks NSW 2000	1 x Class 3 Pumper	2.9 Km

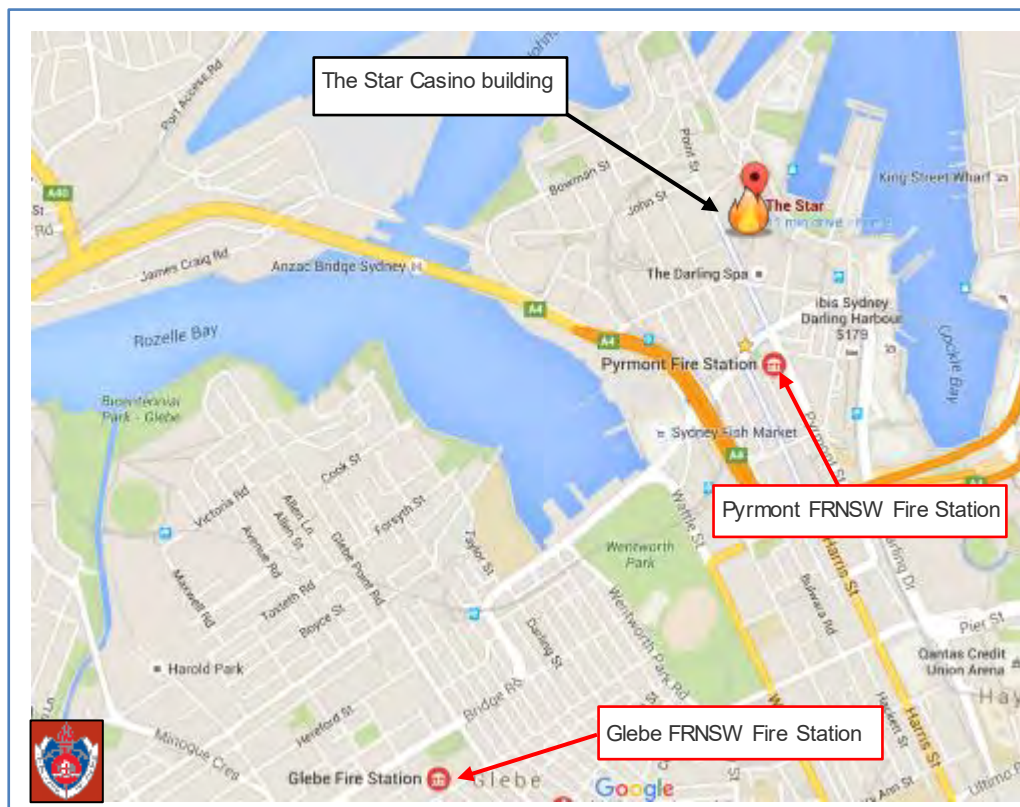


Figure 10: Nearest fire stations to building - (Google Maps©2015)

Fire Brigade Notification of a Fire Emergency

The existing building is sprinkler protected throughout in accordance with AS 2118.1. It is noted that upon activation of a sprinkler head or other fire alarm actuation device (such as a smoke or thermal detector), the Brigade are automatically notified of a fire in the building via the Alarm Signalling Equipment (ASE) within the Main Fire Indicator Panel (MFIP). It is concluded that the fire brigade would be expected to start with their operations / fire suppression activities in the early stages of a fire emergency, given their close proximity to the subject site.

Location of Fire Hydrant Booster & FIP

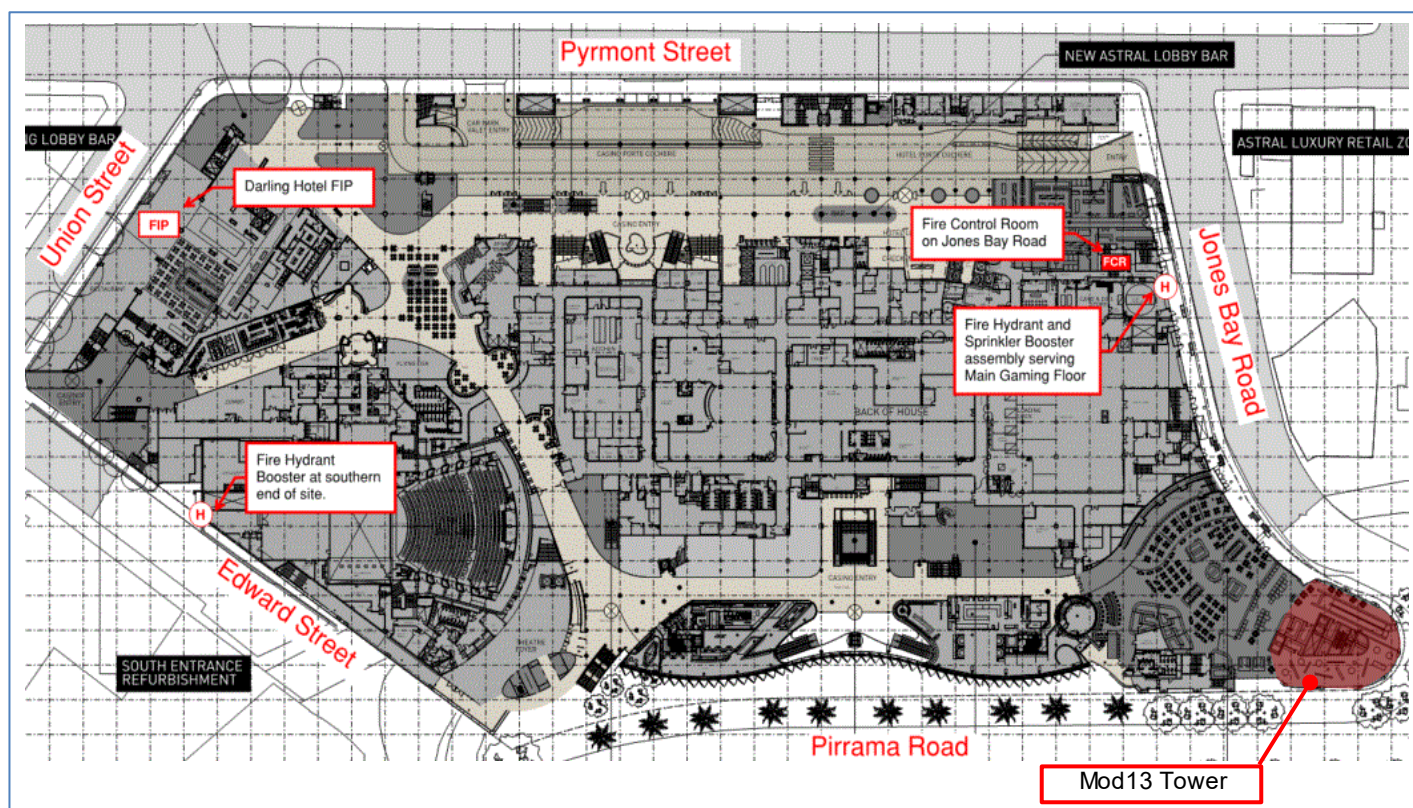


Figure 11: Fire Fighting Facilities

Fire-fighting

When undertaking fire-fighting activities, the fire brigade would set up their fire hoses from the hydrants provided at the storey exits. Fire fighters would then move from the hydrants onto the floor plate under the protection of the hose stream issuing from the nozzle attached to the fire hose. Should they then need to retreat, they can follow the fire hose back to the exit.

It is noted that all points on the floor plate can be adequately covered by fire hoses attached to the hydrant at each storey exit (40 m coverage is afforded from each fire hose which is 30 m of hose length + 10 water stream), unless modified elsewhere in this report by the use of two (2) x 30 m hoses being connected as a single 60 m length.

List key occupant characteristics for the building:

In an emergency, the characteristics of occupants and their corresponding interaction with the building environment and people around them play an important role in their ability to escape in a timely manner. It is therefore necessary to consider the characteristics of the range of occupants that can be expected in the building.

The principal occupant characteristics are listed in the table below.

Table 2 Characteristics of building occupants

Occupancy use / Location	Occupant Groups	Familiarity with surroundings	Occupied period / Occupant density	State of awareness
Class 2 (residential and Hotel levels)	Family groups of all ages. Children accompanied by parents.	Due to simple layout, clear signage and short travel distances able to navigate to exits	Day/night / low	Awake and aware or asleep, potentially impaired by alcohol

Class 6 (Hotel lobbies/function areas)	Members of the public. Single to family groups of all ages. Staff present at all times	Due to simple layout, clear signage, familiarity with entry route and assistance from staff able to navigate to exits	Day / medium	Awake and aware
Class 7a (Carpark)	Single guests to family groups of all ages. Children accompanied by parents.	Due to simple and open air layout, clear signage and short travel distances - able to navigate to exits	Day / High at morning & evening peaks Night / Low	Awake and aware Awake and aware
Plant spaces	Building maintenance personnel / occasional contractors	Familiar with building, location of exits and building alarm tones	Day / Occasionally occupied for short periods for maintenance purposes	Awake and aware

5 Hazards

Outline any hazards unique to the building:

- | | |
|---|--|
| ☐ Insulated sandwich panels | ☐ Dangerous / hazardous goods storage |
| ☐ Electrical hazards (substations/switchboards etc.) | ☐ Alternative electrical generation (e.g. solar, tri-gen) |
| ☐ Other: (provide details) | |

6 Preventative and protective measures

Identify fire safety measures that are, or will be, provided throughout the building, including anything undecided, which should be mentioned as part of the FEBQ review. Additional information may be added to the comments section below to better describe any systems or indicate systems that may be subject to alternative solution.

Occupant warning system

- ☐ Building occupant warning
- ☐ EWIS
- ☒ SSISEP
- ☐ Break glass unit
- ☐ Visual / tactile alarm devices

Smoke hazard management

- ☐ Zone smoke control
- ☐ Purge system (existing building)
- ☐ Smoke and heat vents
- ☒ Smoke exhaust
- ☒ Smoke baffles
- ☐ Ridge vents
- ☐ Stair pressurisation
- ☐ Impulse / jet fans (in carpark)
- ☐ Other: (provide details)

Detection system

- ☐ AS 3786-1993 / AS 3786:2014
- ☒ AS 1670.1:2015
- ☒ AS/NZS 1668.1:2015
- ☒ AS 1670.3-2004 (monitored)
- ☐ Smoke alarms
- ☐ Heat alarms
- ☒ Smoke detectors
- ☒ Heat detectors
- ☐ Flame detectors
- ☐ CO detectors
- ☐ Multi-criteria fire detectors
- ☐ Aspirated smoke detection
- ☐ Beam detection
- ☐ Other: (provide details)

Signage

- ☒ Emergency lighting
- ☒ Exit and direction signs
- ☒ Warning and operational signs

Hydrant system

- ☒ AS 2419.1-2005
- ☐ AS 2419.1-1994 (existing building)
- ☐ Ordinance 70 (existing building)
- ☐ External hydrants
- ☒ Internal hydrants
- ☐ Street hydrant coverage only
- ☒ Hydrant booster assembly
- ☒ Pumpset
- ☐ Other: (provide details)

Suppression system

- ☐ CA16 (existing building)
- ☒ AS 2118.1-1999
- ☐ AS 2118.1-2006
- ☐ AS 2118.2-2010 (wall-wetting)
- ☐ AS 2118.3-2010 (deluge)
- ☒ AS 2118.4-2012 (residential)
- ☐ AS 2118.5-2006 (domestic)
- ☐ AS 2118.6-2012 (combined)
- ☒ Fast response heads
- ☐ ESFR
- ☐ Storage mode sprinklers
- ☐ Gaseous suppression system
- ☐ Water mist system
- ☐ Other: (provide details)

Facilities for emergency services

- ☒ Emergency lifts
- ☐ Fire control centre
- ☒ Fire control room
- ☒ Perimeter vehicular access
- ☒ Standby power supply system

Firefighting equipment

- ☒ Portable fire extinguishers
- ☒ Fire hose reels

Water supply

- ☒ Grade 1
- ☐ Grade 2
- ☐ Grade 3
- ☐ Onsite storage tank
- ☐ Dual supply

Protection of openings

- ☒ Fire doors
- ☐ Smoke doors
- ☐ Solid core doors
- ☐ Fire windows
- ☐ Fire shutters
- ☐ Wall-wetting sprinklers
- ☒ Fire curtain
- ☐ Smoke curtain
- ☐ Safety curtain for openings
- ☒ Fire dampers
- ☒ Smoke dampers
- ☐ Fire seals (intumescent)
- ☐ Hot smoke seals (>200°C)
- ☒ Medium temp. smoke seals

Additional information:

For the Trial Design, it is proposed to consider that the following relevant fire safety provisions will be provided, over and above what is required under the BCA's DtS Provisions. It is assumed all other works will comply with the prescriptive requirements of the BCA.

Active Fire Safety Measures

Automatic Fire suppression system

- The building will be provided with an automatic sprinkler system, in accordance with AS 2118.1. Sprinklers in are to be 68 °C fast response sprinkler heads (subject to ambient temperature) with a RTI of 50 m^{1/2}s^{1/2} or less. Flush mounted sprinkler heads are not to be used unless first deemed acceptable by the fire engineer for use in the nominated area.
- The sprinkler system is required to be connected to and activate an EWIS on site.
- AS 2118.1-1999 sprinkler coverage will be provided to the fire curtain and the stair risers within the fire curtain area i.e. sprinkler protection will be provided to the underside of the stair to protect the flights.
- The car stacker transfer basin at basement 2 and plant room at basement 3 shall be provided with sprinkler protection in accordance with AS 2118.1.-1999.
- The car stacker storage levels (Basement 4 downwards) to be provided with water mist system, in lieu of AS 2118.1 compliant sprinkler protection as required by the BCA. The mist system is to be in a deluge type configuration so that only the fire affected zone will be activated at any one time. The zoning of this system shall be as per **Error! Reference source not found.**
- Additional water mist heads should be incorporated within the vehicle storage bays (including pits). The design of the mist system should be based on all mist heads within one zone operating simultaneously.
- Water mist heads within the storage bays should be positioned so that every corner of each vehicle space / bay is covered as per the following:

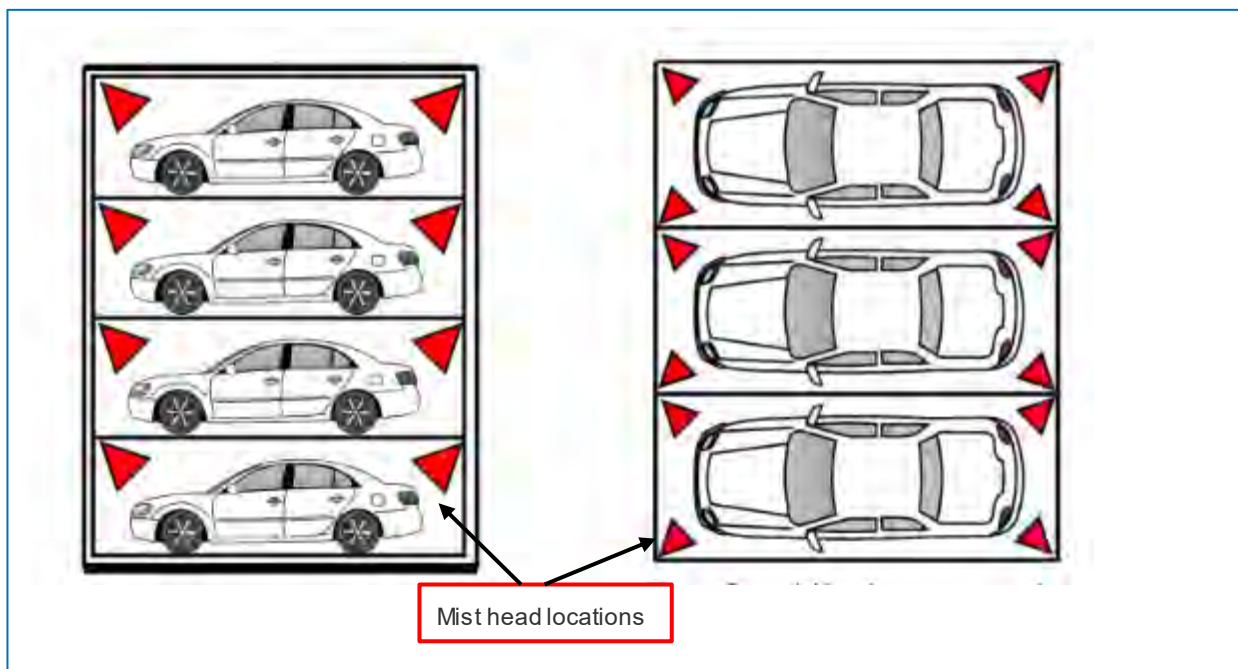


Figure 12: Water mist system layout (P. 32, Guidelines 32, MFB)

Fire detection and alarm system

- Install an addressable smoke detection system to AS 1670.1 in accordance with BCA Specification Clause 4 and connected to activate an EWIS in accordance with Clause 6 with direct brigade connection in accordance with Clause 7.

- AS 1670.1 (2015) compliant smoke detection shall be provided to any internal spaces on Levels 5 and 7 on a 10 m grid layout throughout occupied space areas for the purposes of reducing alarm times to this space.
 - The main Fire Control Room (FCR) serving the building which is located on Jones Bay Road is permitted to be >300 mm above street level at this side of the building.
 - A mimic panel is to be provided in the hotel entry foyer on Basement 2 level (street level on the Pirrama Road side of the building). This panel shall be purely for notification purposes.
 - A Sound System and Intercom System for Emergency Purposes (SSISEP) shall be installed throughout the entire building, in accordance with AS 1670.4.
 - An additional smoke detector is to be included in accordance with AS 1670.1 at the top of the stair void on Level 4.
 - At Level 7, an external sounder and strobe light will be provided within the outdoor space. In the event of a fire alarm sounding for a fire trip within the building, external sounders and strobe lights within the outdoor space will alert occupants to commence evacuation.
 - A red strobe light will be provided within proximity of the interconnecting stair at the rising stairs on level 2 and the top of the stair on level 3. This light will activate upon alarm activation to signal that the fire curtain is lowering.
 - The cascade sequence for the site's Emergency Warning and Intercom System (EWIS) shall be programmed in a '1 up, 1 down' configuration. In the event of a fire being detected on a floor, the fire affected floor will go into alert for two minutes, after which time the alert tone will switch to the evacuation tone. A further three minutes after this change, the cascade sequence will commence, where the floors directly above and below the fire affected floor will go through the same alarm sequence.
 - The occupant warning system shall have automated spoken instructions included in it which shall advise people that an alarm has been identified on their floor, and that the lifts may be used for evacuation.
 - The smoke detection and alarm system within Hotel SOU's shall be in accordance with BCA DTS requirements (Specification E2.2a Clause 4). Smoke detectors shall be installed and located within SOUs in accordance with BCA DTS Specification E2.2a Clause 3(c)(i) and operate as follows:
 - o The smoke detection system shall be configured in a double knock configuration on hotel and serviced apartment levels. In the event of two or more detectors (i.e. one in an SOU and one in the corridor), or any other alarm initiating device being activated (sprinklers, break glass alarm, etc.) then this shall override any ADF timer within the system.
 - o Detection of smoke only within an SOU will activate an alarm condition at the front desk and on the building manager's pager (or equivalent) to enable management to investigate further.
 - o The activation of an SOU smoke detector shall enable staff to acknowledge the alarm condition to commence the Alarm Delay Facility (ADF) countdown of between 120 and 300 seconds as per AS 1670.1 (2015) Clause 3.4.
 - o The detector in the alarm affected room will either be fitted with a sounder base which alerts those in the room of the alarm condition, or a floor-wide alarm shall commence during this preliminary alarm period.
 - o When smoke or steam is cleared from the detector, the localised / floor-wide alarm and the front desk alert shall stop.
 - o Should hotel management find that the alarm condition is a valid one, then the alarm will be raised manually at the front desk immediately.
 - o Where the smoke detector is still in alarm after a period of 120 - 300 seconds, this shall commence the SSISEP cascade sequence and shall call the Brigade out via the ASE.
- FRNSW Comment: Please confirm whether the above also applies to Class 2 SOUs.**
- Note that the twin key SOUs shall be treated as one (1) SOU, thus activation of a smoke detector within one SOU shall also activate the alarm within the adjoining main SOU and vice versa.
 - No further alarm verifications beyond the above are permitted.

Manual Fire Suppression Systems

- The hydrant system serving the Mod 13 Tower shall be provided with four (4) pressure zones and two levels of booster pumps (approximately Level 05 and Level 41).
- The lower portions of the building (Level 03 down to Basement 5) shall be on a gravity feed which is directly fed from the town mains supply. This is not included in the four pressure zones serving the tower i.e. the building as a whole technically contains five zones when this gravity fed zone is taken into account.
- It shall be permitted for the hydrant system to contain four (4) interconnected pressure zones, in lieu of the maximum of three (3) zones specified in the draft edition of AS 2419.1.
- It shall be permitted for the hydrant system to be served by a 75 kL dual purpose storage tank on Level 15 of the Astral Hotel (hydrant and domestic water storage), in lieu of a 50 kL storage tank on the roof of the subject tower as specified in the draft edition of AS 2419.1.

FRNSW: see alt sol #10 comments

- Signage shall be provided at each of the internal fire hydrants that are located on the mid-landing. The signage shall clearly indicate which level the internal fire hydrant is designed to serve.
- Additional signage shall be provided for the Fire Brigade above the fire hydrant booster assembly, beside each FIP on site, beside the fire hydrant pumps, and on the inside face of each fire stair doorway on Level 05 so as to inform personnel of the requirement to utilise two interconnected hoses as detailed below;

ATTENTION FIRE BRIGADE

Two lengths of fire-fighting hose is required to reach all areas on Level 05

The words "ATTENTION FIRE BRIGADE" must be in upper case letters not less than 50 mm in height and all other letters must be not less than 25 mm in height. The lettering shall be in a colour contrasting with the background. The additional signage to be utilised must be fade resistant signage.

A block plan showing the location of each fire stair containing a hydrant valve on Level 05 shall be provided adjacent to each hydrant valve on this floor for Brigade information.

- Fire hose reel coverage is to be omitted within the Class 6 portions of the Mod 13 development.
- Fire extinguishers are to be located within each restaurant / food outlet or bar area with exact locations as detailed in below, in accordance with Sections 1-4 of AS 2444 and installed to cover Class A fire risks by being:
 - an A:B:E type extinguisher; and
 - a minimum size of 2.5 kg within each food outlet / restaurant or bar area and no less than 4.5 kg to be provided within each fire hydrant cupboard or security staff station; and
 - Staff members are to be trained in the location and use of these fire extinguishers to enable them to undertake first aid firefighting activities should a fire break out in their areas; and
 - Extinguishers within food outlet / restaurant or bar areas are permitted to be inaccessible when that particular area is closed.
- Casino, hotel and restaurant / bar staff members are to be trained in the location and use of these fire extinguishers to enable them to undertake first aid firefighting activities should a fire break out in their area.

Smoke Hazard Management

- The basement levels of the Mod 13 development up to the uppermost floor of the neighbourhood centre (Level 4) shall be provided with stair pressurisation in accordance with BCA Clause E2.2 and AS 1668.1 (2015).
- Fire doors shall be provided within the scissor stairs to separate the flights between Level 4 and Level 5 from one another to enable only the lower floors to be provided with stair pressurisation. Level 5 upwards is to be provided with a performance based smoke exhaust system as detailed below.
- The residential and hotel levels (Level 5 up to roof level) will be provided with a performance based smoke exhaust system in lieu of a staircase pressurisation system as detailed below:

- o A mechanical smoke exhaust system is to serve all residential and hotel levels from Level 5 upwards. This system is to be capable of exhausting and supplying a minimum required extraction rate (typically 4 - 5 m³/s) from two locations as highlighted in **Error! Reference source not found.**
- o The above smoke exhaust system is to be designed with a riser at each end of the corridor. Inside each riser there will be both an exhaust and supply fan which serves this system. In the event of a fire being detected on a floor, an exhaust fan is to operate in the riser closest to the fire, and the supply fan is to provide make-up air to this system at the opposite end. The detection system serving each floor is to be split into two zones to allow such a design to operate as required.
- o The supply fan in each riser shall be provided with a Variable Speed Drive (VSD) mechanism to assist in final testing and commissioning of this system. The supply is anticipated to be provided at around 10% less than the exhaust rate for the purposes of creating a negative pressure differential in the corridor.
- o Fan operation shall be monitored, and if the nominated fan does not start, the system is to automatically switch over to the fan at the opposite end of the corridor for N+1 redundancy.
- o On detection of smoke in the corridor, the dampers of both shafts open on the level of fire origin and the fan at the head of the shaft nearest to where smoke was detected activates to draw smoke from the corridor out through the shaft, with make-up air being drawn in via the second shaft with the fan at top free spinning. The dampers on the other floors are to remain closed to mitigate smoke migration through the building. The zoning of this system is shown in **Error! Reference source not found.**, with the schematic representation of how this operates shown in **Error! Reference source not found.**

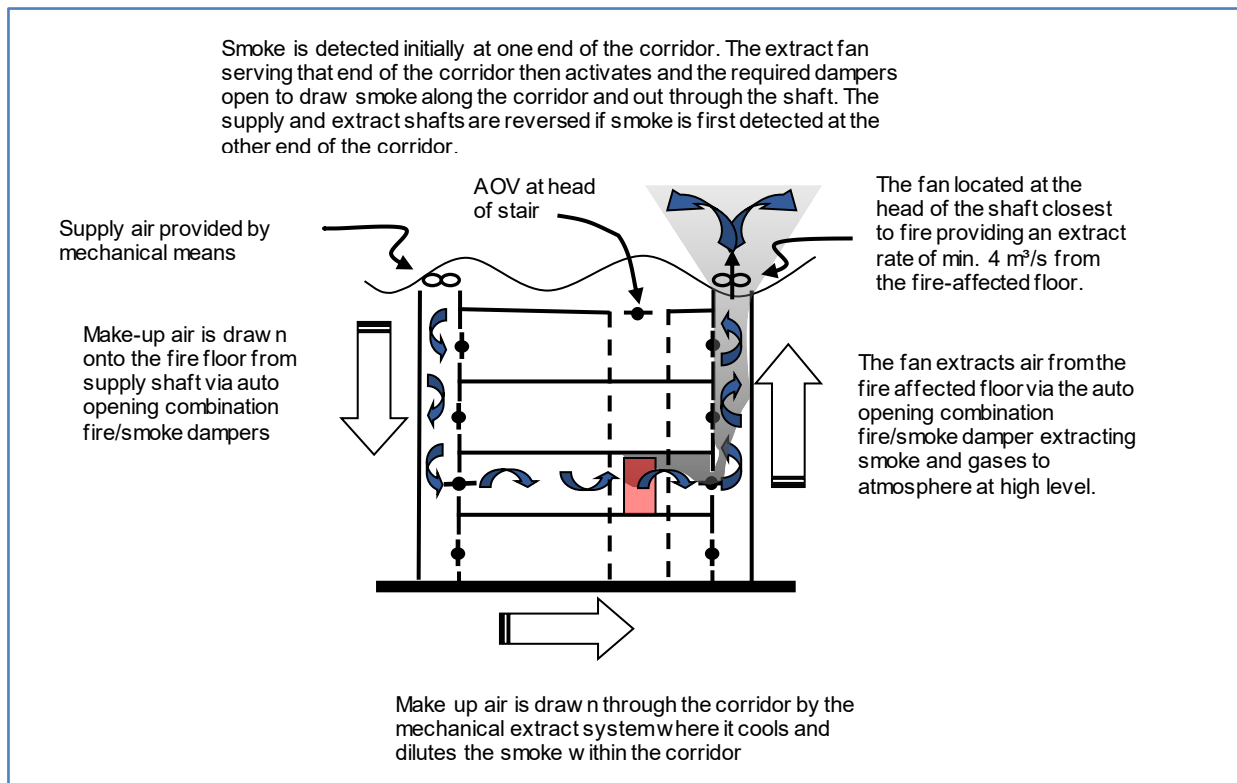


Figure 13: Schematic representation of proposed corridor extraction system.

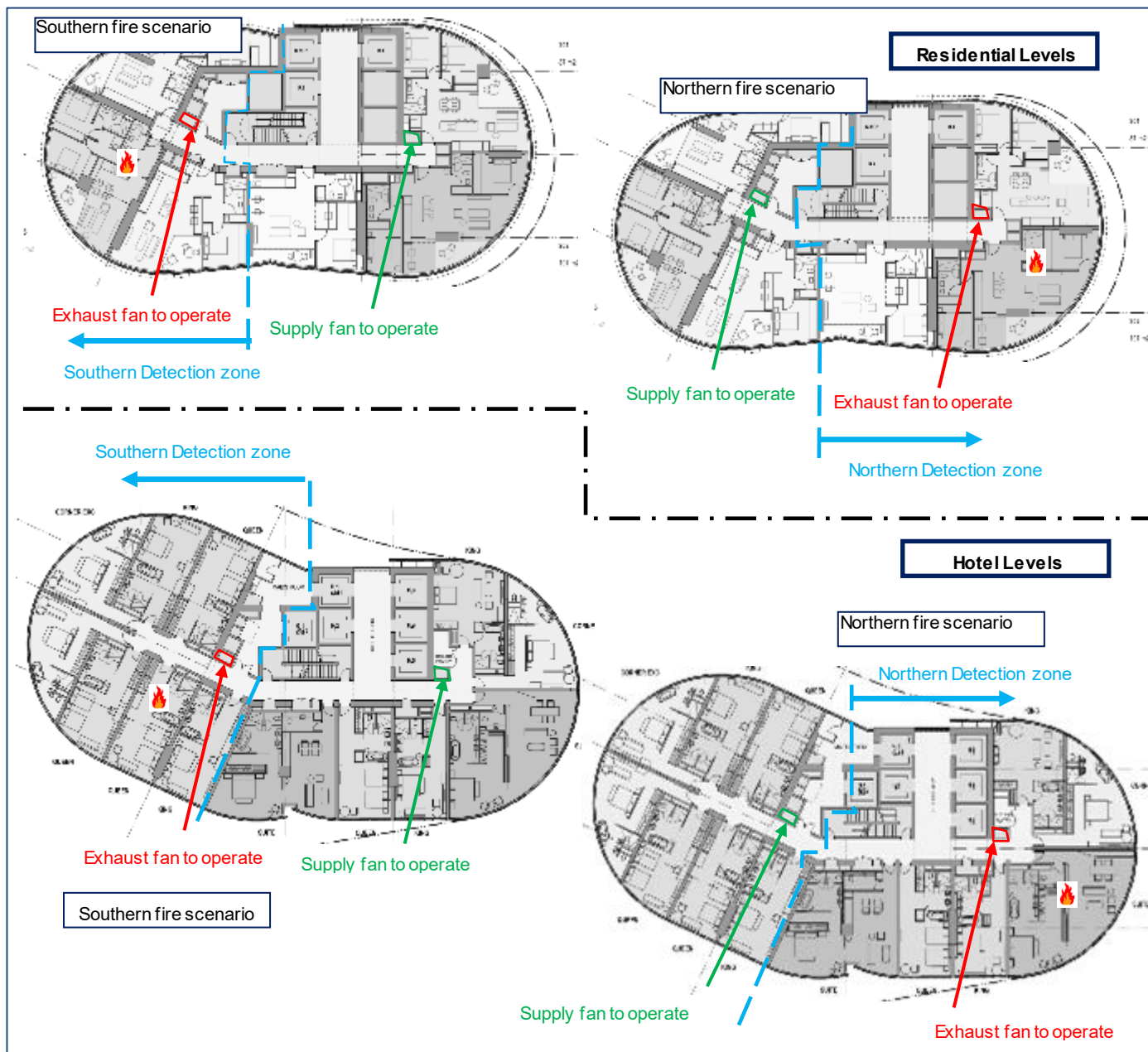


Figure 14: Typical Hotel and Residential levels showing smoke control strategy during north/south fire scenario

- o Power to the Mechanical Services Switch Board (MSSB) which control these systems shall be from the essential services supply. This enables this system to continue to operate after the Brigade cut the power to non-required systems at the main switchboard upon attendance on site. This system shall also be connected to the site's emergency generator power for the purposes of enabling continued operation in the event of a power outage.
- o The smoke exhaust fan is to be designed as smoke-spill fans in accordance with AS 1668.1 and be rated for operating for a period of minimum 2 hours at a smoke temperature of 200°C. The fan is to start up upon any smoke detector or sprinkler head activation on any floor. The fans are to be sized with the necessary allowances for leakage through ducting, dampers and the like to achieve the design requirement specified.
- o The dampers serving the hotel / residential corridor smoke exhaust system are to be electronically controlled smoke dampers which have the same temperature and time rating as the smoke fans noted above.
- o The position of the dampers relative to the operational mode will be automatically monitored and the system will be interfaced with the FIP to provide notification of any fault.
- o The proposed configuration of the fire and smoke dampers be included as an Essential Fire Safety Measure for the building, with the Annual Fire Safety Schedule either referencing the document or

outlining the details of the damper system setup, activation, and its other unique features. The intent is to ensure that the robustness of the system is maintained throughout the life of the building, provided that the analysis demonstrates that the proposed trial design meets the relevant Performance Requirements of the BCA.

- o All dampers on each floor will be controlled by a local control unit located on that specific floor; i.e. controls will be independent between floors so that there is no single point of failure. The control unit on each floor will be provided with battery backup or generator backup.
- o Power supply and control wiring to dampers, automatic opening louvres and fans serving the performance based mechanical systems must comply with AS1668.1. The wiring routes are to be in a protected space and not subject to any possible mechanical damage.
- o S-shaped subducts are to be provided in the shafts as a passive means of smoke control. Flanges will be fitted to the subject subducts to improve airflow in the shaft (refer **Error! Reference source not found.**).

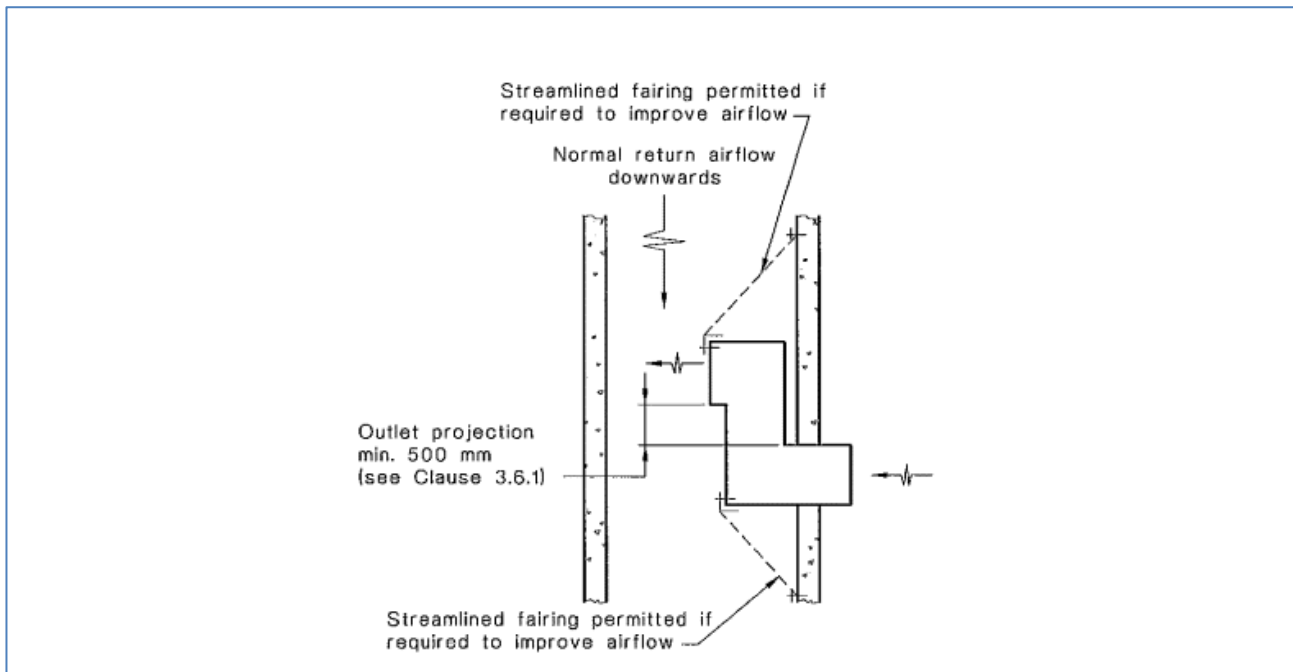


Figure 15: S-shaped sub-duct when airflow in normal operations is downwards

- o Final testing and commissioning of the smoke exhaust system is to be undertaken in accordance with AS 1668.1 Appendix F. The performance criteria which this system must adhere to be as follows:
 - Extract rate at most disadvantaged floor served by this exhaust system shall be no less than that specified.
 - The doors into each fire stair on the floors served by this system shall be openable when the exhaust system is extracting air through that floor with a door force of no greater than 110 N.
- o Smoke seals are to be fitted to all doors opening onto the corridor.
- o A 1 m² fresh air automatic opening vent to be provided at the top of each fire stair shaft to allow air to be drawn across the door threshold while the exhaust system is operating.
- The Neighbourhood Centre will be provided with a performance based smoke exhaust system:
 - o A Fire Curtain with an FRL of -/120/- is to be installed around the non-fire-isolated stair on Level 3. Fire barriers will be provided above the fire curtains within any concealed ceiling space along the line of the fire curtain. The fire curtain will be fully tested in accordance with AS 1905.2 and AS 1530.7 (and provided with fail-safe close on power/motor failure).
 - o The fire curtains are required to resist the passage of flames and hot gases for a minimum of 120 minutes as specified in AS 1530.4.
 - o The fire curtain will be capable of withstanding any adverse deflection of the curtain due to the pressure differentials created by the smoke exhaust system operating on Level 00 – 04.

- o The floor covering of the landing floor area of the fire curtain, the internal stair and the landing area of the stair are to be of non-combustible material.
- o A red strobe light will be provided within proximity of the interconnecting stair at the rising stairs on level 2 and the top of the stair on level 3. This light will activate upon alarm activation to signal that the fire curtain is lowering.
- o Additional exit signage on the inside of the fire curtain on Level 3 is required to read "EXIT ON LEVEL BELOW". The fire curtain will be activated for a fire on Levels 00 – 04 (the above text is not relevant to fire location).
- o The fire curtain will have a staged closing procedure. On alarm activation the fire curtain will close to a point of 2 m above floor level for 60 seconds to afford occupants time to move from the area to the fire isolated stairs. After 60 seconds the fire curtain will then drop to the floor level.
- o The following provisions shall be included in the management in use plan:
 - The area surrounding the interconnecting stairs on Level 3 is required to be clear and free of combustible materials or any storage of any object that could interfere with the safe operation of the fire curtain. This is a requirement for a distance of 1 m of the fire curtain. Signage to be provided to advise occupants of these requirements.
 - The area under the interconnecting stairs is required to be clear and free of combustible materials on level 3. Signage to be provided to advise occupants of these requirements.
- o Each level in the neighbourhood centre will be provided with two smoke extract points (2 x 10m³/s) and a means of mechanical supply air (10 m³/s). For a fire within the neighbourhood centre at Levels 00, 01 and 02, the fire affected floor requires extraction and pressurisation of the level above. For a fire at Level 3 and Level 4, the extraction and make up air supply will be provided in a similar manner.

Emergency lighting, emergency exit and other signage requirements

- Provide emergency lighting in accordance with BCA Clauses E4.2 and E4.4 and AS 2293.1.
- Provide emergency exit signage in accordance with BCA Clauses E4.5, E4.6 and E4.8 and AS 2293.1.
- Signage shall be installed in the lift lobby on each floor stating that 'IN THE EVENT OF A FIRE, OCCUPANTS MAY USE LIFTS AS A MEANS OF ESCAPE'. This signage shall be in lettering of at least 20 mm in height in a colour contrasting that of the background.
- The escape pathway under the covered areas shall have no combustible materials contained within and is to be a designated sterile path. Additional supporting fade resistant signage is to be erected within the pathway outlining this requirement. Signage to read as follows:

"OFFENCES RELATING TO EGRESS PATHWAY"

It is an offence to:

Place anything in the egress pathway which may constitute a fire load or impede the free passage of persons; or remove, damage or otherwise interfere with this notice"

The words "OFFENCES RELATING TO STERILE ZONE" must be in letters not less than 100 mm in height. The lettering shall be in a colour contrasting with the background to which the sign is erected.

Regular monthly inspections are also to be undertaken by the building management so as to ensure that the pathway of egress is kept free from combustibles during the life of the building. The above requirements are to be noted on the essential services schedule and Annual Fires Safety Statement for the building.

Emergency Lifts

- The three (3) emergency lifts serving the building which open into the lift lobby space shall be programmed to enable occupants on the fire affected floor to still call the lift to that floor in the event of a fire following the activation of the FIP into a general fire trip mode.
- All emergency lifts serving the tower (including the dedicated firefighting lift) shall be connected to the building's essential services power supply, which shall have full generator backup as redundancy in relation to ongoing operation.

- Each floor where lifts are used as an additional evacuation route shall have no less than the prescriptive number of exits available to occupants (minimum of two). The use of the emergency lifts during a fire scenario shall only be as a secondary means of escape from that floor.
- The lifts used for evacuation which are serving the tower shall be programmed so that only the floors which have alarm tones emitted on them will be the ones who can call the lifts to their floor during a fire alarm condition.
- During maintenance, no less than two (2) of the three (3) emergency lifts used for evacuation shall remain available to enable this strategy to be upheld at all times.
- The fire brigade key operation at one any of the four (4) emergency lifts (including the three of these used for evacuation) shall override the buttons calling the lift to a specific floor at any time. This will enable FRNSW to take full control of at least one lift at any time during a fire emergency.

Construction Requirements

- FRL of elements of structure to be reduced as those detailed in Table 1 (both Class 6 and 7b areas permitted to have an FRL of 120 minutes, in lieu of the prescriptive requirements of the BCA).
- The essential services serving the subject building shall be provided with back-up generator power. In the event of a general power failure on site, this system shall support all life safety systems within both the Mod 13 and existing portions of the site.
- Escalators are to be constructed of non-combustible materials.
- Escalators running in the direction of egress are to be permitted to remain operating.
- Escalators running reverse to the direction of egress are to be capable of being stopped locally and remotely as follows:
 - o Locally by a manual stopping device at the travellers
 - o Remotely by a manual stopping device at a remote location such as the Fire Control Room or as part of a pre-planned evacuation response
- Where provision is made for remote stopping of escalators counted as means of egress, one of the following is to apply:
 - o The stop is to be delayed until it is preceded by a minimum 15-second audible signal or warning message sounded at the escalators.
 - o Where escalators are equipped with the necessary controls to decelerate in a controlled manner under the full rated load, the stop is to be delayed for at least 5 seconds before beginning deceleration, and the deceleration rate shall be no greater than 0.052 m/sec².
- Where an audible signal or warning message is used, the following is to apply:
 - o The signal or message to have a sound intensity that is at least 15 dBA above the average ambient sound level for the entire length of the escalators.
 - o The signal is to be distinct from the fire alarm signal.
 - o The warning message to meet audibility and intelligibility requirements.
- All escalators which are to be used as secondary egress routes from the carpark levels are to be connected to the site's essential services power supply. This power supply is to be connected to a 'standby power system' complying with BCA Specification G3.8(6) in regards to either having a full generator backup, or being from multiple substations.
- A Fire Curtain with an FRL of -/120/- is to be installed around the non-fire-isolated stair on Level 3 (refer **Figure 16** below). Fire barriers will be provided above the fire curtains within any concealed ceiling space along the line of the fire curtain. The fire curtain will be fully tested in accordance with AS 1530.7 (or where relevant to product, tested to EN 12101.1) and provided with fail-safe close on power/motor failure. Manual testing will be provided to same.

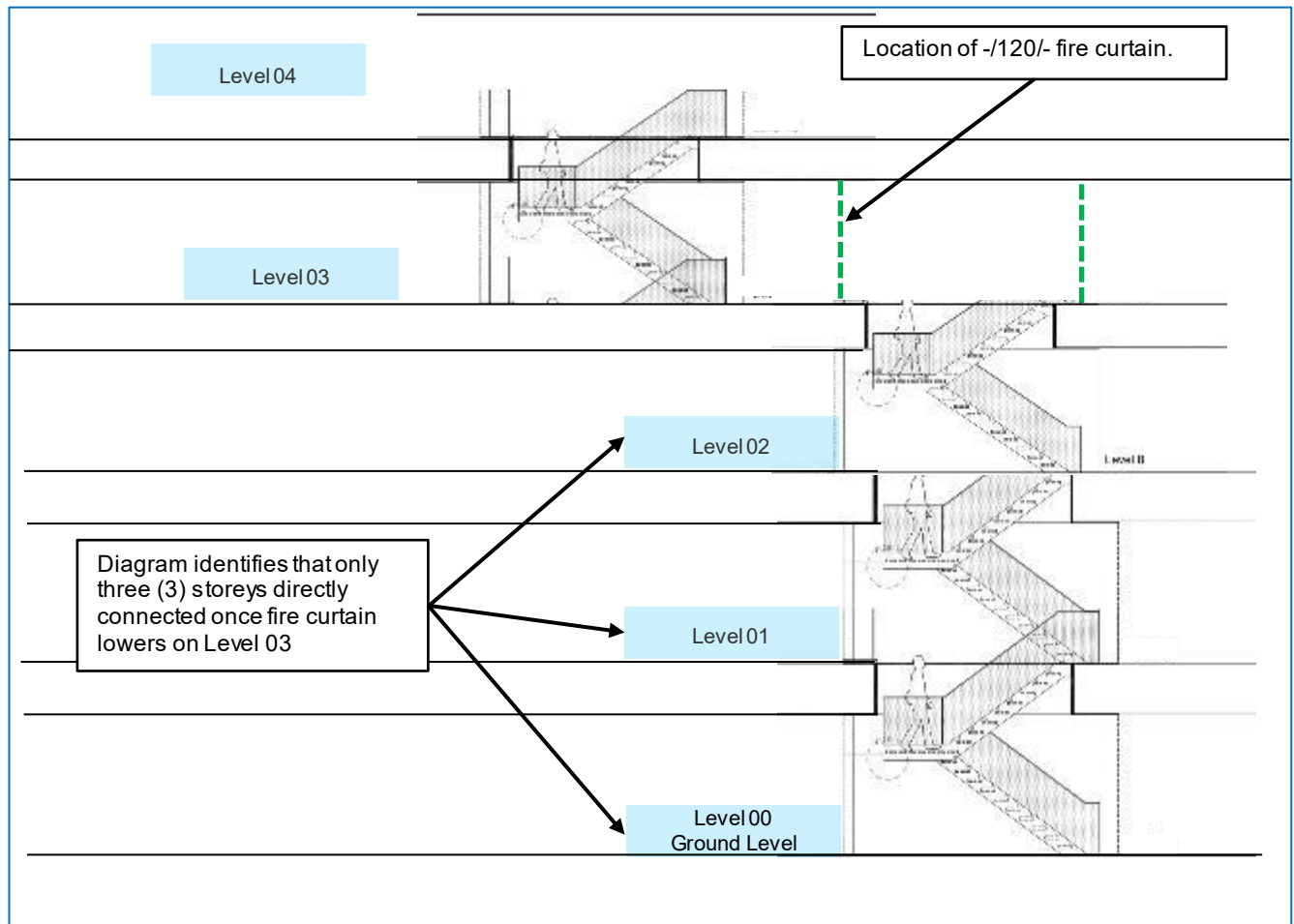


Figure 16: Level 3 Fire curtain

- The fire curtains are required to resist the passage of flames and hot gases for a minimum of 120 minutes as specified in AS 1530.4.
- The fire curtain will be capable of withstanding any adverse deflection of the curtain due to the pressure differentials created by the smoke exhaust system operating on Level 00 – 04.
- The floor covering of the landing floor area of the fire curtain, the internal stair and the landing area of the stair are to be of non-combustible material.
- Additional exit signage on the inside of the fire curtain on Level 3 is required to read “EXIT ON LEVEL BELOW”. The fire curtain will be activated for a fire on Levels 00 – 04 (the above text is not relevant to fire location).
- The fire curtain will have a staged closing procedure. On alarm activation the fire curtain will close to a point of 2 m above floor level for 60 seconds to afford occupants time to move from the area to the fire isolated stairs. After 60 seconds the fire curtain will then drop to the floor level.
- Floor and wall linings within the hotel / serviced apartment corridors are to be compliant with BCA Spec. C1.10.
- The essential services serving the subject building shall be provided with back-up generator power. In the event of a general power failure on site, this system shall support all life safety systems within both the Mod 13 and existing portions of the site.
- The hotel / serviced apartment lift lobbies shall serve as a refuge area for disabled occupants as they await the arrival of the emergency lift. The lift lobby shall comply with BCA Clause D2.6, with the following key points or modifications from this clause:
 - o The corridor exhaust system serving the common corridor on each floor shall be utilised in lieu of pressurising the lift lobby space, as would be the case in a D2.6 compliant smoke lobby.

- o The lift lobby on each floor shall have one of the two systems in place to protect those within the lobby during a fire event (refer to **Figure 23** for further details). Exactly which option is taken is to be determined during the FER stage of works:
 - Option 1: A 1 m² opening will be provided on the western façade to enable fresh air to be drawn into the smoke lobby area when a fire is detected on the floor and the corridor exhaust system commences operation. This shall serve as providing supply air to the system in lieu of a mechanical supply
 - Option 2: Auto-closing -/60/30 fire doors fitted to it to separate this space from the common corridor adjacent. These doors shall be on magnetic hold open devices that will auto-release in the event of a fire alarm being detected on that floor.
- o A smoke detector shall be provided within 1.5 m of each side of the aforementioned fire doors.
- o Smoke seals shall not be required on these doorways as leakage from this area shall be deemed beneficial to the operation of the corridor exhaust system.
- o A WIP phone shall be provided in the smoke lobby for occupant use in a fire scenario.
- A secondary escape route shall be provided from the fire exit on the Pirrama Road side of the building through the main hotel lobby as shown in **Error! Reference source not found.**
- Each of the fire-rated exit discharge doorways shall be fitted with a fire-rated glass viewing panel. This is to enable occupants to assess conditions beyond the doorway prior to entering this space.
- The design and installation of the car stacker system shall be done in accordance with the AS 5124 or equivalent European standard (i.e. EN14010) for the life safety of the attending fire brigade personnel and maintenance personnel.

Management in Use and Maintenance Requirements

- The use of the emergency lifts for evacuation shall form part of the AS 3745 evacuation planning for the site, with this requirement being listed on the site's Annual Fire Safety Statement (AFSS) as a critical measure for the building.
- Egress path via covered areas at Pirrama Road side of the building adjacent the Porte Cochere are to be maintained clear of any obstructions.
- The area surrounding the interconnecting stairs on Level 3 is required to be clear and free of combustible materials or any storage of any object that could interfere with the safe operation of the fire curtain. This is a requirement for a distance of 1 m of the fire curtain. Signage to be provided to advise occupants of these requirements.
- The area under the interconnecting stairs is required to be clear and free of combustible materials on level 3. Signage to be provided to advise occupants of these requirements.

7 Departures from the Deemed-to-Satisfy provisions

Issue number: 1 Rationalisation of FRLs to the Class 6 and Class 7b portions

Details of departures from DtS provisions:

The proposed building is to be built using Type A construction in accordance with Specification C1.1 of the BCA. This means that the various building elements are required to have FRLs according to Table 3 of Specification C1.1, as shown in Table 1.

It is proposed to reduce the required fire resistance within these areas to a level that is commensurate with the risk represented by the space's use, size, fire load, ventilation conditions, and which recognises the fact that the building has full sprinkler protection, as shown in Table 1.

Table 1: Summary of rationalisation of FRLs

Class	Required FRL according to Table 3 of Specification C1.1	Proposed FRL in this Performance Solution
Class 6 retail areas	180/180/180	120/120/120
Class 7b storage areas	240/240/240	120/120/120

Note: The class 7b storage areas above only apply to the large storage areas which constitute more than 10% of the associated floor area. All smaller storage areas (less than 10 % of the associated floor area) are not considered in this Performance Solution, as they are not considered to be their own occupancy classification, as per the BCA, and therefore are only required to have an FRL equal to that of the associated area.

The reduction in FRLs inadvertently creates a non-compliance in that fire separation between classifications no longer complies with the requirements of Specification C1.1. The fire engineering assessment will however, by demonstrating that the proposed applied fire rating is expected to survive a reasonable worst case fire, is considered to address this item automatically.

Where parts with different classifications are situated one above the other in adjoining storeys, the floor between the adjoining parts must have an FRL of whichever is higher.

Applicable DtS provisions:	C1.1, Specification C1.1 (Table 3)	Performance requirements:	CP1 & CP2
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List key fire safety measures:

Refer to Trial Design Requirements detailed in Section 6 of this FEBQ for the fire safety measures relevant to this development. Fire safety measures specific to this Performance Solution are detailed below:

- The building will be provided with an automatic sprinkler system, in accordance with AS 2118.1. Sprinklers in are to be 68 °C fast response sprinkler heads (subject to ambient temperature) with a RTI of 50 m^{1/2}s^{1/2} or less. Flush mounted sprinkler heads are not to be used unless first deemed acceptable by the fire engineer for use in the nominated area.
- FRL of elements of structure to be reduced as those detailed in Table 1 (both Class 6 and 7b areas permitted to have an FRL of 120 minutes, in lieu of the prescriptive requirements of the BCA).

Proposed alternative solution:

Qualitative assessment - Benefits of sprinklers

The building is to be provided with a sprinkler system throughout. In the event of a fire, the sprinkler system is expected to control, if not suppress the fire. The sprinkler system acts to cool the upper smoke layer and wet adjacent combustibles and partitions helping to prevent the fire from spreading beyond the area of origin. The reliability and efficacy of sprinkler systems has been well researched.

Where the sprinkler system operates successfully the fire resistance is largely irrelevant as the fire is not expected to grow large enough to compromise the structural integrity of the building. In this regard it is noted that the efficacy of sprinklers is recognised in the New Zealand Building Code, which permits a 50 % reduction in FRL if sprinklers

are installed, and in the UK [BS EN 1991-1-2:2002], [PD 6688-1-2:2007] which permits a reduction in 39 %. From this it is concluded that a reduction factor in FRL of 0.5 to 0.61 is internationally accepted if sprinklers are installed. This reflects the very low probability of an above average Fire Load Energy Density (FLED) being in place at the same time the sprinkler system fails.

Quantitative Assessment

An equivalent fire severity calculation shall be carried out to demonstrate that in conjunction with the provision of sprinkler protection throughout, the ventilation afforded to this space from the glazing as it fails will keep temperatures below the level at which structural failure may occur. In the event of a fire, it is expected that the sprinkler system should control, (if not suppress) the fire thereby preventing flashover. The proposed reduction of the fire resistance levels of the building elements is therefore not expected to represent a significant risk for occupants or Fire Brigade personnel provided the sprinkler system is designed appropriate to the hazard and operates as intended.

A quantitative analysis shall be undertaken to evaluate the time equivalence of the proposed building design where appropriate. The time equivalence approach gives the equivalent structural fire severity for exposure to the standard fire curve for a given enclosure based on Fuel Load Energy Density (FLED), ventilation conditions and lining materials. Research efforts over the years have resulted in several different time-equivalency formulae. These include the method of Law, the CIB Method, Eurocode Method, Harmathy Method and others. Most of these equations were established from experimental test performed with wooden crib fires in relatively small compartments. The Eurocode equation in contrast was however determined from calculations of the fire behaviour of a concrete slab, based on a heat balance, using the MRFC computer program developed at the University of Kassel in Germany. Results predicted by the various models sometimes differ significantly, and none are good for deep compartments as reviewed by [Law].

To reduce uncertainty in results, it is proposed that three widely used methodologies, i.e the CIB W14 method [Buchanan], [Law] method and the Eurocode method, are used to calculate the time equivalence for the Class 2, 6 & 7 areas. This is in line with guidance provided by FRNSW. The most conservative of the three results will then be used to determine the FRL of the structure.

Proposed FLED Values to be used

Typical FLED values for the of the occupancies in the development have been detailed in Table 3 below which has been based on detail contained in Section 3.4.1 and Table 3.4.1a of the [IFEG].

Table 3: Fire load energy densities (FLEDs) for different occupancies of the development

Occupancy	Fire load density, $q_{f,k}$			
	Mean (MJ/m ²)	Fractile (MJ/m ²)		
		80 %	90 %	95 %
Class 6 (Shops)	600	900	1100	1300
Class 7b (Storage)	1180	1800	2240	2690

NOTE:

- 1) The FLEDs in this table have been based on detail contained within Table A.19 of [PD 7974-1] and Table 3.4.1a of the [IFEG]. The 80 % fractal is the value that is not exceeded in 80 % of the rooms or occupancy of the survey data.
- 2) The 80 %, 90 % & 95 % values have been determined based on guidance given in Section 3.4.1 of the IFEG for well-defined occupancies (such as dwellings).
- 3) The FLED value specified for the Class 7b is more affiliated to that of a Manufacturing & Storage type occupancy and not that of a store which is ancillary to the main use of the development.

The following is the main recommendations issued by FRNSW for undertaking time equivalence calculation;

- Time equivalence calculations will be based on the three most widely used correlations, i.e. Eurocode, CIB and Law correlations. The most onerous result of these three is to be used in our assessment.
- At least a 95 % fractile fire load should be adopted (as per the recommendation on page 3.4-8 of the IFEG). If using the figures from Table 3.4.1a of IFEG, at least a 90 % fractile value should be chosen calculated as per the methodology given on page 3.4-2 of IFEG.
- Where a reliable sprinkler system is installed appropriate to the hazard, a sprinkler reduction factor of 0.5 may be applied to the fire severity calculations (to FLED values). However, a larger value should be

considered where local member failure could cause disproportionate structural collapse. However if the mean fuel load is higher than this value the mean fuel load should be used.

Hence based on the guidance from FRNSW, the FLED values detailed in Table 4 have been adopted for the time equivalence calculations. It is noted that in all instances a 95 % percentile value has been adopted.

Table 4: Proposed FLED values utilised for assessment

Use	Class	95 % Fractile (MJ/m ²)	Sprinkler Protection 50 % Fractile Value (MJ/m ²)	Mean FLED (MJ/m ²)	Proposed FLED Used (MJ/m ²)
Retail	6	1300	650	600	650
Storage	7b	2690	1345	1180	970 ⁽¹⁾

NOTE:

- 1) For the identified storage areas of the building it is proposed to adopt a FLED at 95 % Fractile for a Dwelling Fire of 970 MJ/m² (as per Table 3). Given the intended use of the space ancillary to the main building use this is noted to be a conservative FLED value and allows for redundancy in the design.

Performance solution:

- ☐ A0.3(a)(i) - Comply with the performance requirements
☒ A0.3(a)(ii) - Be at least equivalent to the DtS provisions

Assessment methods:

- ☐ A0.5(a) - Evidence of suitability
☐ A0.5(b)(i) - Verification methods in the NCC
☒ A0.5(b)(ii) - Other verification methods
☐ A0.5(c) - Expert judgement
☐ A0.5(d) - Comparison with the DtS provisions

Assessment approach:

- ☐ Comparative ☒ Qualitative ☒ Deterministic
☒ Absolute ☒ Quantitative ☐ Probabilistic

IFEG sub-systems used in the analysis:

- ☐ A – Fire initiation and development and control ☐ D – Fire detection, warning and suppression
☐ B – Smoke development and spread and control ☐ E – Occupant evacuation and control
☒ C – Fire spread and impact and control ☒ F – Fire services intervention

Acceptance criteria and factor of safety:

To determine whether the Alternative Solution is considered to meet the BCA Performance Requirements, it needs to be demonstrated that reducing the FRLs will not lead to the failure of any structural members during a credible fire event. It will be shown that the building elements will survive the complete burnout of a fire, while maintaining structural adequacy, integrity and insulation for this period.

The Performance Solution will be written around the sprinkler system failing, which provides a significant safety factor in the results. The sprinkler system would be expected to control or extinguish the fire in the majority of cases (> 90%).

Fire scenarios and design fire parameters:

The building is provided with a sprinkler system throughout. A fire in the building is very likely to be controlled if not extinguished by the operation of sprinklers and the fire would be contained within the area of origin. For assessing the adequacy of the proposed FRLs for the building elements, a post-flashover fire scenario would be adopted for the analysis without considering the effects of sprinklers. The fire scenario used shall be a post-flashover fire.

Describe how fire brigade intervention will be addressed or considered:

Fire brigade intervention in the proposed development will be discussed in the FER stage.

Verification/validation analyses:

☐ Sensitivity studies ☐ Redundancy studies ☐ Uncertainty studies ☒ None

Provide details on proposed modelling/assessment tools:

n/a

FRNSW Comment: FRNSW recommends the ventilation assumptions for the time equivalency analysis be detailed and justified. FRNSW recommends a maximum of 50% glazing breakage be considered. Anything above 50% should be appropriately quantitatively justified.

Issue number: 2 Extended travel distances B04 – B00 & B7

Details of departures from DtS provisions:

The following areas exceed the maximum allowable travel distance defined by the DtS Provisions of the BCA:

Basement B4

- Travel distance within the residential storage areas to a single exit of 28 m in lieu of 20 m
- Travel distance within the car stacker area to a single exit of 38 m in lieu of 20 m

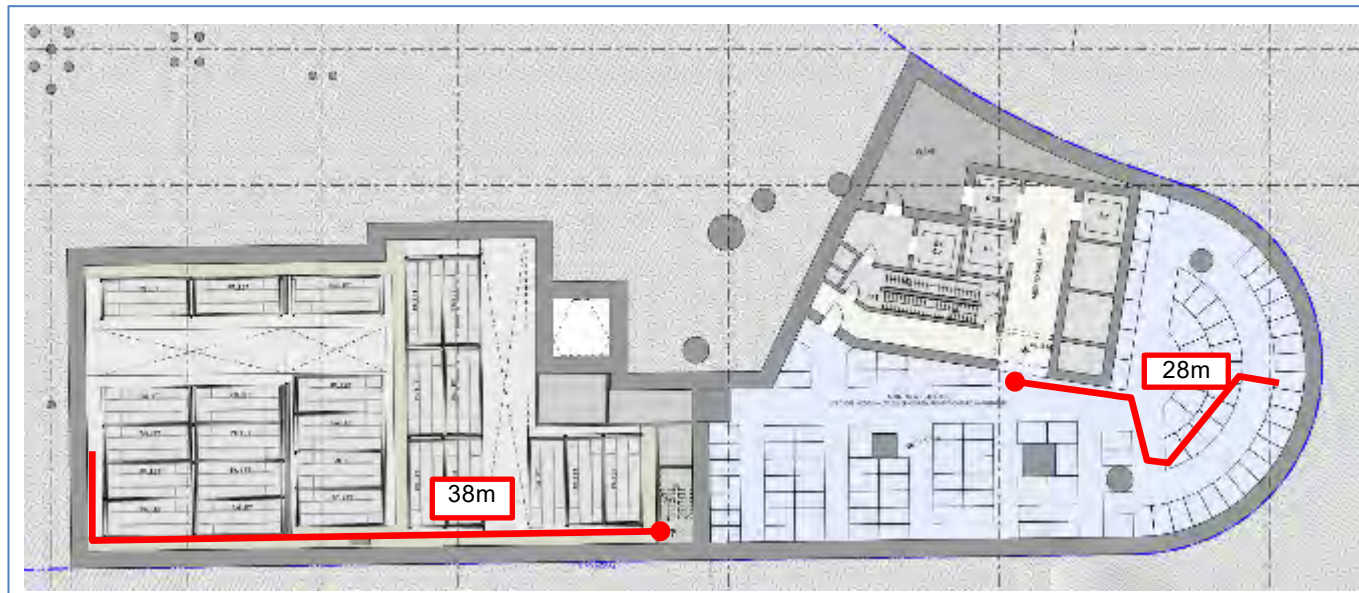


Figure 17: Extended travel distance at Basement B4

Basement B3

- Travel distance to a single exit of 30m in lieu of 20m from BOH hotel staff area.

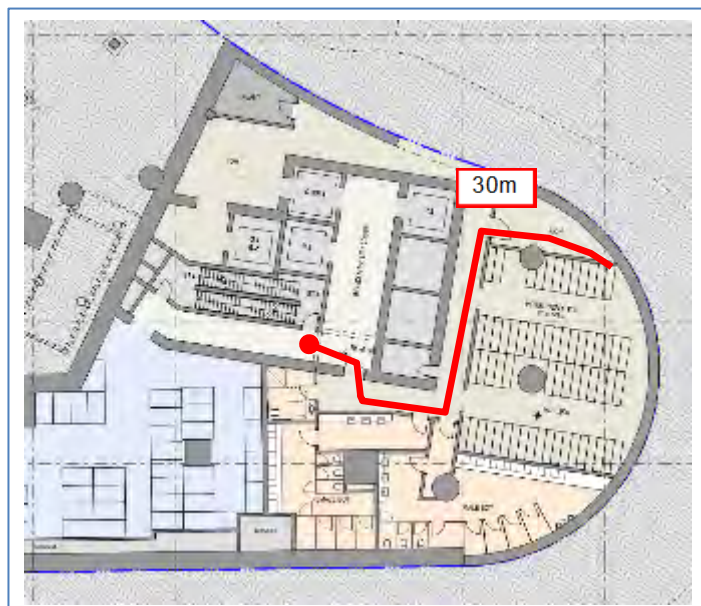


Figure 18: Extended travel distance at Basement B4

Hotel Entry Ground Level 00

- Travel distance to a single exit of 38 m in lieu of 20 m

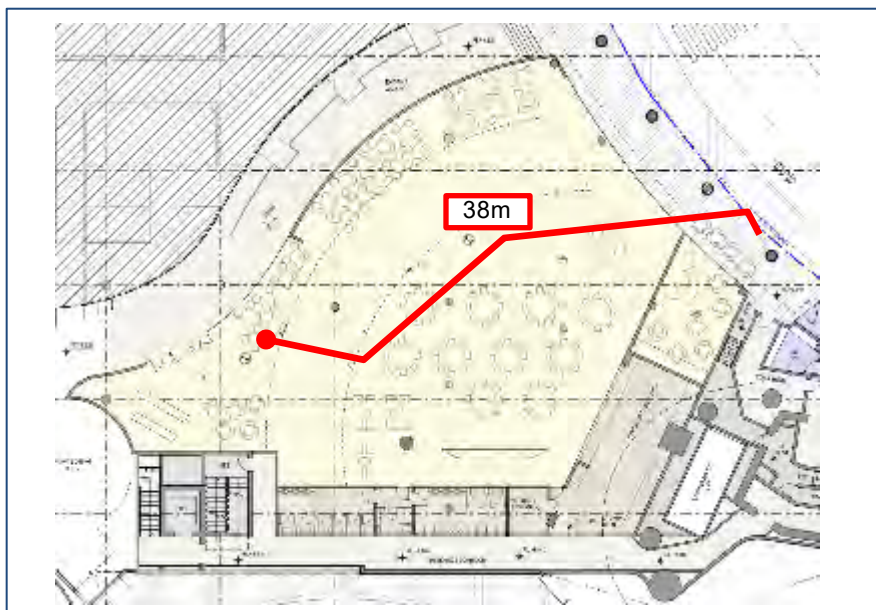


Figure 19: Extended travel distance in hotel entry Ground

Level 7

- Travel distance to a point of choice of 26m in lieu of 20 m in hotel gym
- Travel distance to an exit after a point of choice of 51 m in lieu of 40 m
- Travel distance between exits 74 m in lieu of 60 m

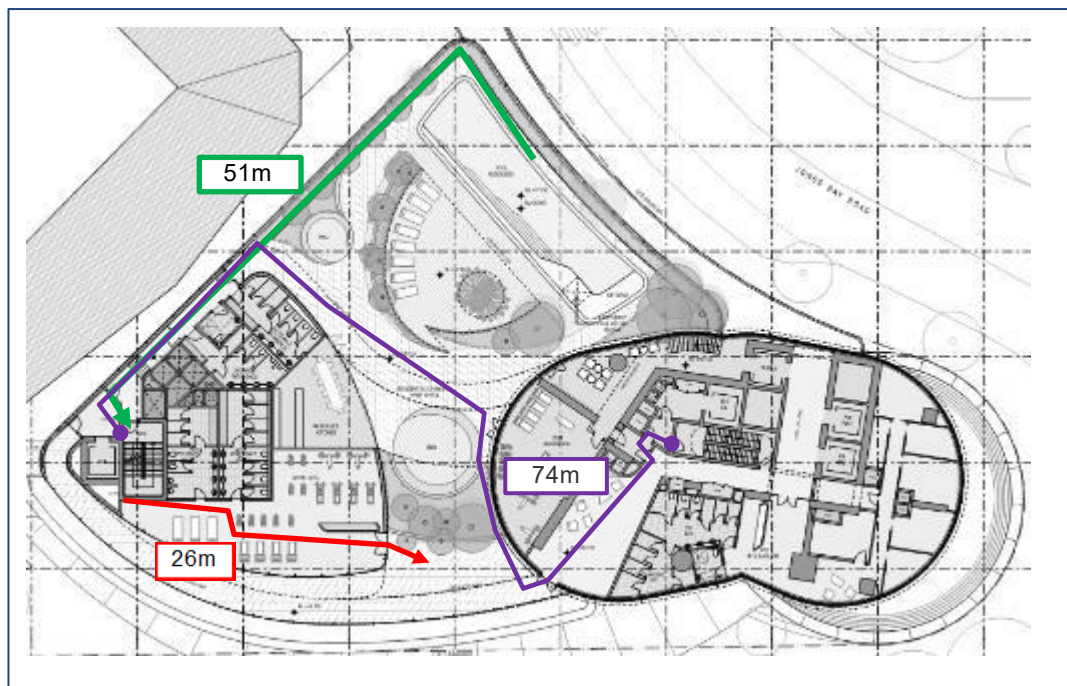


Figure 20: Extended travel distance at Level 7

Applicable DtS provisions: D1.4, D1.5

Performance requirements: DP4, EP2.2

List key fire safety measures:

Refer to Trial Design Requirements detailed in Section 6 of this FEBQ for the fire safety measures relevant to this development. Fire safety measures specific to this Performance Solution are detailed below:

- The building will be provided with an automatic sprinkler system, in accordance with AS 2118.1. Sprinklers are to be 68 °C fast response sprinkler heads (subject to ambient temperature) with a RTI of 50 m^{1/2}s^{1/2} or less. Flush mounted sprinkler heads are not to be used unless first deemed acceptable by the fire engineer for use in the nominated area.
- At Level 7, an external sounder and strobe light will be provided at the outdoor space. In the event of a fire alarm sounding for a fire trip within the building external sounders and strobe light at the outdoor space will alert occupants to commence evacuation.

Proposed alternative solution:

Qualitative Assessment - Sprinkler Protection

Sprinkler protection in accordance with AS2118.1-1999 will be provided throughout the building. The reliability of automatic sprinklers has been widely documented. Sprinkler reliability in the UK has been estimated to be up to 95% whilst in Australia it has been estimated to be up to 99 % as researched by [Bukowski]. Therefore, the likelihood of sprinklers not activating is considered to be low. Sprinklers offer an effective means of automatically controlling fire size and preventing fire spread. As such, provision of sprinklers in the building dramatically enhances life safety, property protection and fire brigade intervention. A fire sprinkler system will dramatically reduce the likelihood of a large fire in the loading docks.

It should also be noted that the same travel distances are stipulated by the BCA for Class 5 – 9 buildings. The travel distances are therefore generic and do take into consideration the difference in risk associated with the use of the space. This means for example that a carpark has the same travel distance limitations as an assembly building, office or storage warehouse, although the fire risks are clearly different. Many international building codes consider the specific risks associated with the use of the space and have different travel distance limitations for each.

A comparison of distance provisions in a sample of international building codes demonstrating extended travel distance allowances when sprinklers are provided – refer to the following table.

Table 5: Comparison of single exit travel distance provisions & allowances for sprinkler inclusion

Building Code	Maximum allowable travel distance to a single exit or point of choice		Allowable increase for sprinklers (%)
	No sprinkler protection	Sprinkler protection	
Australia – BCA 2014	20	20	0
US – NFPA 101 (2009)	23	30	30
BS 9999 (Risk profile B2)	20	24	20
New Zealand – C/AS7 (2013)	45	70	55

Table 6: Comparison of maximum travel distance to the nearest exit provisions & allowances for sprinkler inclusion

Building Code	Maximum allowable travel distance to the nearest exit of alternative exits		Allowable increase for sprinklers (%)
	No sprinkler protection	Sprinkler protection	
Australia – BCA 2014	40	40	0
US – NFPA 101 (2009)	60	91	50
BS 9999 (Risk profile B2)	50	60	20
New Zealand – C/AS7 (2013)	110	180	63

The tables above demonstrate that up to 50 % travel distance increases are allowed by some building codes in recognition of the efficacy of sprinklers. It should however be noted that a direct comparison between the absolute travel distances are not appropriate as the overall fire safety measure provisions and the ways that travel distances are measured could vary between the codes. However, the principle of allowing an increase when sprinklers are provided is clearly demonstrated.

B4/B3 Basement Levels, Hotel Entry Ground and Level 7 Hotel Gym

It is proposed to mitigate the extended travel distance through the provision of providing fast response sprinklers heads in the basement levels and through reduced smoke detectors' spacing in the remaining levels (i.e. hotel entry ground, Level 7 hotel gym, sky lobby levels and club lounge). The reduction in detection time afforded by the provision of fast response sprinkler heads and reduced spacing smoke detector is compared to the increase in travel time resulting from the extended travel distance.

Non-compliant travel distances will be assessed using a comparative RSET-RSET assessment. The RSET is determined by detection time, pre-movement time and the travel time as expressed in the following formula [PD 7974]:

$$RSET = T_{det} + T_{pre} + T_{mov}$$

Where:

T_{det} = Detection time – the time until a fire is detected (s)

T_{pre} = Pre-movement time – consisting of alarm recognition and response times (s)

T_{mov} = Movement time – the time occupants take to move through the exit (s) and consists on both the time required to travel to the exit (walking), as well as the time spend queuing at the exit(s).

Note that an absolute RSET is not required to be calculated as the assessment is done in comparative terms and the alarm and pre-movement times are assumed to be the same for both the proposed design and DtS case. The differences in detection and movement time are therefore only considered.

Level 7 Outdoor Space

The proposed extended travel distances will be supported based on the following:

- The majority portion of the extended travel distances are in outdoor space, which will enable smoke and heat to vent away to the atmosphere and a descending smoke layer will not occur and occupants will have a choice of two exits to move towards an available exit. In addition, at least one of the exits will be available at all times.
- An external sounder and strobe light will be provided at the outdoor space. In the event of a fire alarm sounding for a fire trip within the building external sounders and strobe light at the outdoor space will alert occupants to commence evacuation. The combined occupant warning provisions of SSISEP and strobe lighting is an enhanced system compared to DtS provisions, and reduces the pre-movement time within the space as the need for emergency evacuation will be more clearly conveyed to occupants.

Performance solution:

- ☒ A0.3(a)(i) - Comply with the performance requirements
- ☐ A0.3(a)(ii) - Be at least equivalent to the DtS provisions

Assessment methods:

- ☐ A0.5(a) - Evidence of suitability
- ☐ A0.5(b)(i) - Verification methods in the NCC
- ☒ A0.5(b)(ii) - Other verification methods
- ☐ A0.5(c) - Expert judgement
- ☐ A0.5(d) - Comparison with the DtS provisions

Assessment approach:

- | | | |
|---|--|---|
| ☒ Comparative | ☒ Qualitative | ☒ Deterministic |
| ☒ Absolute | ☒ Quantitative | ☐ Probabilistic |

IFEG sub-systems used in the analysis:

- | | |
|--|---|
| ☐ A – Fire initiation and development and control | ☒ D – Fire detection, warning and suppression |
| ☒ B – Smoke development and spread and control | ☒ E – Occupant evacuation and control |
| ☐ C – Fire spread and impact and control | ☐ F – Fire services intervention |

Acceptance criteria and factor of safety:

To determine whether the Performance Solution is considered to meet the BCA Performance Requirements, it will be demonstrated that the installation of hot temperature smoke seals, provision of smoke control system and fast response sprinkler heads will enhance the evacuation time in comparison with a DtS design.

Fire scenarios and design fire parameters:

Refer to Performance Solution 13

Describe how fire brigade intervention will be addressed or considered:

n/a

Verification/validation analyses:

- ☐ Sensitivity studies ☐ Redundancy studies ☐ Uncertainty studies ☒ None

Provide details on proposed modelling/assessment tools:

n/a

FRNSW Comment: In principle support is provided subject to all inputs and assumptions used in the quantitative analysis being included in Version 3 of this FEBQ (or FER as applicable). As a minimum, this should include:

- Sprinkler/detector RTI for both fast and standard response heads;
- Radial distance from fire source to sprinkler/detector;
- Fire source location above floor level; and
- Ceiling height

Issue number: 3 **Distance between alternative exits**

Details of departures from DtS provisions:

The distance between alternative exits into the fire-isolated stair serving the residential and hotel levels are less than 9 m apart as required under BCA Clause D1.5(b); however, they are greater than 6 m apart as illustrated in the following figure.



Figure 21: Distance between exits

Applicable DtS provisions:	D1.5	Performance requirements:	DP4, EP2.2
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List key fire safety measures:

Refer to Trial Design Requirements detailed in Section 6 of this FEBQ for the fire safety measures relevant to this development. Fire safety measures specific to this Performance Solution are detailed below:

- The building will be provided with an automatic sprinkler system, in accordance with AS 2118.1. Sprinklers in are to be 68 °C fast response sprinkler heads (subject to ambient temperature) with a RTI of 50 m¹/s^{1/2} or less. Flush mounted sprinkler heads are not to be used unless first deemed acceptable by the fire engineer for use in the nominated area.
- Floor and wall linings within the corridors will be compliant with BCA Spec. C1.10

Proposed alternative solution:

The proposed Performance Solution will be supported on the following basis:

- The distance between alternative exits is primarily only relevant to open plan layouts where access to an exit could potentially be blocked by fire owing to the fact that combustibles could be present along the path of travel to an exit. In residential buildings on the other hand, the common corridors are fire separated from adjoining spaces by fire rated construction with all doors fire rated and fitted with self-closing devices. Lift landing doors and access doors / hatches into service shafts are also fire rated. Garbage shaft doors and doors to electrical distribution boards are of non-combustible construction. The ancillary rooms and Maid rooms opening directly to the common rooms will be a separate fire compartment which minimise the risk of fire and smoke spread to the common corridors.
- The corridors are used for circulation and are to be kept free from obstructions and clear from combustibles. Floor and wall linings are to be compliant with BCA Spec. C1.10 and as such will have a low flame spread potential. Initiation of a fire within a residential corridor or fire spread from an adjoining space into the corridor is therefore highly unlikely. Hence given the common corridors main use, ignition sources within the corridors will be minimal and the overall fire risk will be low and as such does not present a credible fire source to prevent occupants from being able to access the storey exits which is by way of fire-isolated stairs. The building is noted to be sprinkler protected throughout in accordance with AS 2118.1 which includes the use of fast response sprinkler heads which allow for earliest sprinkler actuation.
- A corridor smoke exhaust system will be provided which will maintain tenable conditions in the corridor throughout the evacuation time.

Performance solution:

- ☒ A0.3(a)(i) - Comply with the performance requirements
- ☐ A0.3(a)(ii) - Be at least equivalent to the DtS provisions

Assessment methods:

- ☐ A0.5(a) - Evidence of suitability
- ☐ A0.5(b)(i) - Verification methods in the NCC
- ☒ A0.5(b)(ii) - Other verification methods
- ☐ A0.5(c) - Expert judgement
- ☐ A0.5(d) - Comparison with the DtS provisions

Assessment approach:

- | | | |
|---|--|---|
| ☒ Comparative | ☒ Qualitative | ☒ Deterministic |
| ☐ Absolute | ☒ Quantitative | ☐ Probabilistic |

IFEG sub-systems used in the analysis:

- | | |
|--|---|
| ☐ A – Fire initiation and development and control | ☐ D – Fire detection, warning and suppression |
| ☒ B – Smoke development and spread and control | ☒ E – Occupant evacuation and control |
| ☐ C – Fire spread and impact and control | ☐ F – Fire services intervention |

Acceptance criteria and factor of safety:

To determine whether the Performance Solution is considered to meet the BCA Performance Requirements, it will be demonstrated that ignition sources within the corridors will be minimal and the overall fire risk will be low and as such does not present a credible fire source to prevent occupants from being able to access the storey exits.

Fire scenarios and design fire parameters:

n/a

Describe how fire brigade intervention will be addressed or considered:

n/a

Verification/validation analyses:

- ☐ Sensitivity studies ☐ Redundancy studies ☐ Uncertainty studies ☒ None

Provide details on proposed modelling/assessment tools:

n/a

FRNSW Comment: In principle support is provided subject to the analysis in the FER demonstrating compliance with the performance requirements of the NCC.

Issue number: 4 Utilizing lifts as part of the egress strategy for the tower

Details of departures from DtS provisions:

With cities growing at an exponential rate throughout Australia, the need to build vertically rather than laterally in city centres is growing ever more necessary. A key outcome of this is that residential towers are increasing in height in recent years, as can be seen by the scale of many of the developments occurring in each of the key State capitals at present.

The Mod 13 tower is over 200 m in height, and contains over 60 storeys. To evacuate occupants from the uppermost floors of this building would require them to walk down in excess of 60 flights of stairs, which would be virtually impossible for certain type of building occupants (for e.g. disabled, old age, pregnant woman etc.) during an emergency.

The BCA has prescriptive requirements in Clause E3.3 where it states that signage must be fitted in place on site warning people that lifts cannot be used in the event of a fire. Given the height of the Mod 13 tower (>200 m at its highest point), it is considered that many occupants may be unable to travel down this number of stairs to safely evacuate from the building. There are no prescriptive requirements relating to the use of lifts for evacuation, meaning the use of such a strategy can only ever be provided through a performance based design.

It is proposed to justify the emergency lifts serving the building as a secondary means of escape, for the purposes of assisting in the evacuation of those who may be unable to travel down 60+ flights of stairs to reach road or open space. The location of the lift lobby in relation to the tower as a whole can be seen in the diagram below.



Figure 22: Location of lifts proposed to be used for evacuation (typical hotel floor)

Applicable DtS provisions:	E3.3	Performance requirements:	DP7
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List key fire safety measures:

Refer to Trial Design Requirements detailed in Section 6 of this FEBQ for the fire safety measures relevant to this development. Fire safety measures specific to this Performance Solution are detailed below:

- The three (3) emergency lifts serving the building which open into the lift lobby space shall be programmed to enable occupants on the fire affected floor to still call the lift to that floor in the event of a fire following the activation of the FIP into a general fire trip mode.

- All emergency lifts serving the tower (including the dedicated firefighting lift) shall be connected to the building's essential services power supply, which shall have full generator backup as redundancy in relation to ongoing operation.
- Each floor where lifts are used as an additional evacuation route shall have no less than the prescriptive number of exits available to occupants (minimum of two). The use of the emergency lifts during a fire scenario shall only be as a secondary means of escape from that floor.
- The cascade sequence for the site's Emergency Warning and Intercom System (EWIS) shall be programmed in a '1 up, 1 down' configuration. In the event of a fire being detected on a floor, the fire affected floor will go into alert for two minutes, after which time the alert tone will switch to the evacuation tone. A further three minutes after this change, the cascade sequence will commence, where the floors directly above and below the fire affected floor will go through the same alarm sequence.
- The occupant warning system shall have automated spoken instructions included in it which shall advise people that an alarm has been identified on their floor, and that the lifts may be used for evacuation.
- The lifts used for evacuation which are serving the tower shall be programmed so that only the floors which have alarm tones emitted on them will be the ones who can call the lifts to their floor during a fire alarm condition.
- Signage shall be installed in the lift lobby on each floor stating that 'IN THE EVENT OF A FIRE, OCCUPANTS MAY USE LIFTS AS A MEANS OF ESCAPE'. This signage shall be in lettering of at least 20 mm in height in a colour contrasting that of the background.
- During maintenance, no less than two (2) of the three (3) emergency lifts used for evacuation shall remain available to enable this strategy to be upheld at all times.
- The fire brigade key operation at one any of the four (4) emergency lifts (including the three of these used for evacuation) shall override the buttons calling the lift to a specific floor at any time. This will enable FRNSW to take full control of at least one lift at any time during a fire emergency.
- The lift lobby shall serve as a refuge area for disabled occupants as they await the arrival of the emergency lift. The lift lobby shall comply with BCA Clause D2.6, with the following key points or modifications from this clause:
 - o The corridor exhaust system serving the common corridor on each floor shall be utilised in lieu of pressurising the lift lobby space, as would be the case in a D2.6 compliant smoke lobby.
 - o The lift lobby on each floor shall have one of the two systems in place to protect those within the lobby during a fire event (refer to **Figure 23** for further details). Exactly which option is taken is to be determined during the FER stage of works:
 - Option 1: A 1 m² opening will be provided on the western façade to enable fresh air to be drawn into the smoke lobby area when a fire is detected on the floor and the corridor exhaust system commences operation. This shall serve as providing supply air to the system in lieu of a mechanical supply
 - Option 2: Auto-closing -/60/30 fire doors fitted to it to separate this space from the common corridor adjacent. These doors shall be on magnetic hold open devices that will auto-release in the event of a fire alarm being detected on that floor.
 - o A smoke detector shall be provided within 1.5 m of each side of the aforementioned fire doors.
 - o Smoke seals shall not be required on these doorways as leakage from this area shall be deemed beneficial to the operation of the corridor exhaust system.
 - o A WIP phone shall be provided in the smoke lobby for occupant use in a fire scenario.
- The use of the emergency lifts for evacuation shall form part of the AS 3745 evacuation planning for the site, with this requirement being listed on the site's Annual Fire Safety Statement (AFSS) as a critical measure for the building.

Proposed alternative solution:

As noted; the BCA does not contain any prescriptive requirements in relation to the use of lifts for emergency evacuation. It is therefore proposed to implement a performance based solution within this building to enable occupants to safely use the lift lobby as a refuge space as they await the arrival of one of the two emergency lifts. Once the lift arrives, they will then be able to use this to safely evacuate the floor.

As can be seen in Figure 18, a typical hotel floor has in the region of 14 hotel rooms, with each containing a single double bed. The serviced apartments on the lower levels have in the region of four to nine units, with up to 13 double beds in total across this quantity of apartments. Based on the highest number of beds (14) this equates to a population of up to 28 persons on each of these floors. Assuming that a third of each floor would need to use the lifts to evacuate the fire affected floor (which is a hugely conservative assumption), this quantity of persons (10) could easily be accommodated in a single trip by the three emergency lifts available for evacuation. Even with one person using a wheelchair, it is not considered that the number of trips would be increased given the floor area of each emergency lift is in the region of 4 m². At a population density of 0.5 m² per person in each car, this would mean that eight persons could fit in one lift, while a disabled occupant in a wheelchair could use each of the two other lifts available if needed.

A key risk when using lifts for evacuation purposes is that if the fire spreads to the corridor containing the lift buttons, heat exposure could potentially result in the buttons expanding in situ, which in turn will call the lift to that floor without any human interaction with the system. If occupants or Brigade personnel are already within the lift at that time, this could potentially put them at risk. The provision of a 1 hr fire door between the lift lobby and the common corridor will provide a barrier to prevent fire spread to this space (refer **Figure 23**). The corridor exhaust system shall also serve to reduce the temperatures in the corridor, and provide greater visibility to the space as occupants evacuate the floor. This will assist occupants on making their way to either the fire exits or the lift lobby refuge space.

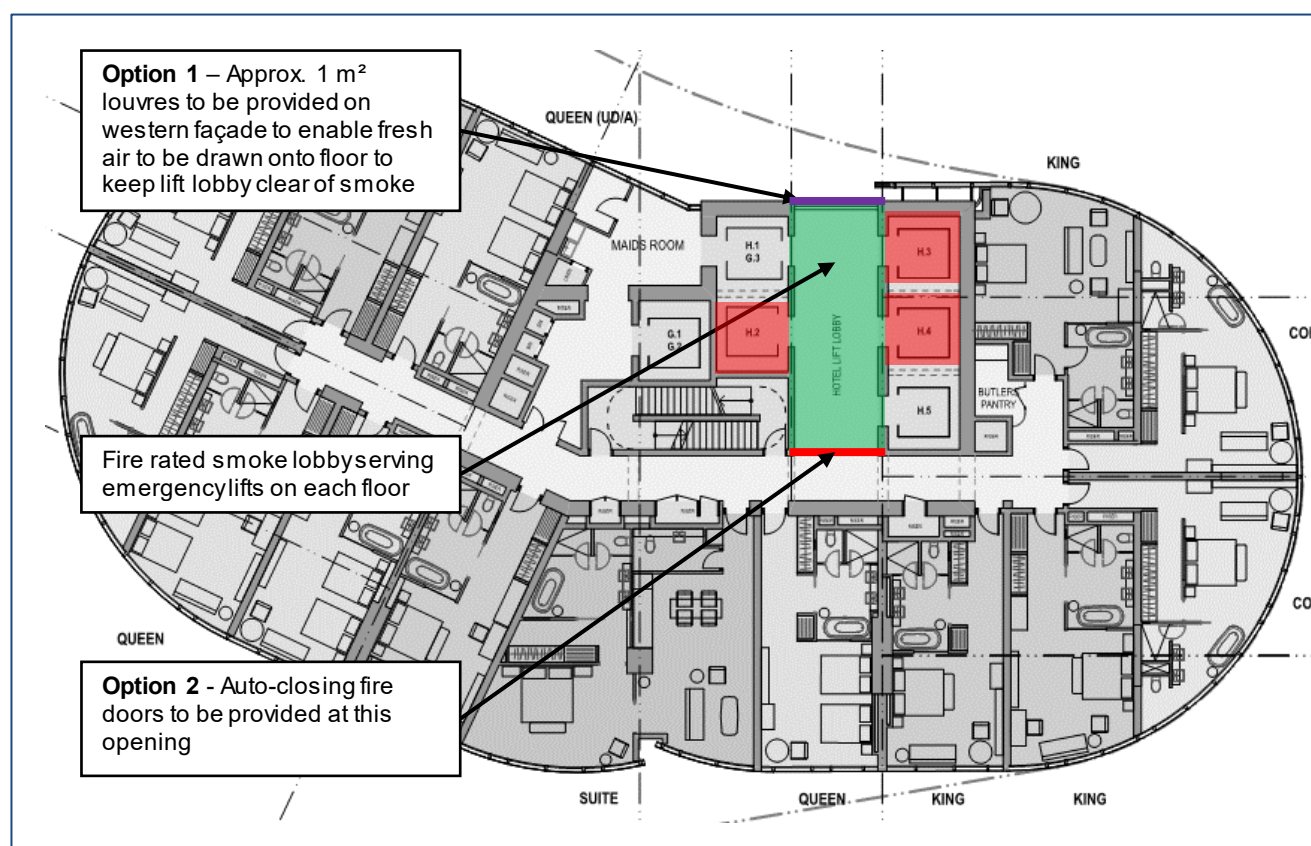


Figure 23: Location of lifts proposed to be used for evacuation (typical hotel floor)

FRNSW will always have control of at least one of the two emergency lifts within the building, through the provision of a Brigade key lock at the ground level lobby area. The fact that the goods lift will serve as an emergency lift which is not used for evacuation shall also mean that Brigade operations shall have no impact on the evacuation process should the lifts be in use at the time of their arrival.

While the above strategy will be further developed between the fire engineer, lift consultant, architect and client as the Mod 13 design progresses, this strategy is being tabled here for review and comment by FRNSW as a key stakeholder in such a design.

Performance solution:

- ☒ A0.3(a)(i) - Comply with the performance requirements
- ☐ A0.3(a)(ii) - Be at least equivalent to the DtS provisions

Assessment methods:

- ☐ A0.5(a) - Evidence of suitability
☐ A0.5(b)(i) - Verification methods in the NCC
☒ A0.5(b)(ii) - Other verification methods
☐ A0.5(c) - Expert judgement
☐ A0.5(d) - Comparison with the DtS provisions

Assessment approach:

- ☐ Comparative ☒ Qualitative ☒ Deterministic
☒ Absolute ☐ Quantitative ☐ Probabilistic

IFEG sub-systems used in the analysis:

- ☐ A – Fire initiation and development and control
☐ B – Smoke development and spread and control
☐ C – Fire spread and impact and control
☐ D – Fire detection, warning and suppression
☒ E – Occupant evacuation and control
☒ F – Fire services intervention

Acceptance criteria and factor of safety:

It must be demonstrated that the use of lifts for evacuation will not put occupants at risk as they await the arrival of the lift in the lobby area, and that such a design will not impact on Brigade operations on site.

Fire scenarios and design fire parameters:

N/A

Describe how fire brigade intervention will be addressed or considered:

Brigade intervention is a key criterion for developing an acceptable solution for the use of lifts for emergency evacuation. Given this is being tabled to FRNSW for comment here, their input on this solution is considered a key component of the design. These comments will then be incorporated in the final design.

Verification/validation analyses:

- ☐ Sensitivity studies ☐ Redundancy studies ☐ Uncertainty studies ☒ None

N/A

Provide details on proposed modelling/assessment tools:

N/A

In relation to the assessment proposed FRNSW have the following general concerns and recommend the following should be addressed:

1. All issues raised in the ABCB Handbook: Lifts Used during Evacuation (2013) should be addressed by the assessment.
2. EP2.2 should be addressed as the lifts shaft is considered part of the path of travel to an exit.
3. The assessment of the corridor smoke exhaust system is recommended to demonstrate that conditions within the corridor will be maintained to enable the lobby area to be used as a refuge during evacuation.
4. High Temperature and Lift Reliability: Lifts are intended to operate in temperatures of up to 40°C. Above 40°C, the reliability of lift equipment may be reduced, which increases the likelihood of malfunction. This is acknowledged in NCC BCA Spec E3.1 Part 4(a), European Lift Standard EN81-1:1998 Section 0.3.15 and Section 6.4.6, as referenced by AS1735.1-2003 Section A1.
5. Lift Capability: FRNSW recommend that confirmation should be provided by the lift manufacturer (and service provider) that the Alternative Solution is feasible. This confirmation should be provided to FRNSW as part of the FER.

6. Occupant Behaviour: The assessment is recommended to provide detail on how access to the lifts will be managed during evacuation. The assessment should address occupant behaviours (e.g. panic) which may be detrimental to the operation of the lift. For example, overloading and doors being held open for extended duration causes lifts to go into fault mode and shut down
7. Shut Down Procedure: The assessment should consider trapped occupants within the lift, as a result of shut down.
8. Management procedures for lift evacuation should be detailed in the FER.

Issue number: 1 Discharge of final exits

Details of departures from DtS provisions:

The fire isolated stairs serving the new tower discharge into an area that is not open for at least 1/3 of its perimeter as required under BCA Clause D1.7.

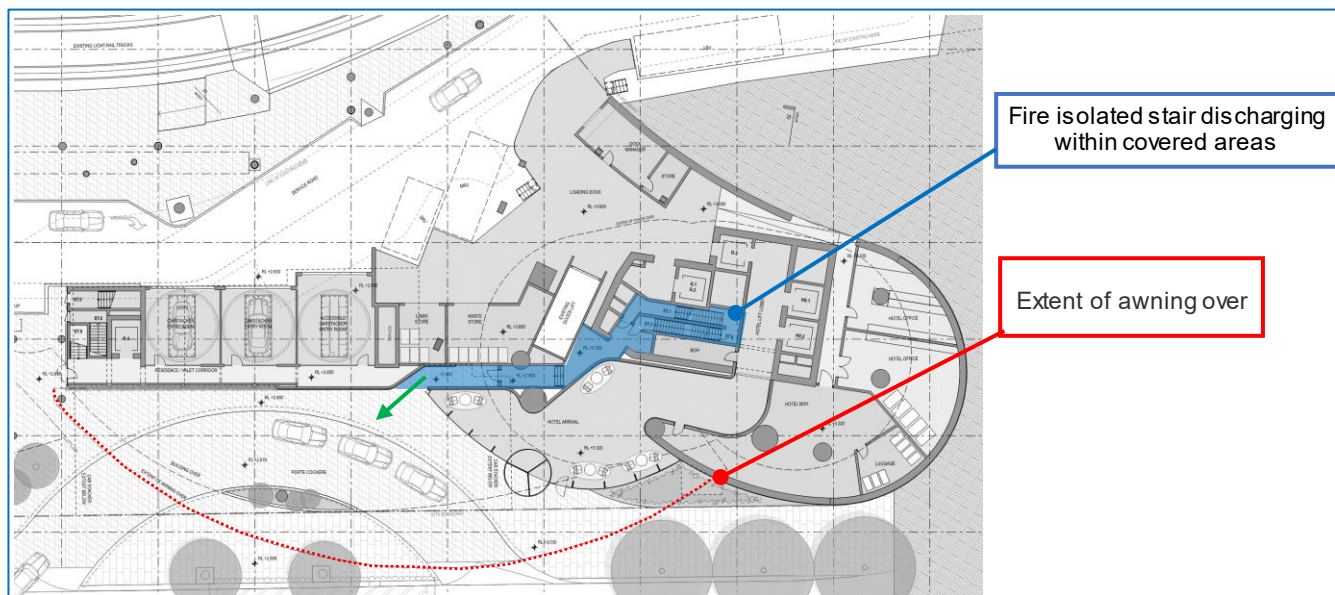


Figure 1: Fire isolated stair discharging within covered areas at Level B2

Applicable DtS provisions: D1.7

Performance requirements: DP4, EP2.2

List key fire safety measures:

The fire safety measures listed in Section 6 form the holistic fire safety design for the development incorporating measures specific to the consideration of the Performance Solutions. Fire safety measures specific to this solution are listed below;

- Egress path via covered areas at Pirrama Road side of the building adjacent the Porte Cochere are to be maintained clear of any obstructions.
- A secondary escape route shall be provided from the fire exit on the Pirrama Road side of the building through the main hotel lobby as shown in Figure 1.
- Each of the fire-rated exit discharge doorways shall be fitted with a fire-rated glass viewing panel. This is to enable occupants to assess conditions beyond the doorway prior to entering this space.
- The escape pathway under the covered areas shall have no combustible materials contained within and is to be a designated sterile path. Additional supporting fade resistant signage is to be erected within the pathway outlining this requirement. Signage to read as follows:

“OFFENCES RELATING TO EGRESS PATHWAY”

It is an offence to:

Place anything in the egress pathway which may constitute a fire load or impede the free passage of persons; or remove, damage or otherwise interfere with this notice”

The words “OFFENCES RELATING TO STERILE ZONE” must be in letters not less than 100 mm in height. The lettering shall be in a colour contrasting with the background to which the sign is erected.

Regular monthly inspections are also to be undertaken by the building management so as to ensure that the pathway of egress is kept free from combustibles during the life of the building. The above requirements are to be noted on the essential services schedule and Annual Fires Safety Statement for the building.

Proposed alternative solution:

The proposed Performance Solution will be assessed based on the following:

- Once occupants are within the covered space, the occupants are essentially provided with a choice in the direction of egress in reaching a road or open space as indicatively illustrated in Figure 1. To facilitate in directing the evacuating occupants to an open space, additional wayfinding exit signage is proposed to be located along the stair discharge pathway so there is no ambiguity in evacuating from the building.
- A secondary egress route will also be available via the hotel lobby area to mitigate the risk of occupants escaping within a vicinity of a car fire outside of the building.
- Viewing panels are to be fitted in each of the discharge doorways so that occupants can verify that this pathway is safe prior to entering the space. Should a hazard be identified, then the alternative route can be used which is >6 m from the potential fire source.
- The discharge pathway from the stair is proposed to become a sterile area which is free of combustible materials with the additional supporting signage to be incorporated so as to enforce this requirement;
- Management of the building are to periodically inspect the stair discharge pathway weekly to ensure the designated egress pathway detailed above is being maintained.
- The introduction of the above fire safety measures to the discharge pathway shall reduce the potential for a fire in this location as well as ensuring that it a designated egress route is being maintained.

Performance solution:

- ☐ A0.3(a)(i) - Comply with the performance requirements
- ☒ A0.3(a)(ii) - Be at least equivalent to the DtS provisions

Assessment methods:

- ☐ A0.5(a) - Evidence of suitability
- ☐ A0.5(b)(i) - Verification methods in the NCC
- ☐ A0.5(b)(ii) - Other verification methods
- ☐ A0.5(c) - Expert judgement
- ☒ A0.5(d) - Comparison with the DtS provisions

Assessment approach:

- | | | |
|---|---|---|
| ☒ Comparative | ☒ Qualitative | ☒ Deterministic |
| ☐ Absolute | ☐ Quantitative | ☐ Probabilistic |

IFEG sub-systems used in the analysis:

- | | |
|--|---|
| ☐ A – Fire initiation and development and control | ☐ D – Fire detection, warning and suppression |
| ☐ B – Smoke development and spread and control | ☒ E – Occupant evacuation and control |
| ☒ C – Fire spread and impact and control | ☐ F – Fire services intervention |

Acceptance criteria and factor of safety:

To determine whether the Performance Solution is considered to meet the BCA Performance Requirements, it needs to be demonstrated that the design provides a level of safety to occupants that is at least equivalent to a DtS compliant building in terms of the potential risk they may be put at while seeking egress from a fire isolated stair.

Fire scenarios and design fire parameters:

n/a

Describe how fire brigade intervention will be addressed or considered:

n/a

Verification/validation analyses:

☐ Sensitivity studies ☐ Redundancy studies ☐ Uncertainty studies ☒ None

Provide details on proposed modelling/assessment tools:

n/a

FRNSW Comment: In principle support is provided subject to the analysis in the FER demonstrating compliance with the performance requirements of the NCC.

Issue number: 2 Aggregate egress widths from Levels 5 and 7

Details of departures from DtS provisions:

It is noted that based on the assessment carried out by the Principle Certifying Authority (PCA), there is an egress width non-compliance at Levels 5 and 7. It is proposed to rationalise the required egress width at each level, and permit the reduced egress width as follow. It is also proposed to justify the use of escalators from these two floors for evacuation purposes.

FRNSW Comment: Please confirm whether the egress width of the escalators has been included in the proposed egress width in the table below.

Level	Floor area	Number of Occupants	DtS Egress Width	Proposed Egress Width
Level 5	4,020 m ²	2,287	19.5 m	10 m
Level 7	850 m ²	615	5.5 m	3.5 m

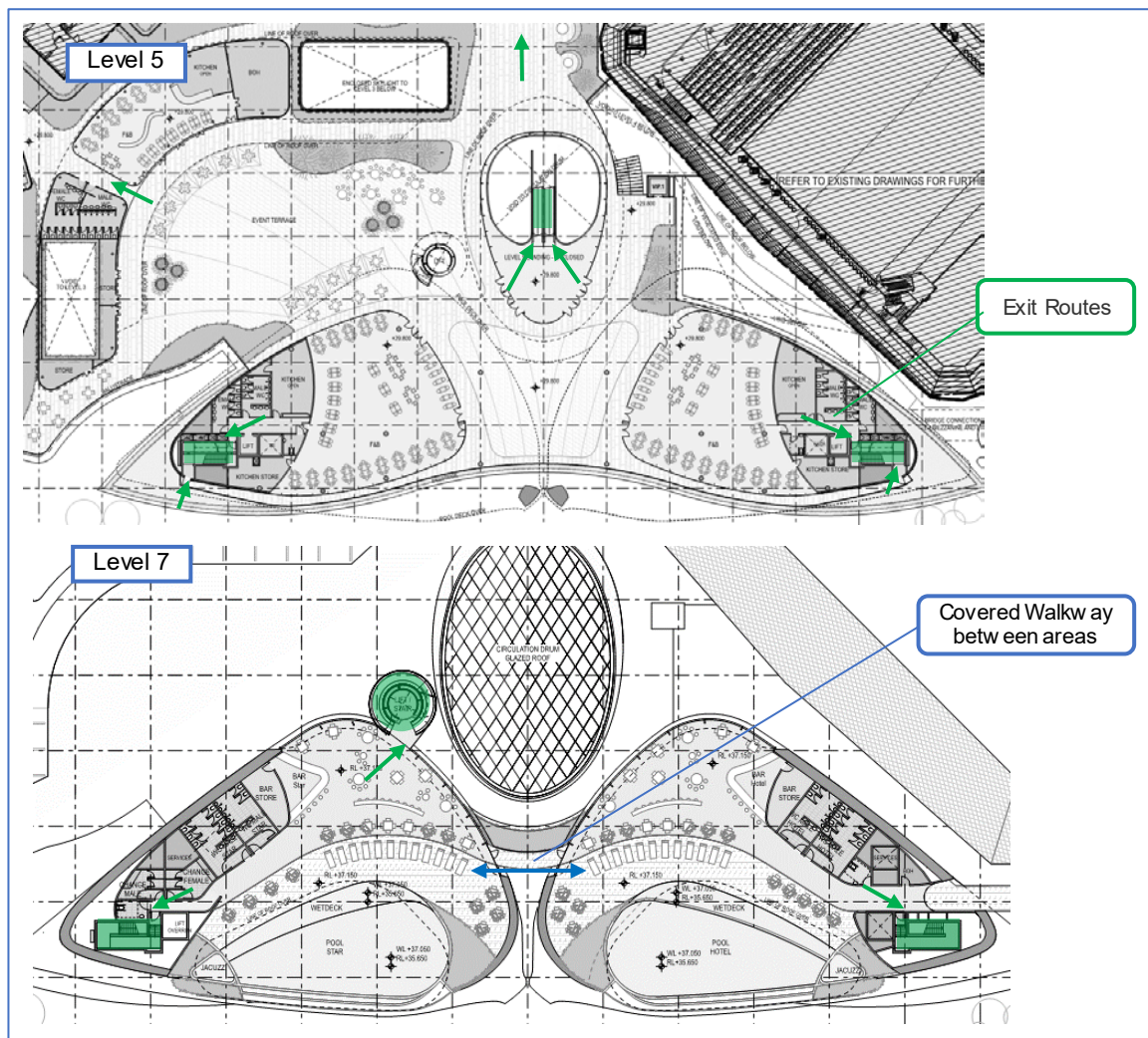


Figure 2: Exit routes at Level 5 and 7

Applicable DtS provisions: D1.6

Performance requirements: DP4, EP2.2

List key fire safety measures:

The fire safety measures listed in Section 6 form the holistic fire safety design for the development incorporating measures specific to the consideration of the Performance Solutions. Fire safety measures specific to this solution are listed below;

It shall be acceptable for escalators to be used for evacuation purposes subject to compliance with the following **key** requirements:

- AS 1670.1 (2015) compliant smoke detection shall be provided to any internal spaces on Levels 5 and 7 on a 10 m grid layout throughout occupied space areas for the purposes of reducing alarm times to this space.
- Escalators are to be constructed of non-combustible materials.
- Escalators running in the direction of egress are to be permitted to remain operating.
- Escalators running reverse to the direction of egress are to be capable of being stopped locally and remotely as follows:
 - Locally by a manual stopping device at the travellers
 - Remotely by a manual stopping device at a remote location such as the Fire Control Room or as part of a pre-planned evacuation response
- Where provision is made for remote stopping of escalators counted as means of egress, one of the following is to apply:
 - The stop is to be delayed until it is preceded by a minimum 15-second audible signal or warning message sounded at the escalators.
 - Where escalators are equipped with the necessary controls to decelerate in a controlled manner under the full rated load, the stop is to be delayed for at least 5 seconds before beginning deceleration, and the deceleration rate shall be no greater than 0.052 m/sec².
- Where an audible signal or warning message is used, the following is to apply:
 - The signal or message to have a sound intensity that is at least 15 dBA above the average ambient sound level for the entire length of the escalators.
 - The signal is to be distinct from the fire alarm signal.
 - The warning message to meet audibility and intelligibility requirements.
- All escalators which are to be used as secondary egress routes from the carpark levels are to be connected to the site's essential services power supply. This power supply is to be connected to a 'standby power system' complying with BCA Specification G3.8(6) in regards to either having a full generator backup, or being from multiple substations.

FRNSW Comment: Please see previous comments regarding the training of staff in the operation of escalators in fire alarm.

Proposed alternative solution:

The proposed Performance Solution will be supported based on the following:

- Increased smoke detection within internal portions of these floors will enable the alarm times in this space to the external rooftop areas to be expedited.
- Any increased evacuation times as a result of reduced aggregate egress widths will be largely irrelevant once occupants reach the external rooftop areas on level 5. In the unlikely event of fire, the smoke produced by the fire would be directly dispersed to the ambient atmosphere, reducing the heat and radiation exposure to occupants queuing outside of the fire isolated stairs.

FRNSW Comment: FRNSW recommends this assumption be quantified to demonstrate that occupants are not exposed to untenable conditions during queuing.

- It is intended to utilise the escalators at Level 5 as a secondary means of escape. Although not recommended in the BCA, escalator use as an acceptable means of escape is internationally accepted as part of the evacuation strategy for underground stations and large public buildings. This has been documented under NFPA 130, London Underground and BS 9999. It should be noted that although these standards allow for the use of escalators as part of an evacuation strategy, it is only as a secondary means of escape, and not as the sole means of egress from a building or fire compartment. BS 9999 Section 14.3(h) acknowledges

that in certain situations escalators may be used as part of the means of escape solution, requiring a fully fire engineered assessment carried out.

Performance solution:

- ☒ A0.3(a)(i) - Comply with the performance requirements
☐ A0.3(a)(ii) - Be at least equivalent to the DtS provisions

Assessment methods:

- ☐ A0.5(a) - Evidence of suitability
☐ A0.5(b)(i) - Verification methods in the NCC
☒ A0.5(b)(ii) - Other verification methods
☐ A0.5(c) - Expert judgement
☐ A0.5(d) - Comparison with the DtS provisions

Assessment approach:

- | | | |
|--|---|---|
| ☐ Comparative | ☒ Qualitative | ☒ Deterministic |
| ☒ Absolute | ☐ Quantitative | ☐ Probabilistic |

IFEG sub-systems used in the analysis:

- | | |
|--|---|
| ☐ A – Fire initiation and development and control | ☒ D – Fire detection, warning and suppression |
| ☐ B – Smoke development and spread and control | ☒ E – Occupant evacuation and control |
| ☐ C – Fire spread and impact and control | ☐ F – Fire services intervention |

Acceptance criteria and factor of safety:

To determine whether the Performance Solution is considered to meet the BCA Performance Requirements, it needs to be demonstrated that the design provides a level of safety to occupants that is at least equivalent to a DtS compliant building in terms of the potential risk they may be put at while seeking egress towards fire isolated stairs.

Fire scenarios and design fire parameters:

n/a

Describe how fire brigade intervention will be addressed or considered:

n/a

Verification/validation analyses:

- ☐ Sensitivity studies ☐ Redundancy studies ☐ Uncertainty studies ☒ None

Provide details on proposed modelling/assessment tools:

n/a

Issue number: 3 Protection of openings in adjoining compartments
Details of departures from DtS provisions:

BCA Table C3.3 stipulates the minimum distance between external walls and associated openings in adjacent fire compartments for walls with angles between 0° to more than 180°. In addition, the prescriptive provisions of the BCA stipulate that openings within building elements required to have an FRL shall be protected as follows:

- Any external opening within 3 m of the fire source feature protected by -/60/- fire rated construction, or externally located wall wetting sprinklers, or an alternate solution be provided to verify CP2 of the BCA.
- Penetrations through fire rated floors to be protected either by a tested prototype (e.g. fire collar, fire damper, etc) or be installed within a fire rated shaft achieving the FRL applicable to the classification
- Any penetration through a wall or room required to have an FRL (e.g. substation, boiler room, apartment separating wall etc) is to be protected either by a tested prototype (e.g. fire collar, fire damper, etc) or be installed within a shaft achieving the FRL applicable to the classification (120/120/120 where it is a room such as a substation). This applies to doors serving as horizontal exits.
- Self-closing -/60/30 fire doors to the doors opening to the fire isolated stairs.

Where non-compliances with the above occur, these will be assessed in more detail to review the suitability of supporting them as a Performance Base solution. The location of each of these subject openings will be fully detailed at FER stage.

FRNSW Comment: Since the locations and distances of the subject openings have not been detailed FRNSW do not support the qualitative assessment presented. FRNSW recommends the assessment be quantified to demonstrate compliance with CP2.

Applicable DtS provisions:	C3.3, C3.4	Performance requirements:	CP2
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List key fire safety measures:

Refer to Trial Design Requirements detailed in Section 6 of this FEBQ for the fire safety measures relevant to this development. It is proposed to install the following measures to support the Performance Solution:

- The building will be provided with an automatic sprinkler system, in accordance with AS 2118.1. Sprinklers in are to be 68 °C fast response sprinkler heads (subject to ambient temperature) with a RTI of 50 m^{1/2}s^{1/2} or less. Flush mounted sprinkler heads are not to be used unless first deemed acceptable by the fire engineer for use in the nominated area.
- Install an addressable smoke detection system to AS 1670.1 in accordance with BCA Specification Clause 4 and connected to activate an EWIS in accordance with Clause 6 with direct brigade connection in accordance with Clause 7.

Proposed alternative solution:

The proposed Performance Solution will be assessed on the following basis:

- A significant fire is unlikely to occur in subject areas, in the unlikely event of a fire, the provision of sprinkler protection will likely confine the fire to the room of origin. With sprinkler cooling effect on fire taken into consideration, the radiation level from the rooms concerned will be limited and is not expected to result in fire spread between fire compartments.

FRNSW Comment: FRNSW recommends the above be quantified to demonstrate that fire spread will not occur for the fire scenarios.

- Fuel load restrictions will also be implemented to the affected area on a case-by-case basis

FRNSW Comment: FRNSW recommends the assessment specify what and how the fuel load restrictions will be implemented.

- In areas with significant fuel load where fuel load restriction is not feasible, radiation calculation will be performed to demonstrate that the unprotected openings in these areas will not result in fire spread.

Performance solution:

- ☒ A0.3(a)(i) - Comply with the performance requirements
- ☐ A0.3(a)(ii) - Be at least equivalent to the DtS provisions

Assessment methods:

- ☐ A0.5(a) - Evidence of suitability
- ☐ A0.5(b)(i) - Verification methods in the NCC
- ☒ A0.5(b)(ii) - Other verification methods
- ☐ A0.5(c) - Expert judgement
- ☐ A0.5(d) - Comparison with the DtS provisions

Assessment approach:

- | | | |
|--|--|---|
| ☐ Comparative | ☒ Qualitative | ☒ Deterministic |
| ☒ Absolute | ☒ Quantitative | ☐ Probabilistic |

IFEG sub-systems used in the analysis:

- | | |
|--|--|
| ☐ A – Fire initiation and development and control | ☐ D – Fire detection, warning and suppression |
| ☒ B – Smoke development and spread and control | ☐ E – Occupant evacuation and control |
| ☒ C – Fire spread and impact and control | ☐ F – Fire services intervention |

Acceptance criteria and factor of safety:

The proposed Performance Solution will demonstrate that the reduced fire protection due to the exposed openings will not result in fire spread between buildings.

Fire scenarios and design fire parameters:

n/a

Describe how fire brigade intervention will be addressed or considered:

n/a

Verification/validation analyses:

- ☐ Sensitivity studies ☐ Redundancy studies ☐ Uncertainty studies ☒ None

Provide details on proposed modelling/assessment tools:

n/a

Issue number: 4 Retail units served by a single exit

Details of departures from DtS provisions:

The building has been determined by the PCA to have an effective height of greater than 25 m. Therefore, all the levels within the building, including the retail units at Ground floor, are required to be provided with two exits to comply with the BCA DtS provisions. It is proposed to develop a fire engineered Performance Solution to permit the Ground floor retail units to have a single exit in lieu of two.

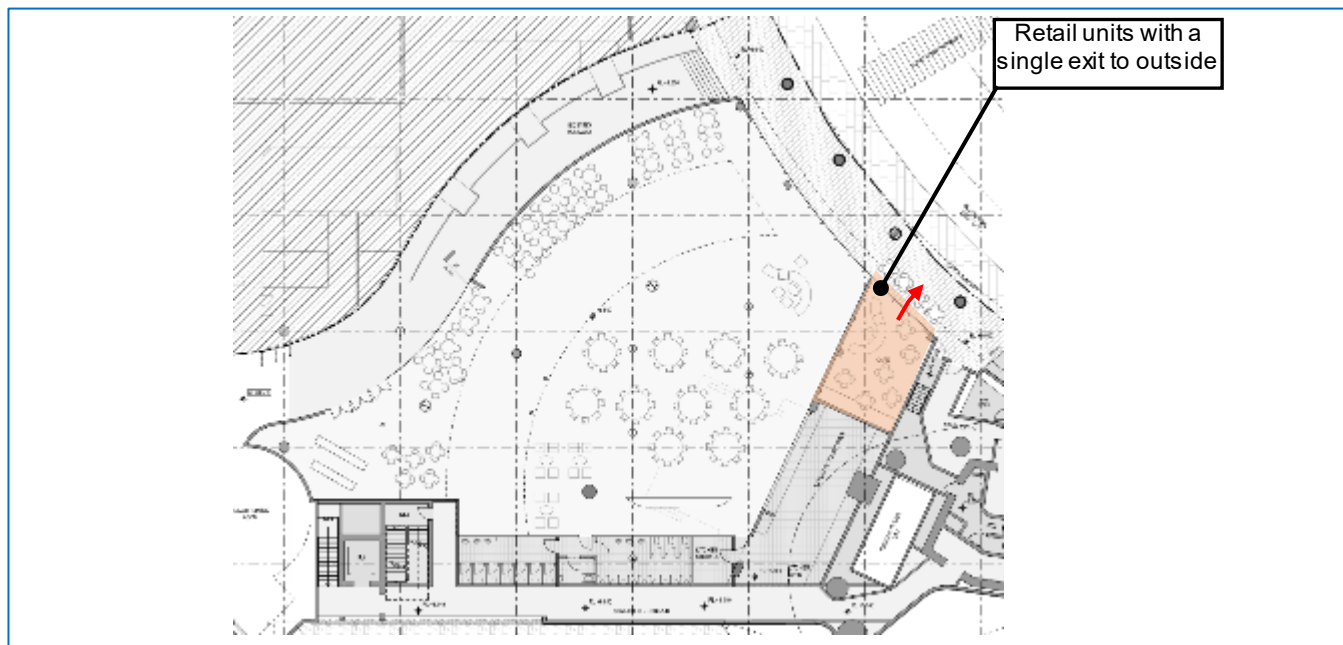


Figure 3: Location of retail units served with a single exit

Applicable DtS provisions:

D1.2

Performance requirements:

DP4

List key fire safety measures:

Refer to Trial Design Requirements detailed in Section 6 of this FEBQ for the fire safety measures relevant to this development. It is proposed to install the following measures to support the Performance Solution:

- The building will be provided with an automatic sprinkler system, in accordance with AS 2118.1. Sprinklers are to be 68 °C fast response sprinkler heads (subject to ambient temperature) with a RTI of 50 m^{1/2}s^{1/2} or less. Flush mounted sprinkler heads are not to be used unless first deemed acceptable by the fire engineer for use in the nominated area.
- The sprinkler system is required to be connected to and activate an EWIS on site.
- Install an addressable smoke detection system to AS 1670.1 in accordance with BCA Specification Clause 4 and connected to activate the EWIS in accordance with Clause 6 with direct brigade connection in accordance with Clause 7.
- Provide emergency lighting in accordance with BCA Clauses E4.2 and E4.4 and AS 2293.1.
- Provide emergency exit signage in accordance with BCA Clauses E4.5, E4.6 and E4.8 and AS 2293.1.

Proposed alternative solution:

The proposed Performance Solution will be assessed based on the following:

- The hazard associated with providing a single exit from parts of a building with an effective height greater than 25m is that a single exit could potentially be compromised before all the occupants could safely egress owing to the relatively long evacuation times that are characteristic of high rise buildings.
- Each of the retail units at ground floor level of the proposed development is provided with a single exit which is directly to the outside. The building will be sprinkler protected throughout in accordance with AS 2118.1 and is also to be provided with an automatic fire detection and alarm system in accordance with

BCA Clause E2.2a and Clause 3, 4 & 6 of Specification E2.2 which shall contribute to the safe egress of occupants from the building.

- It is further noted that the retail units will be a separate fire compartments from the remainder of the building and located at level of egress discharge. A fire located elsewhere in the building would therefore not have an effect on evacuating occupants from the retail units. Hence two exits in this instance is irrelevant as the DtS Provisions is applicable to a building with an effective height > 25 m.

Performance solution:

- ☐ A0.3(a)(i) - Comply with the performance requirements
- ☒ A0.3(a)(ii) - Be at least equivalent to the DtS provisions

Assessment methods:

- ☐ A0.5(a) - Evidence of suitability
- ☐ A0.5(b)(i) - Verification methods in the NCC
- ☐ A0.5(b)(ii) - Other verification methods
- ☐ A0.5(c) - Expert judgement
- ☒ A0.5(d) - Comparison with the DtS provisions

Assessment approach:

- | | | |
|---|---|---|
| ☒ Comparative | ☒ Qualitative | ☒ Deterministic |
| ☐ Absolute | ☐ Quantitative | ☐ Probabilistic |

IFEG sub-systems used in the analysis:

- | | |
|--|---|
| ☐ A – Fire initiation and development and control | ☒ D – Fire detection, warning and suppression |
| ☐ B – Smoke development and spread and control | ☒ E – Occupant evacuation and control |
| ☐ C – Fire spread and impact and control | ☐ F – Fire services intervention |

Acceptance criteria and factor of safety:

The acceptance criterion for this solution is that the occupants in the subject retail units will be afforded at least the same opportunity to safely escape as occupants exposed to similar risks in a DtS compliant building.

Fire scenarios and design fire parameters:

n/a

Describe how fire brigade intervention will be addressed or considered:

n/a

Verification/validation analyses:

- ☐ Sensitivity studies ☐ Redundancy studies ☐ Uncertainty studies ☒ None

Provide details on proposed modelling/assessment tools:

n/a

FRNSW Comment: In principle support is provided subject to the analysis in the FER demonstrating compliance with the performance requirements of the NCC.

Issue number: 5 Community/Neighbourhood Centre

Details of departures from DtS provisions:

To comply with BCA D1.12 non-required stairways must not connect more than three storeys with one of those storeys is situated at a level at which there is direct egress to a road or open space. It is proposed to develop a fire engineered performance solution to allow the open stair in the community/neighbourhood centre to interconnect five levels (Level 0 to 4). The location of the internal stair is illustrated in the following figures.

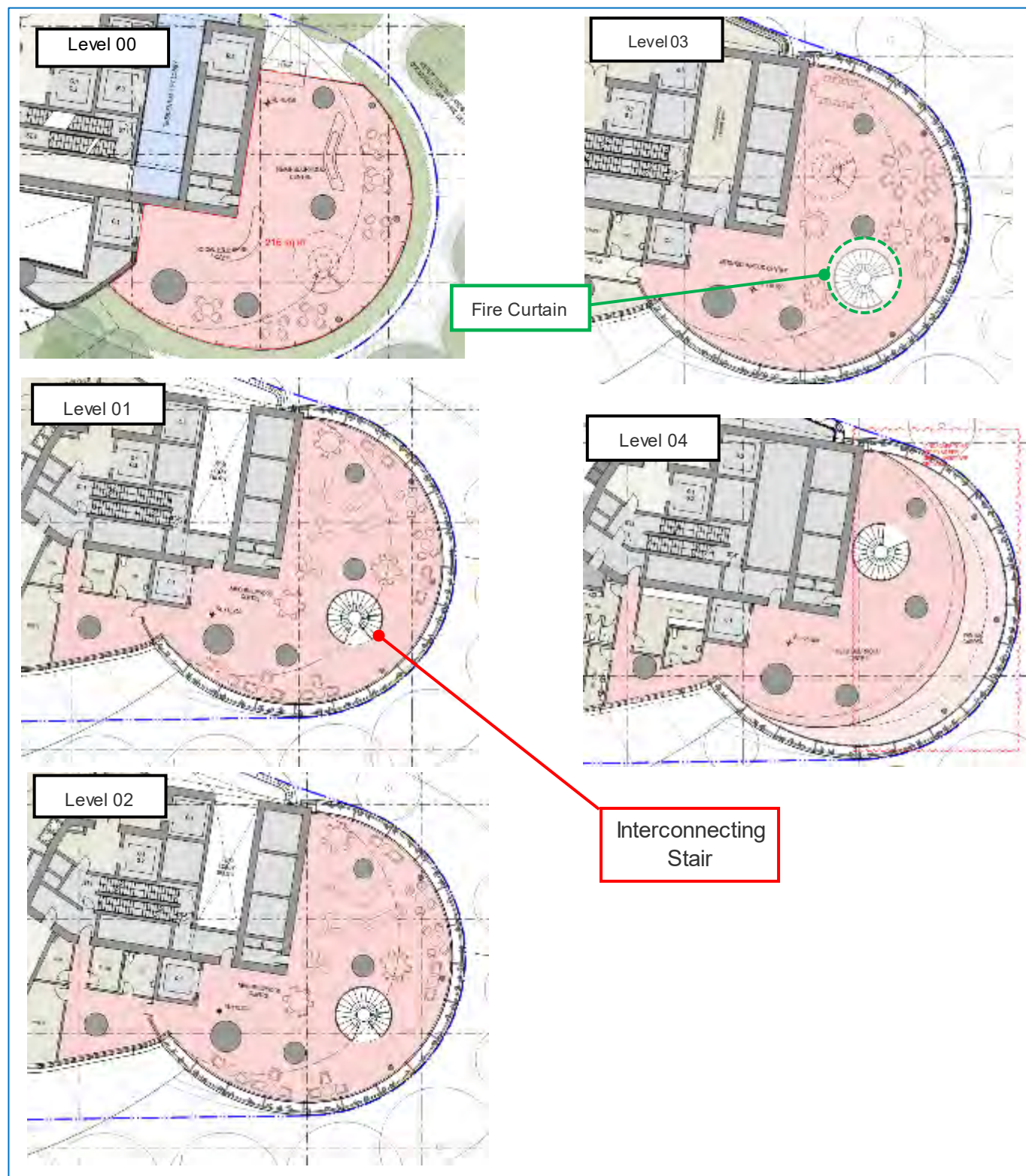


Figure 4: Interconnecting Stair in Community/Neighbourhood Centre

Applicable DtS provisions:	D1.12	Performance requirements:	EP2.2
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List key fire safety measures:

The fire safety measures listed in Section 6 form the holistic fire safety design for the development incorporating measures specific to the consideration of the Performance Solutions. Fire safety measures specific to this solution are listed below;

- The building will be provided with sprinkler system in accordance with AS 2118.6-2012. Fast response sprinklers will be installed in the community/neighbourhood centre, having a temperature rating of 68 °C (subject to ambient temperature) and a Response Time Index (RTI) of not greater than 50 (m·s)^{1/2}. Flush mounted sprinkler heads are not to be used unless first deemed acceptable by the fire engineer for use in the nominated area.
- An additional smoke detector is to be included in accordance with AS 1670.1 at the top of the stair void on Level 4.
- A Fire Curtain with an FRL of -/120/- is to be installed around the non-fire-isolated stair on Level 3. Fire barriers will be provided above the fire curtains within any concealed ceiling space along the line of the fire curtain. The fire curtain will be fully tested in accordance with AS 1530.7 (or where relevant to product, tested to EN 12101.1) and provided with fail-safe close on power/motor failure. Manual testing will be provided to same.
- The fire curtains are required to resist the passage of flames and hot gases for a minimum of 120 minutes as specified in AS 1530.4.
- The fire curtain will be capable of withstanding any adverse deflection of the curtain due to the pressure differentials created by the smoke exhaust system operating on Level 00 – 04.
- The floor covering of the landing floor area of the fire curtain, the internal stair and the landing area of the stair are to be of non-combustible material.
- AS 2118.1-1999 sprinkler coverage will be provided to the fire curtain and the stair risers within the fire curtain area i.e. sprinkler protection will be provided to the underside of the stair to protect the flights.
- A red strobe light will be provided within proximity of the interconnecting stair at the rising stairs on level 2 and the top of the stair on level 3. This light will activate upon alarm activation to signal that the fire curtain is lowering.
- Additional exit signage on the inside of the fire curtain on Level 3 is required to read "EXIT ON LEVEL BELOW". The fire curtain will be activated for a fire on Levels 00 – 04 (the above text is not relevant to fire location).
- The fire curtain will have a staged closing procedure. On alarm activation the fire curtain will close to a point of 2 m above floor level for 60 seconds to afford occupants time to move from the area to the fire isolated stairs. After 60 seconds the fire curtain will then drop to the floor level.

The following provisions shall be included in the management in use plan:

- The area surrounding the interconnecting stairs on Level 3 is required to be clear and free of combustible materials or any storage of any object that could interfere with the safe operation of the fire curtain. This is a requirement for a distance of 1 m of the fire curtain. Signage to be provided to advise occupants of these requirements.
- The area under the interconnecting stairs is required to be clear and free of combustible materials on level 3. Signage to be provided to advise occupants of these requirements.

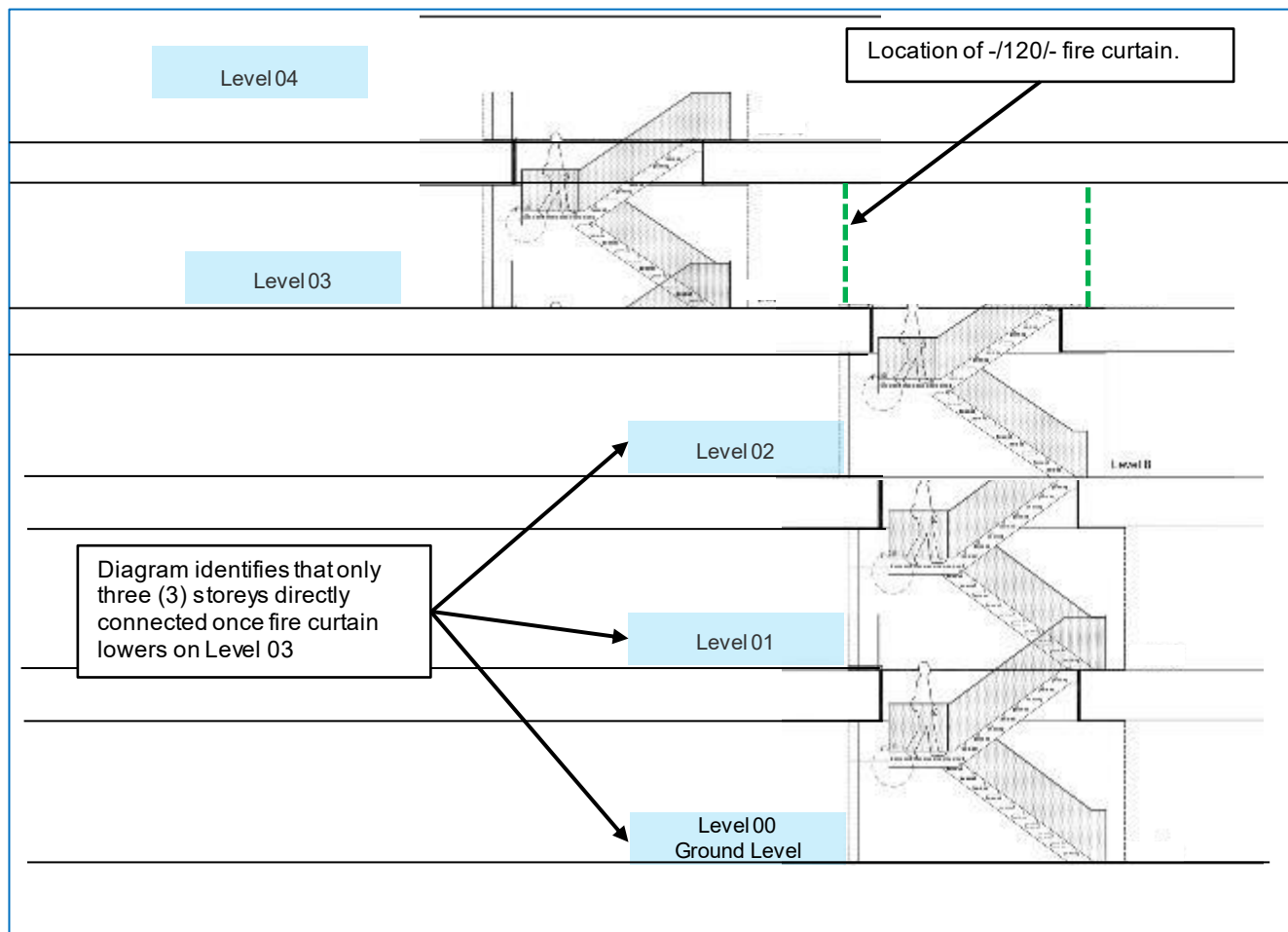


Figure 5: Level 3 Fire curtain

Proposed alternative solution:

The proposed Performance Solution will be supported based on the following provisions:

- The community/neighbourhood centre will be provided with sprinkler coverage throughout. In the event of a fire it is expected that the sprinkler system will control, if not suppress the fire. The sprinkler system will act to wet adjacent combustible materials and partitions and is expected to prevent fire spread beyond the area of fire origin. By controlling the size of a fire the sprinkler system minimises the amount of smoke produced and is expected, therefore, to ensure the safety of occupants outside the immediate vicinity of the fire start.
- The five storeys connected essentially form a single fire compartment. It is noted that this compartment is well within the floor area and volume limits allowed under the DtS provisions of the BCA Clause C2.2 for Class 9b buildings (the total floor area of the community/neighbourhood centre is less than 8,000m², at 1,130m²). The addition of an automatic 2 hr fire curtain on Levels 3 will provide fire separation between these two floors and on those below this. This results in only three floors being connected to each other with one of these levels (Level 00) discharging at Ground floor, which is comparable to a BCA DtS design. The fire curtain is required to be fully tested in accordance with AS 1530.7 (or where relevant to product, tested to EN 12101.1) and provided with fail-safe close on power failure. Manual testing and fire service override switches will be provided to this curtain.
- When the fire curtain is lowered there is a potential for deflection to occur due to the pressure differential between the two areas. The fire curtain will be capable of withstanding any adverse deflection.
- To prevent occupants from becoming trapped beneath the fire curtain, it will have a staged closing procedure. On alarm activation the fire curtain will close to a point of 2 m above floor level. After 60 seconds the fire shutter will then fully drop to the floor level to provide fire and smoke separation between the two areas.
- The main risk to fire spread is through the radiant heat from a fire within close proximity to the fire curtain since the fire curtain does not have an insulation rating (-/120/-). The area surrounding the Level 3 stair will be clear and free of combustible materials as it will be used as a circulation space and a path of access

between the five levels. This area, including the fire curtain, will be provided with full sprinkler coverage. Due to the sterile nature of the space around the stair this area will be devoid of combustible materials and owing to this lack of fuel and relatively few ignition sources in these areas, a fire starting in these areas is deemed unlikely. Even if a fire were to occur, it would likely be a smouldering fire which would burn out relatively quickly owing to the limited fuel load available. This does not pose a significant risk to the spread of fire between the levels where the fire curtain does not have an insulation FRL value.

- In the event of an occupant using the non-required, non-fire isolated stair whilst there is a fire on Level 3, there will be additional signage on the inside of the curtain stating "EXIT ON LEVEL BELOW" which will inform the occupants of the requirement to descent the stairs to the levels below.

Performance solution:

- ☒ A0.3(a)(i) - Comply with the performance requirements
- ☐ A0.3(a)(ii) - Be at least equivalent to the DtS provisions

Assessment methods:

- ☐ A0.5(a) - Evidence of suitability
- ☐ A0.5(b)(i) - Verification methods in the NCC
- ☒ A0.5(b)(ii) - Other verification methods
- ☐ A0.5(c) - Expert judgement
- ☐ A0.5(d) - Comparison with the DtS provisions

Assessment approach:

- | | | |
|--|---|---|
| ☐ Comparative | ☒ Qualitative | ☒ Deterministic |
| ☒ Absolute | ☐ Quantitative | ☐ Probabilistic |

IFEG sub-systems used in the analysis:

- | | |
|--|---|
| ☐ A – Fire initiation and development and control | ☒ D – Fire detection, warning and suppression |
| ☒ B – Smoke development and spread and control | ☒ E – Occupant evacuation and control |
| ☒ C – Fire spread and impact and control | ☐ F – Fire services intervention |

Acceptance criteria and factor of safety:

The acceptance criteria will demonstrate that two connecting floors will be achieved based on relying on an active fire safety system (fire curtain). In addition, the acceptance criteria will demonstrate that the egress of occupants on Level 4 is not impeded, due to a fire on the lower levels.

Fire scenarios and design fire parameters:

n/a

Describe how fire brigade intervention will be addressed or considered:

n/a

Verification/validation analyses:

- ☐ Sensitivity studies ☐ Redundancy studies ☐ Uncertainty studies ☒ None

Provide details on proposed modelling/assessment tools:

n/a

FRNSW Comment: FRNSW recommends the fire curtain be listed as a Critical Fire Safety Measure on the Fire Safety Schedule to be tested a minimum of every 3 months.

Issue number: 6 Fire hydrant pumping arrangements**Details of departures from DtS provisions:**

Under the 2005 edition of AS 2419.1 (which is the BCA 2016 mandated fire hydrant standard), a hydrant system may be designed with any number of pressure zones, as long as the pumping appliances on site can enable compliant pressures and flows to be achieved at the most disadvantaged valve(s). It also makes no limitation to the number of pressure zones which can be served through a 'cascade' type arrangement by water being pumped to the top of the building, and then dropping through the pressure reduction valves at the bottom of each zone to achieve compliant pressure and flow.

It has also been identified during the Mod 13 works that the draft 2016 edition of AS 2419.1 stipulates that:

- a) a 50 kL hydrant tank is required at the top of the uppermost pressure zone since the building is >50 m in effective height; and
- b) that a building can contain no greater than three (3) pressure zones which are configured in a cascade type sequence.

The proposed design for the new Mod 13 tower will utilise the existing 75 kL fire hydrant tank infrastructure on the roof of the Astral Hotel tower to serve this building (Level 15 of this tower), in lieu of containing a 50 kL tank at the top of the highest pressure zone in the MOD 13 tower building. It will also contain four (4) pressure zones to serve the new tower between Level 5 (RL 31.60) and Level 64 (RL 223.5). While the system has not been designed as having four zones served by a single 'cascade' type arrangement as each pumping station only serves a maximum of two pressure zones before it reaches the next set of pumps, this is still considered to deviate slightly from the wording put forward in the draft edition of AS 2419.1.

The pumps provided as part of this configuration shall also serve as both the MOD 13 tower base building booster pumps (to achieve compliant pressure and flow without Brigade assistance) and the MOD 13 tower relay pumps for when the Brigade connect their appliances to the booster connections on Ground level.

An overview of the pumping station locations, the set-out of the pressure zones and the cross mains where these are divided can be found in **Figure 6** on the following page.

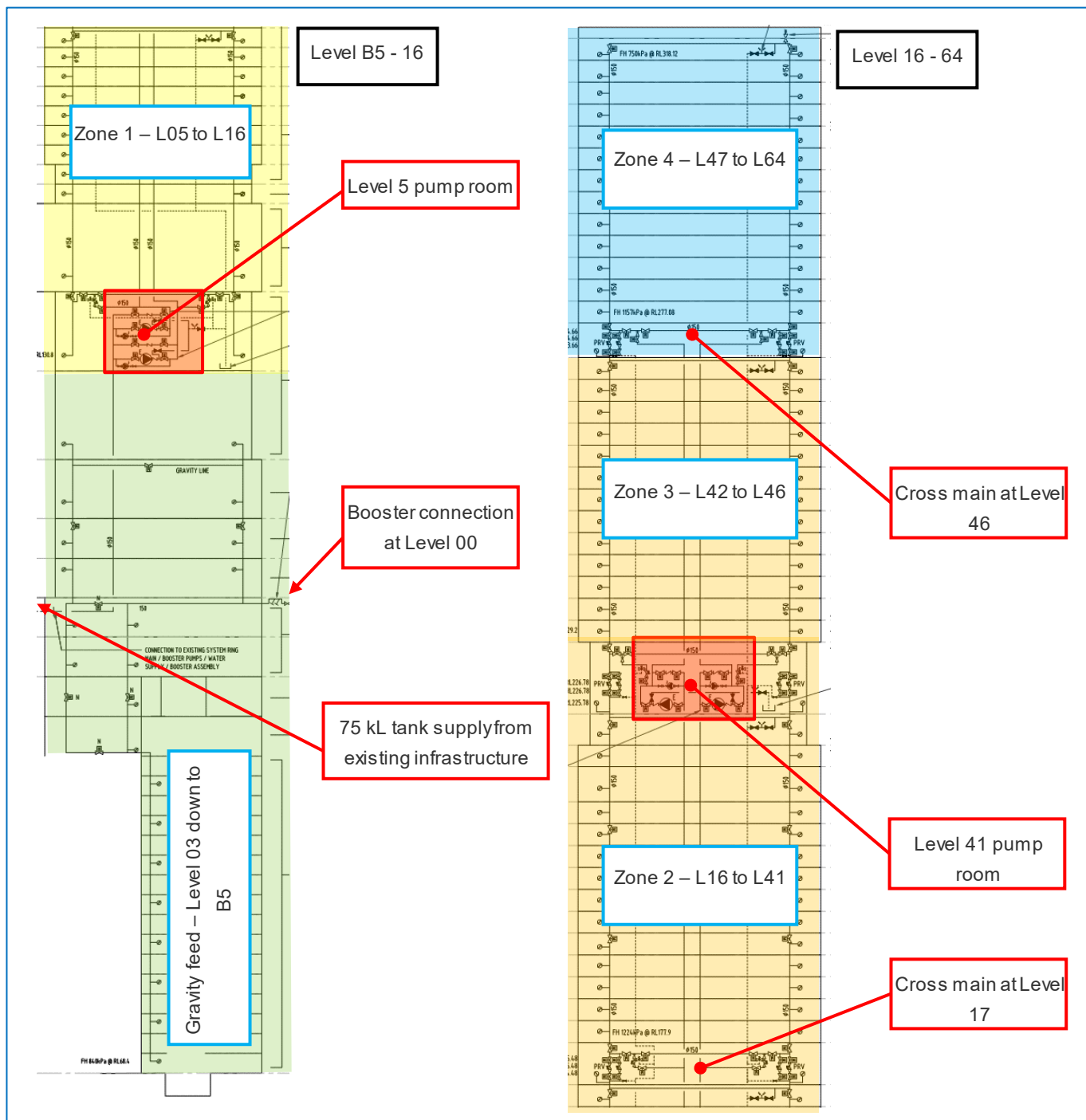


Figure 6: Proposed fire hydrant schematic incorporating 4 x pressure zones and 2 x relay pump stations

While not technically a non-compliance with the currently mandated edition of AS 2419.1, the proposed design is being tabled to FRNSW at this early stage of the design process as a best-practice measure to ensure all stakeholders are in agreement to that the proposed design provides an acceptable level of performance in relation to facilitating Brigade operations on site.

Applicable DTS provisions:	E1.3, AS 2419.1	Performance requirements:	EP1.3
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List key fire safety measures:

Refer to Trial Design Requirements detailed in Section 6 of this FEBQ for the fire safety measures relevant to this development. It is proposed to install the following measures to support the Performance Solution:

- The hydrant system serving the Mod 13 Tower shall be provided with four (4) pressure zones and two levels of booster pumps (approximately Level 05 and Level 41).

- The lower portions of the building (Level 03 down to Basement 5) shall be on a gravity feed which is directly fed from the town mains supply. This is not included in the four pressure zones serving the tower i.e. the building as a whole technically contains five zones when this gravity fed zone is taken into account.
- It shall be permitted for the hydrant system to contain four (4) interconnected pressure zones, in lieu of the maximum of three (3) zones specified in the draft edition of AS 2419.1.
- It shall be permitted for the hydrant system to be served by a 75 kL dual purpose storage tank on Level 15 of the Astral Hotel (hydrant and domestic water storage), in lieu of a 50 kL storage tank on the roof of the subject tower as specified in the draft edition of AS 2419.1.

Proposed alternative solution:

The design being tabled here, although not complying in full with the draft standard, is deemed to provide an equivalent level of safety in relation to the number of pressure zones connected by pressure reducing stations. It is also deemed to be fully compliant with the currently mandated edition of AS 2419.1 (2005), but the design is being tabled to FRNSW as a best practice measure here.

If you refer to Figure K6 of this draft standard (refer **Figure 7** below), you can see that the pumps provided at the ground level of this design are the only pumping devices available to deliver the required pressure and flow to the uppermost zone, with all three zones reliant on these pumps to achieve the desired results. In the Mod 13 design being tabled here however, we are pumping water up the building in stages by providing pumps on Level 5 and Level 41. By doing so, at no point is any greater than two zones reliant on a single pair of pumps to achieve the required pressure and flow for compliance. The provision of four (4) hydrant pumps up the building in fact adds to the reliability of this system,

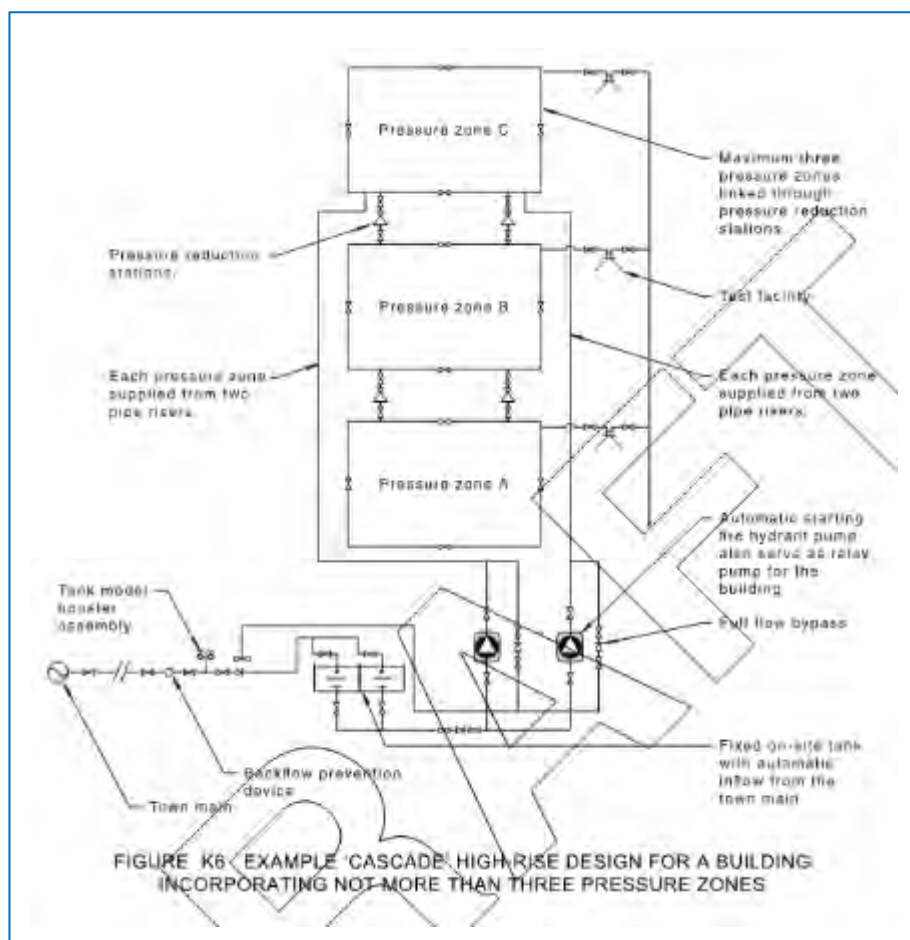


Figure 7: AS 2419.1 (draft) Figure K6 showing 'cascade' type design connecting no greater than three pressure zones

The existing storage tank serving the hydrants on site sits on the top of the Astral Hotel tower (Level 15). Its elevated position in the building is already more than sufficient to provide in excess of 300 kPa of positive pressure in the water supply to the pumps proposed on Level 5 of the Mod 13 tower. The tank also provides dual use functionality, where a minimum of 25 kL is provided for the hydrant system, but 50 kL is also available as a backup water supply to the hotel portions of the building. Given this is only a backup supply for domestic water use, it is

therefore considered that a far greater quantity of stored water (up to 200% more than the 25 kL currently required under AS 2419.1) would likely be available to the hydrant system in the event of a fire occurring on site.

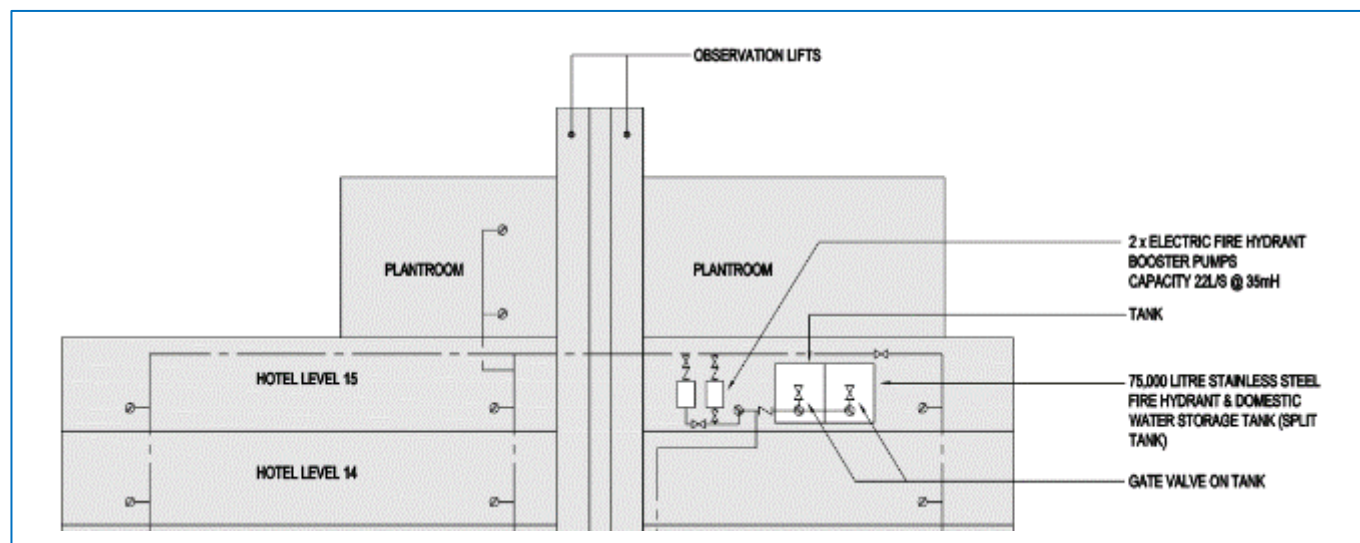


Figure 8: Snapshot of existing hydrant block plan showing pumps and tanks on Level 15 of Astral Hotel Tower

With the provision of added redundancy in the pumping configuration through four pumps being provided in lieu of two, and the additional capacity and already elevated position of the existing fire hydrant tank on site, it is considered acceptable for the hydrant system to utilise the existing tank supplies on site, in lieu of providing a new 50 kL tank on the roof of the Mod 13 tower as per the draft edition of AS 2419.1.

It should be noted that the fire hydrant pumps provided as part of these works will have a dual use. Their first function will be to provide compliant pressure and flow using only the town mains and tank supplies available to the system. They will also then function as the Brigade relay pumps once FRNSW connect to either of the two booster assemblies on Ground Level also.

In addition to the above commentary, we note that a key failure point of a hydrant design which the draft edition of AS 2419.1 aims to resolve is where a system may contain pipework which has pressures in excess of 2400 kPa. It is assumed that the new requirement is to mitigate the risk of excessive pressure causing pipe blow-outs over the lifespan of the building. WSP can confirm that through the proposed two-stage pumping arrangement in the existing design, system pressure will not exceed this figure at any point, both in relation to static pressure and the boosted configuration.

Performance solution:

- ☒ A0.3(a)(i) - Comply with the performance requirements
- ☐ A0.3(a)(ii) - Be at least equivalent to the DtS provisions

Assessment methods:

- ☐ A0.5(a) - Evidence of suitability
- ☐ A0.5(b)(i) - Verification methods in the NCC
- ☒ A0.5(b)(ii) - Other verification methods
- ☐ A0.5(c) - Expert judgement
- ☐ A0.5(d) - Comparison with the DtS provisions

Assessment approach:

- | | | |
|--|---|---|
| ☐ Comparative | ☒ Qualitative | ☒ Deterministic |
| ☒ Absolute | ☐ Quantitative | ☐ Probabilistic |

IFEG sub-systems used in the analysis:

- | | |
|--|--|
| ☐ A – Fire initiation and development and control | ☐ D – Fire detection, warning and suppression |
| ☐ B – Smoke development and spread and control | ☐ E – Occupant evacuation and control |
| ☐ C – Fire spread and impact and control | ☒ F – Fire services intervention |

Acceptance criteria and factor of safety:

The Brigade's review of this Performance Solution as part of this FEBQ submission is considered to be the key acceptance criterion for this strategy.

Fire scenarios and design fire parameters:

N/A

Describe how fire brigade intervention will be addressed or considered:

The hydrant system will function as per AS 2419.1 (2005) as a result of this solution. This is only being tabled to FRNSW for the purposes of confirming that they have no issues with the design we are proposing in relation to the upcoming revisions being made to this standard. No further discussion on this point is deemed necessary.

Verification/validation analyses:

☐ Sensitivity studies
 ☐ Redundancy studies
 ☐ Uncertainty studies
 ☒ None

N/A

Provide details on proposed modelling/assessment tools:

N/A

Based on the information provided, FRNSW do not support the proposed design for the following reasons;

- The 'unassisted pressure' provided to level 3 would be significantly less than the required 700 KPa.
- It is unclear how level 4 is served by the proposed hydrant system.
- An inappropriate level of redundancy is provided within the design. For example, should the pumps on level 5 fail, FRNSW would be unable to boost the upper levels of zone 2. Similarly, with the failure of the pumps on level 41 FRNSW would be unable to boost the upper levels.

With consideration to the comments above and to ensure an appropriate level of redundancy to the system the following comments are offered;

Where a building has an effective height greater than 50 m, tank(s) shall be provided. The tank(s) shall—

- (a) be capable of providing the minimum required firefighting flow rate for not less than 30 min;
- (b) be capable of providing the required pressures either assisted (with pumps) or unassisted without pumps;
- (c) be taken into consideration when determining the required 4 h water supply where the tank serves as a reduced capacity tank with automatic inflow; and
- (d) not be taken into consideration when determining the capacity of the primary water supply unless the tank(s) serves as a reduced capacity tank(s) and is provided with automatic inflow from another water source.

Where a building incorporates more than three above-ground pressure zones, supply to the pressure zones above 135 m shall be from a high-rise tank located at or near the top of the uppermost pressure zone and intermediate tanks as required to ensure the maximum pressure in the supply pipework does not exceed 2400 kPa in accordance with Clause 2.3.2 and the pressure zone limits in Clause 8.12 are complied with.

Without adequate water supply from storage on the roof, FRNSW are unable to supply water to floors above 135m in the event of pump failure. Gravity fed systems are considered more reliable and are recommended in this instance.

FRNSW recommends that the location of the booster connection for the proposed tower be clarified in any future submissions.

Issue number: 7 Fire hydrant coverage to Level 5 areas
Details of departures from DtS provisions:

One of the requirements of AS 2419.1 is being able to cover the whole of each floor plate using a 30 m hydrant hose and 10 m hose stream which is fed from hydrant landing valves which are predominantly located within the fire isolated stairwells. Given the size of the rooftop space at Level 5, it is not possible to cover the whole of the floor using only the hydrant valves within the stairs and a prescriptive single length of hydrant hose. It is therefore proposed to utilise two hydrant hoses connected to one another to achieve compliant coverage on this floor (Level 05), in a similar manner to that proposed and approved by FRNSW for the recently upgraded (or currently under construction) portions of the building such as North West Gaming (Level 01) and Astral Lobby (Level 00).

This arrangement does not strictly comply with AS 2419.1, but is seen as offering a greater level of life safety to the existing internal fire hydrant configuration given Fire Brigade personnel will be adequately protected within the stairwell during their initial setup phase of operations. Some additional supplementary hydrants will likely be required across the floorplate to enable complete coverage to be achieved (TBC by hydraulic engineer during detailed design stage).

Applicable DtS provisions:	E1.3 and AS 2419.1	Performance requirements:	EP1.3
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List key fire safety measures:

Refer to Trial Design Requirements detailed in Section 6 of this FEBQ for the fire safety measures relevant to this development. Fire safety measures specific to this Performance Solution are detailed below:

Fire safety measures specific to this Performance Solution are detailed below:

- Signage shall be provided at each of the internal fire hydrants that are located on the mid-landing. The signage shall clearly indicate which level the internal fire hydrant is designed to serve.
- Additional signage shall be provided for the Fire Brigade above the fire hydrant booster assembly, beside each FIP on site, beside the fire hydrant pumps, and on the inside face of each fire stair doorway on Level 05 so as to inform personnel of the requirement to utilise two interconnected hoses as detailed below;

ATTENTION FIRE BRIGADE

Two lengths of fire-fighting hose is required to reach all areas on Level 05

The words "ATTENTION FIRE BRIGADE" must be in upper case letters not less than 50 mm in height and all other letters must be not less than 25 mm in height. The lettering shall be in a colour contrasting with the background. The additional signage to be utilised must be fade resistant signage.

A block plan showing the location of each fire stair containing a hydrant valve on Level 05 shall be provided adjacent to each hydrant valve on this floor for Brigade information.

Proposed alternative solution:
Fire Hydrants Coverage throughout Level 05
Overview of existing building and proposed modifications

The Star Casino was first opened in 1997. While these works took place when the Building Code of Australia (BCA) was in place, there have since been modifications to the hydrant standard (AS 2419.1) which has resulted some items which are no longer deemed compliant from a current code perspective.

However, as confirmed by the fire services consultant, the existing fire hydrant system infrastructure within the subject development which was originally designed to comply with the AS 2419.1-1995 has been upgraded in 2010 to comply with the current AS 2419.1-2005 requirements.

In the previous edition of this standard (1994), fire hydrants were required to be installed within 4 m of the fire stair entry. The intent with this approach was the Brigade personnel would first enter the fire affected compartment, and then set up their equipment once they had confirmed it was safe to do so. In the current edition of this standard (2005), the location of internal fire hydrants had changed. It was instead nominated that hydrants would be provided within the fire isolated stairwells themselves, thereby enabling Brigade personnel to set up their equipment in a safe environment prior to entering the fire affected compartment.

As confirmed by the fire services consultant, the fire hydrants serving the existing building have been relocated within the fire isolated stairs to comply with the current code requirements.

Overview of Brigade operations and safety of personnel

As noted previously; the provision of fire hydrant landing valves within the fire stairs allows for Brigade personnel to set up and charge their hoses prior to entering the compartment of fire origin. This enables them to immediately 'mist' the hot smoke layer as soon as they enter the compartment to start lowering the temperature of the space. This is particularly important when dealing with smaller fire compartments, as there is a smaller volume to heat meaning the space will likely be hotter by the time the Brigade attend site.

In the case of a fire on Level 05 of The Star; the Brigade will be attacking a fire across a largely outdoor area with a significant floor area (>10,000 m²). The provision of additional external landing valves across this space is deemed unnecessary given compliant coverage can be largely provided using only the hydrants within the fire stairs should a 60 m hose length be used.

Being able to cover all areas of the Level 05 rooftop area using only fire hydrants within the fire isolated stairwells alone is seen as beneficial to Brigade operations on this floor. By removing the need to connect into additional internal hydrant valves as they make their way across the floorplate will in fact expedite Brigade operations as they move through the space. **FRNSW: two lengths of charged lines are far heavier and difficult to drag and manoeuvre than one length.**

Based on the assessment above it is considered the proposed use of two fire hose lengths in conjunction with the proposed additional fire safety measures above DtS requirements provides a level of safety that is considered to meet Performance Requirement EP1.3 of the BCA.

There appears to be no alternative solution presented for mid landing valves. FRNSW recommends that illustrations be provided as part of the assessment.

Performance solution:

- ☒ A0.3(a)(i) - Comply with the performance requirements
- ☐ A0.3(a)(ii) - Be at least equivalent to the DtS provisions

Assessment methods:

- ☐ A0.5(a) - Evidence of suitability
- ☐ A0.5(b)(i) - Verification methods in the NCC
- ☒ A0.5(b)(ii) - Other verification methods
- ☐ A0.5(c) - Expert judgement
- ☒ A0.5(d) - Comparison with the DtS provisions

Assessment approach:

- | | | |
|---|---|---|
| ☒ Comparative | ☒ Qualitative | ☒ Deterministic |
| ☐ Absolute | ☐ Quantitative | ☐ Probabilistic |

IFEG sub-systems used in the analysis:

- | | |
|--|--|
| ☐ A – Fire initiation and development and control | ☐ D – Fire detection, warning and suppression |
| ☐ B – Smoke development and spread and control | ☐ E – Occupant evacuation and control |
| ☐ C – Fire spread and impact and control | ☒ F – Fire services intervention |

Acceptance criteria and factor of safety:

To determine whether the Performance Solution is considered to meet the BCA Performance Requirements, it needs to be demonstrated that the intent of the BCA is met in that the location of the fire hydrants serving the 'whale tail' parts of the site, do not adversely affect the ability of the fire-fighting personnel to apply water to a fire and that the hydrants provide the necessary coverage to the storey they serve. In addition it will be demonstrated that the intent of the BCA and AS 2419.1 is met in that sufficient provisions have been made for fire brigade intervention across the Level 05 rooftop areas.

FRNSW approval will also form part of the acceptance criteria of this Performance Solution.

Fire scenarios and design fire parameters:

N/A

Describe how fire brigade intervention will be addressed or considered:

Refer text in main body of assessment above.

Verification/validation analyses:

☐ Sensitivity studies ☐ Redundancy studies ☐ Uncertainty studies ☒ None

Provide details on proposed modelling/assessment tools:

N/A

FRNSW Comment: FRNSW do not support the alternative solution. Given the difficulty in manoeuvring two lengths of charged lines and as supplementary (additional) hydrant valves are required in any case, FRNSW recommends that hydrant coverage be designed on the compliant 30 plus 10m coverage.

FRNSW recommends that where additional hydrants (as per Clause 3.2.3.3 of AS2419.1-2005) are proposed, floor specific block plans (minimum A3 in size) should be installed adjacent to the internal fire hydrants located within the fire isolated stairwells. The sole purpose of these floor specific block plans is to assist fire-fighters to locate the additional internal hydrants on that level.

The floor specific block plans should be permanently mounted and oriented in such a manner so as to reflect the aspect of the installation as it is presented to the reader and be incorporated into the fire safety schedule.

Issue number: 8 Omission of Fire Hose Reels
Details of departures from DtS provisions:

It is proposed to omit fire hose reels from the Class 6 and 9b portions of the Mod 13 development and instead provide additional fire extinguishers across the floor plate for first aid firefighting purposes. This will apply to areas on all of the lower levels (Level 00 – 07), the mid level Sky Lobby (Level 39/40) and the Level 59 Club Lounge. This is deemed to be a non-compliance under BCA Clause E1.4.

Applicable DtS provisions:	E1.4	Performance requirements:	EP1.1
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List key fire safety measures:

Refer to Trial Design Requirements detailed in Section 6 of this FEBQ for the fire safety measures relevant to this development.

Fire safety measures specific to this Performance Solution are detailed below:

- Fire hose reel coverage is to be omitted within the Class 6 portions of the Mod 13 development.
- Fire extinguishers are to be located within each restaurant / food outlet or bar area with exact locations as detailed in below, in accordance with Sections 1-4 of AS 2444 and installed to cover Class A fire risks by being:
 - an A:B:E type extinguisher; and
 - a minimum size of 2.5 kg within each food outlet / restaurant or bar area and no less than 4.5 kg to be provided within each fire hydrant cupboard or security staff station; and
 - Staff members are to be trained in the location and use of these fire extinguishers to enable them to undertake first aid firefighting activities should a fire break out in their areas; and
 - Extinguishers within food outlet / restaurant or bar areas are permitted to be inaccessible when that particular area is closed.
- Casino, hotel and restaurant / bar staff members are to be trained in the location and use of these fire extinguishers to enable them to undertake first aid firefighting activities should a fire break out in their area.

Proposed alternative solution:

The intent of hose reels, as discussed in the Guide to the BCA, is to provide a means of first aid fire-fighting to occupants. It is noted that the primary objective of the BCA is to ensure building occupants are not put in a scenario of undue risk. This is particularly true when dealing with occupants within a building which occupants have no personal connection with, in contrast to an apartment where they may have personal belongings which they want to save.

Fire hose reels are connected to the water main and can therefore supply an indefinite amount of water. Fire hoses can provide enough water for extinguishing relatively large fires as a result. The amount of extinguishing agent in a portable fire extinguisher is limited and there may be fires that are too large to extinguish with a portable fire extinguisher based on the amount of extinguishing agent needed. If the fire is noticed at an early stage both fire hose and fire extinguishers provide sufficient means for undertaking an initial attack. If the fire is noticed at a later stage, it could have developed to a size where it is beyond the capabilities of a fire extinguisher. A fire hose might be sufficient, but due to the larger fire size the risk to occupants will have increased.

It is not considered appropriate under such conditions for occupants to attempt to extinguish such a fire, particularly those whom have no affiliation with the site (such as in the Class 6 and 9b areas of the building). If the fire is too large to extinguish with a portable extinguisher it is growing at an exponential rate. Occupants are unlikely to be trained to use a fire hose for an attack meaning there will likely be a time delay before the attack can be undertaken, thereby allowing the fire to grow larger. Even if the amount of water during the attack is indefinite, occupants will have to fight the fire without any personal protective equipment or breathing apparatus. In addition to heat from the fire and toxic gas, occupants could also be harmed by the steam produced when applying water to the fire. There is also the risk of electrocution with the use of this extinguishing medium. If the fire is too large to extinguish with a portable fire extinguisher, occupants should evacuate the building instead of undertaking an initial attack.

Sprinkler coverage is being provided throughout this space too, which is likely to contain if not suppress the fire in the first instance anyway. Fire extinguishers complying with Australian Standards are marked with a classification and rating, determined in accordance with AS 1850 as shown in Table 1.

Table 1: Categories of Fire Extinguishers

Fire Extinguisher Type	Description
Class A	Fires in ordinary combustible materials, such as wood, cloth, paper, rubber and many plastics.
Class B	Fires in flammable and combustible liquids, greases, and oils.
Class C	Fires in combustible gases.
Class D	Fires in combustible metals.
Class E	Fires which involve energised electrical equipment.
Class F	Fires for cooking oils and fats.

A water extinguisher or a fire hose reel is only appropriate for Class A fires while a portable multipurpose extinguisher can be used for any of the above fire types (subject to the extinguisher classification). It is proposed to utilise A:B:E fire extinguishers as part of this Performance Solution, meaning there is far more versatility in the fires they can fight in comparison with a hose reel alone.

The use of fire hose reels could increase the likelihood of injury in the event of a fire due to the occupants fighting the fire rather than evacuating. Occupants within the casino as a whole have a high likelihood of being intoxicated, meaning their inability to handle this type of equipment could increase the risk to themselves and other occupants as a result. Further to this; a laid out fire hose reel presents a significant trip hazard to the occupant fighting the fire and other evacuating occupants. Fire hose reels are also quite heavy and require an amount of strength which many occupants may not possess. Extinguishers are much lighter meaning they are easy to move and wield and therefore are more useful to a wider number of the buildings occupants.

Fire extinguishers are considered to be a much more appropriate method for initial attack on a fire as they have a limited capacity of approximately 30 seconds of continuous use, at which point occupants can evacuate if they have not been able to extinguish a fire. This means that it is less likely for a person to continue attempting to fight a fire which may put himself / herself at risk. Portable fire extinguishers do not cause the problems of creating trip hazards which are encountered when using a fire hose reel, which is a particularly prevalent point in a densely occupied space such as a casino gaming floor.

A requirement of this FER is for staff to be trained in the location and use of these extinguishers to enable them to undertake first aid firefighting activities in this space. This will enable a suitable level of first aid firefighting attack to take place in the early stages of any fire, should this be deemed possible at the time.

Based on the highly managed status of the casino site as a whole, staff members being trained to attack fires in the early stages, and the provision of additional fire extinguishers throughout this area, removal of hose reels is considered acceptable for the Class 6 and 9b portions of the Mod 13 development.

Performance solution:

- ☒ A0.3(a)(i) - Comply with the performance requirements
- ☐ A0.3(a)(ii) - Be at least equivalent to the DtS provisions

Assessment methods:

- ☐ A0.5(a) - Evidence of suitability
- ☐ A0.5(b)(i) - Verification methods in the NCC
- ☒ A0.5(b)(ii) - Other verification methods
- ☐ A0.5(c) - Expert judgement
- ☐ A0.5(d) - Comparison with the DtS provisions

Assessment approach:

- | | | |
|--|---|---|
| ☐ Comparative | ☒ Qualitative | ☒ Deterministic |
| ☒ Absolute | ☐ Quantitative | ☐ Probabilistic |

IFEG sub-systems used in the analysis:

- | | |
|---|--|
| ☒ A – Fire initiation and development and control | ☐ D – Fire detection, warning and suppression |
| ☐ B – Smoke development and spread and control | ☐ E – Occupant evacuation and control |
| ☐ C – Fire spread and impact and control | ☐ F – Fire services intervention |

Acceptance criteria and factor of safety:

To determine whether the Performance Solution is considered to meet the BCA Performance Requirements, it needs to be demonstrated that the intent of the BCA is met in that sufficient provision has been made to allow occupants to conduct initial attack on a fire.

Fire scenarios and design fire parameters:

N/A

Describe how fire brigade intervention will be addressed or considered:

N/A

Verification/validation analyses:

- | | | | |
|--|---|--|--|
| ☐ Sensitivity studies | ☐ Redundancy studies | ☐ Uncertainty studies | ☒ None |
|--|---|--|--|

N/A

Provide details on proposed modelling/assessment tools:

N/A

FRNSW Comment: In principle support is provided subject to the analysis in the FER demonstrating compliance with the performance requirements of the NCC.

Issue number: 9 Water mist within the basement car stacker

Details of departures from DtS provisions:

Given 'The Star' is a building >25 m in effective height, the BCA requires this building to be sprinkler protected in accordance with AS 2118.1 throughout. This effectively means that all areas of the building require sprinkler protection unless areas are specifically excluded from needing this under AS 2118.1 (1999) Clause 3.1.3.

Due to existing site constraints, the Mod 13 project team propose to include a multi-storey car stacker which starts on Basement 2 (ground level on the Pirrama Road side of the building). Under AS 2118.1, these floors would technically need to be provided with sprinkler coverage throughout. Given the remote location of the car stacker 'storage racks' in relation to the rest of the building, and the fact that sprinklers are not generally very efficient at extinguishing car fires due to the shielding effects of the bonnet, roof and other areas, it is instead proposed to use a water mist system to protect this space. This applies to Basement 4 downwards. The design of this car stacker is proposed to generally be in accordance with the MFB guidance paper, other than the mist system component.

The following diagrams illustrate where the car stacker sits in relation to the existing site layout for reference.

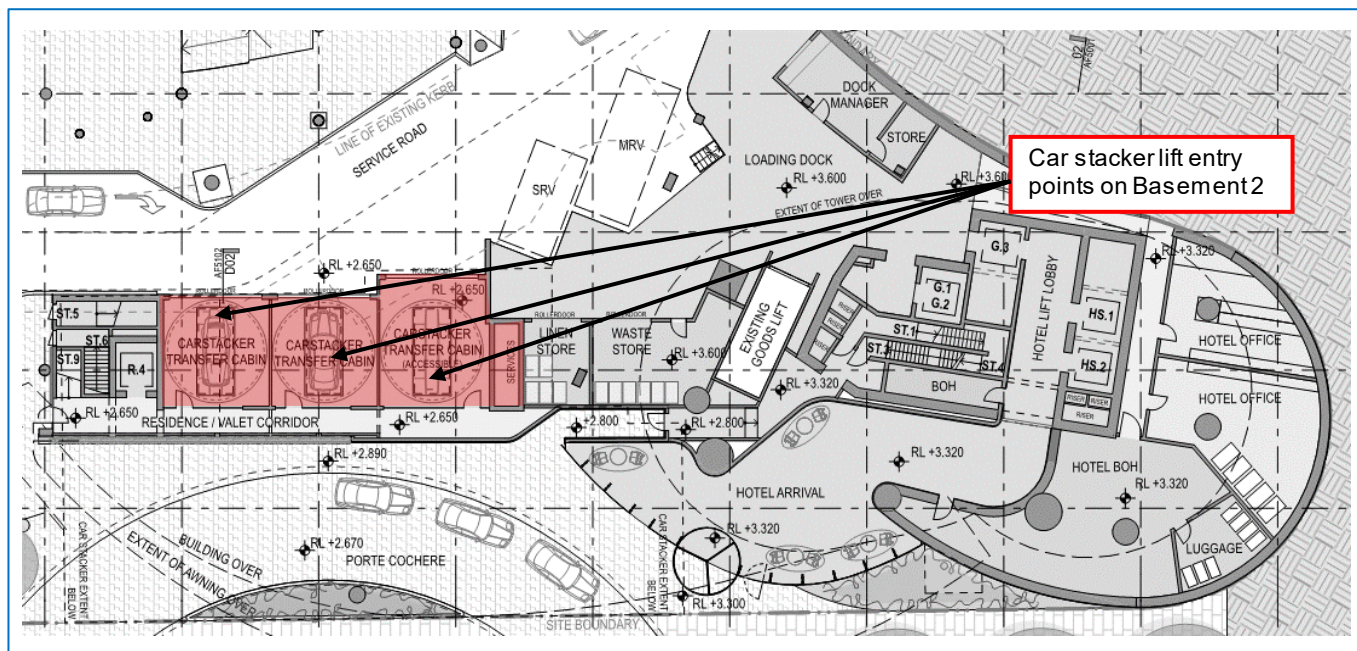


Figure 9: Mod 13 car stacker entry on Basement 2 level

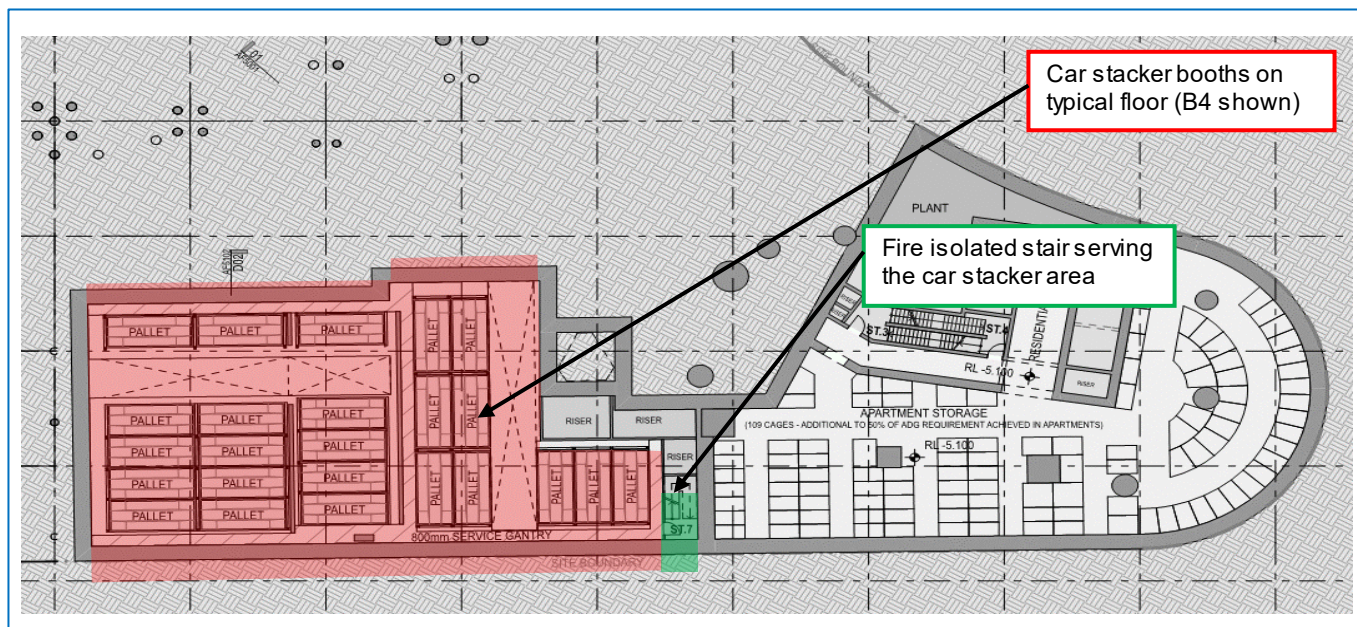


Figure 10: Typical car stacker floor (Basement 4 shown)

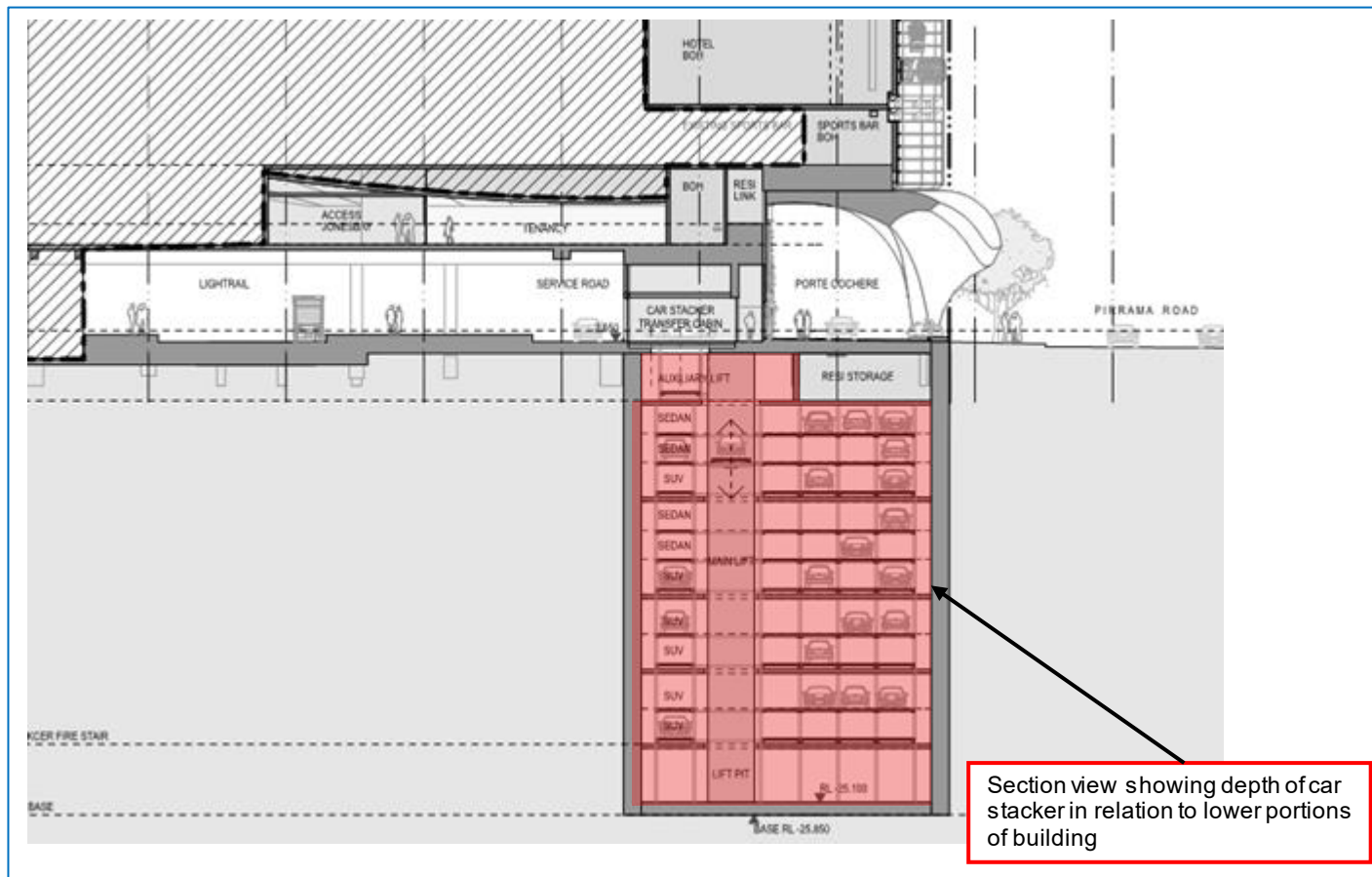


Figure 11: Section showing location of car stacker levels in relation to lower portion of building

Applicable DtS provisions:	E1.5, Spec. E1.5 and AS 2118.1	Performance requirements:	EP1.4
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List key fire safety measures:

Refer to Trial Design Requirements detailed in Section 6 of this FEBQ for the fire safety measures relevant to this development. It is proposed to install the following measures to support the Performance Solution:

- The design and installation of the car stacker system shall be done in accordance with the AS 5124 or equivalent European standard (i.e. EN14010) for the life safety of the attending fire brigade personnel and maintenance personnel.
- The car stacker transfer basin at basement 2 and plant room at basement 3 shall be provided with sprinkler protection in accordance with AS 2118.1.-1999.
- The car stacker storage levels (Basement 4 downwards) to be provided with water mist system, in lieu of AS 2118.1 compliant sprinkler protection as required by the BCA. The mist system is to be in a deluge type configuration so that only the fire affected zone will be activated at any one time. The zoning of this system shall be as per Figure 13.
- Additional water mist heads should be incorporated within the vehicle storage bays (including pits). The design of the mist system should be based on all mist heads within one zone operating simultaneously.
- Water mist heads within the storage bays should be positioned so that every corner of each vehicle space / bay is covered as per the following:

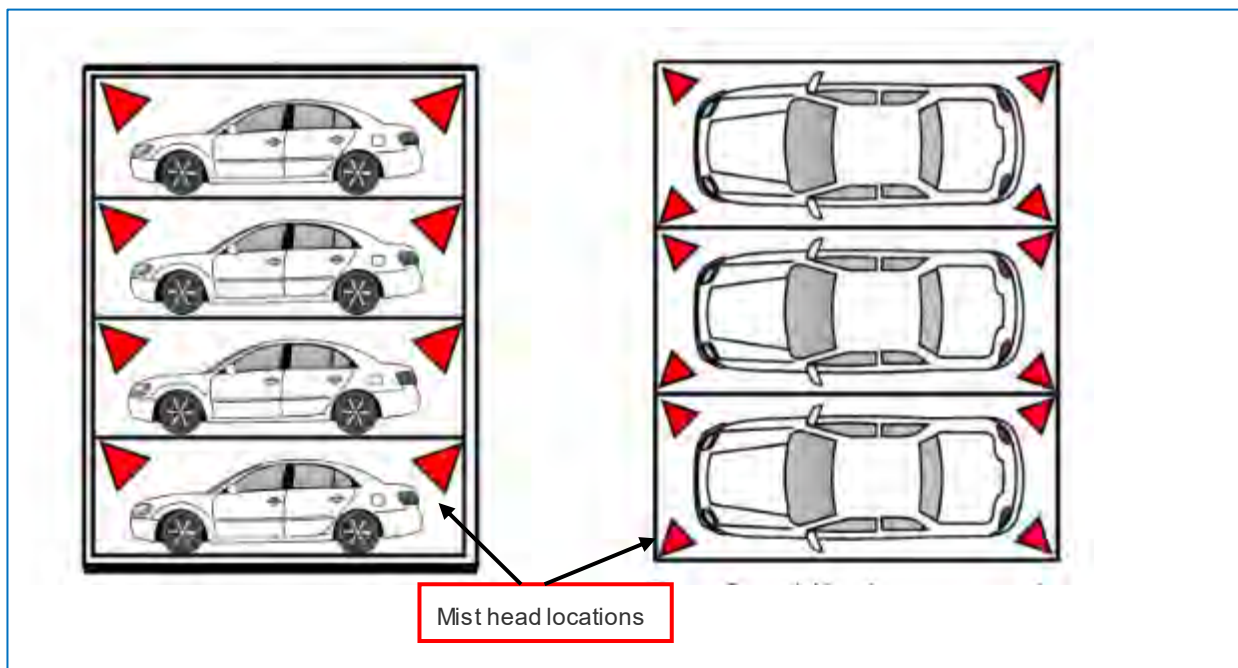


Figure 12: Water mist system layout (P. 32, Guidelines 32, MFB)

Proposed alternative solution:

General

It is understood that the proposed car stacker system is an automated system where cars parked at the stacker lift entry points on basement 2 shall be automatically parked within different bays located within basement 4 and downwards. Except for maintenance personnel, the proposed car stacker mechanism shall be considered as a non-occupied space where very few (if any) occupants are expected to be located at any time.

The fire hazard associated with the vertical stacking of cars is considerably higher than in a regular carpark where vehicles are not stacked. AS 2118.1 specifies a sprinkler system designed to OH2 for carpark. The design criteria contained within AS 2118.1 assumes that cars are not stacked, and no design criteria are provided for this application in the current mandated edition of AS 2118.1 (1999).

Currently there are no international sprinkler standards that address this specific hazard. A performance based sprinkler system design would therefore be required to address the specific hazard inherent in the car stacking arrangement.

The performance of the general sprinkler system to contain the fire within car stackers has already been well documented. The BRE Fire and Security had been commissioned by the British Automatic Fire Sprinkler Association (BAFSA) to conduct live fire testing to assess the performance of a general car stacker sprinkler system. A description of the test and the results are provided in the test report.

The test result has demonstrated that a normal sprinkler systems is effective in mitigating the risk of fire spread beyond the test rig (i.e. car on fire) to nearby cars (horizontally and vertically). In addition, the design of the car stacker shall be done in accordance with the Guidelines No -32, Buildings Incorporating Automated Vehicle Parking Systems (AVPS) prepared by Melbourne Fire Brigade.(V1, 01 May 2017).

Water Mist System:

As part of the performance based design, the car stacker storage levels (Basement 4 downwards) shall be provided with alternative fire suppression method of water mist system, in lieu of AS 2118.1 compliant sprinkler protection as required by the DtS provisions of the BCA.

There is a major concern with installation of traditional sprinkler system within car park stacker that a “shielded fire” may develop within these areas. In case of a potential fire within the car body itself, the fire will be completely shielded from the sprinkler water spray by the car body.

As the cars shall be stacked one above the other within the racks and all racks shall be placed in close vicinity of each other as shown in Figure 11, there is a risk that the fire could potentially spread to the adjacent cars to grow a larger fire within the area. The risk of a “shielded fire” with the traditional sprinkler system can be fully mitigated by the provision of high pressure water mist system within the car stacker areas.

Similar to the traditional sprinkler system, the water mist system also did not reach the primary seat of the fire underneath the car. However, it reduces the ceiling level temperature better than the traditional one because of the higher cooling capacity of the smaller water droplets. The spread of fire between the vehicles who are stacked close to each other would therefore be prevented due to the direct cooling (wetting) of the cars, and to the superior performance of the small water droplets in absorbing thermal radiation. It can be concluded that a correctly sized and installed water mist system provides a level of protection that is fully comparable if not greater with that of a traditional sprinkler system when dealing with this type of fire risk.

FRNSW Comment: FRNSW recommends the water mist system zoning (with the use of flow switches) should be considered in conjunction with fire brigade access points to enable accurate identification of the location of the fire and appropriate access point.

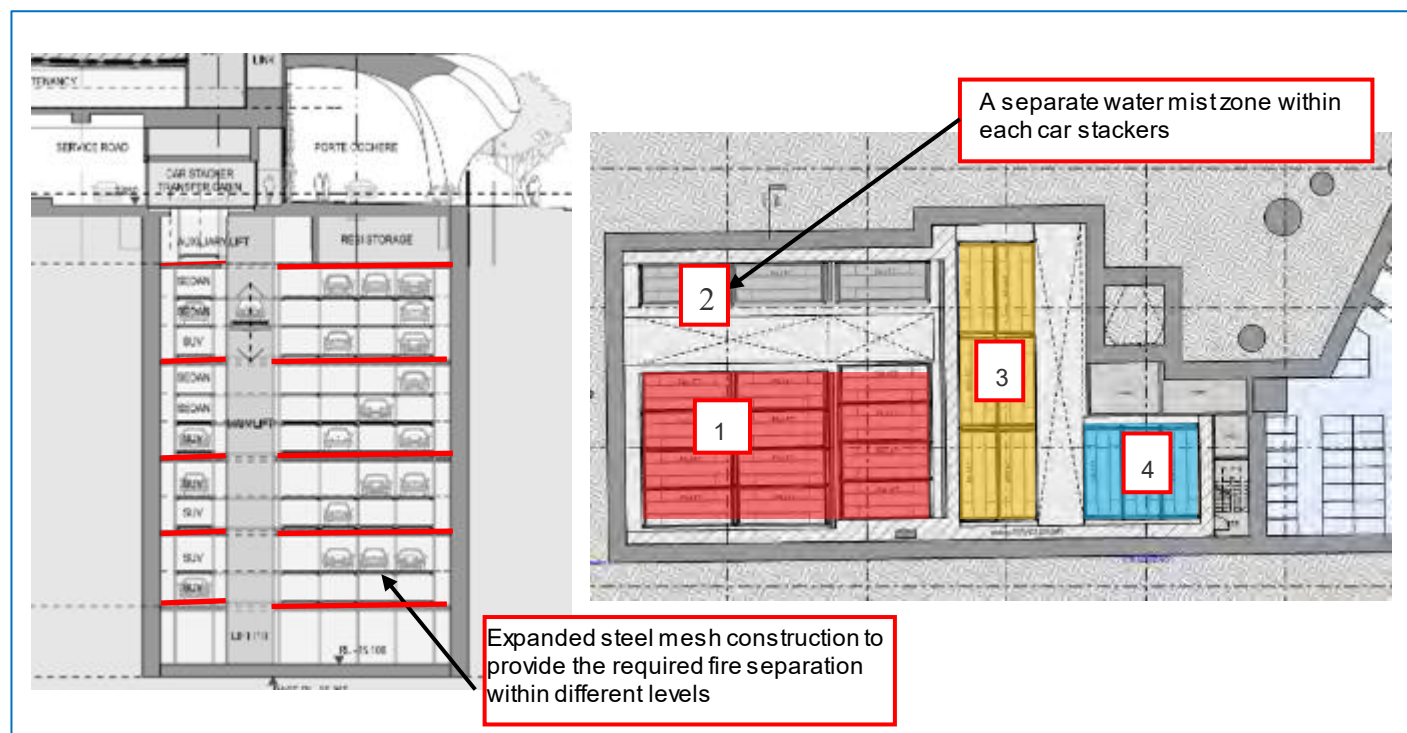


Figure 13: Section showing location of car stacker levels in relation to lower portion of building

Melbourne Fire Brigade has also provided the design guidelines for the car stacker system called Guidelines No - 32, Buildings Incorporating Automated Vehicle Parking Systems (AVPS) (V1, 01 May 2017). The design of the system as a whole shall generally be undertaken in accordance with this document, other than the proposed use of a water mist system in lieu of sprinkler protection.

Structural Requirements:

The car stacker shall be provided with expanded steel mesh construction to provide the required fire separation within different levels.

The car stacker enclosure shall be fire separated with 240 minutes' fire rating from the remaining building structure and any door leading into the vehicle storage area should achieve a fire rating of -/240/30 and be provided with smoke seals in accordance with the MFB guidelines.

FRNSW Comment: The structural stability of the automated racking machinery should be assessed in conjunction with a Fire Brigade Intervention Model (FBIM).

Automatic Shutdown of AVPS

The following applies to the operation of the car stacker in the event of a fire being detected on site:

- The car stacker system shall interface with the building FIP and shut down upon General Fire Alarm (GFA) within the building. The system should not automatically start back up when the fire panel has been reset.

FRNSW Comment: Power isolation and automatic shutdown procedures should be clearly defined, including whether the car stacker will finish the racking cycle prior to shutdown. FRNSW recommends that shutdown occur after the car in transit is located to an area of adequate sprinkler coverage.

- Visual warning signal shall be provided at the FIP and access to the stacked car to highlight the status of the system like **'vehicle parking system operating'** or **'vehicle parking system isolated'**.
- Vehicle lifts shall be programmed to return to the level of fire upon general fire alarm within the area to act as void fall protection for firefighters potentially entering the area or safe evacuation of the maintenance personnel (If any).

Fire Brigade Intervention

A fire safety assessment shall be undertaken to demonstrate that fire brigade intervention will not be affected with the proposed water mist spray system. The car stacker area will be provided with fire isolated stair to serve each level in case of an emergency. Fire brigade can access the fire stair to start their intervention. Fire brigade will also be provided with perimeter access around the stacker at each level as shown in Figure 45. Fire brigade is expected to carry the "Jumbo" ladder while attacking the fire within the stacked car system.

Furthermore, car stacker area will be provided with mechanical smoke exhaust system in accordance with the DtS provisions of the BCA with smoke exhaust capacity of approximate 20-30 m³/s in accordance with the AS 1668.1-2015 requirements. This will assist in maintaining tenable conditions as required for fire brigade intervention and occupant evacuation. Makeup air for the smoke exhaust system shall be provided at the bottom of the stack enclosure through ductwork from the upper levels.

There is a risk that fire brigade may be unable to access/egress from each stacker level in case of blockage of the only single fire stair serving the area. A permanent safety ladder will be provided within the car stacker which will serve as an alternative access/egress point for the fire brigade in case of blockage of the primary fire stair. The location of ladder will be in south portion of the area at a distance apart from the fire stair (Location need to be confirmed by consulting stakeholders). Permanent safety ladders must have an increased clearance to that detailed in AS 1657.

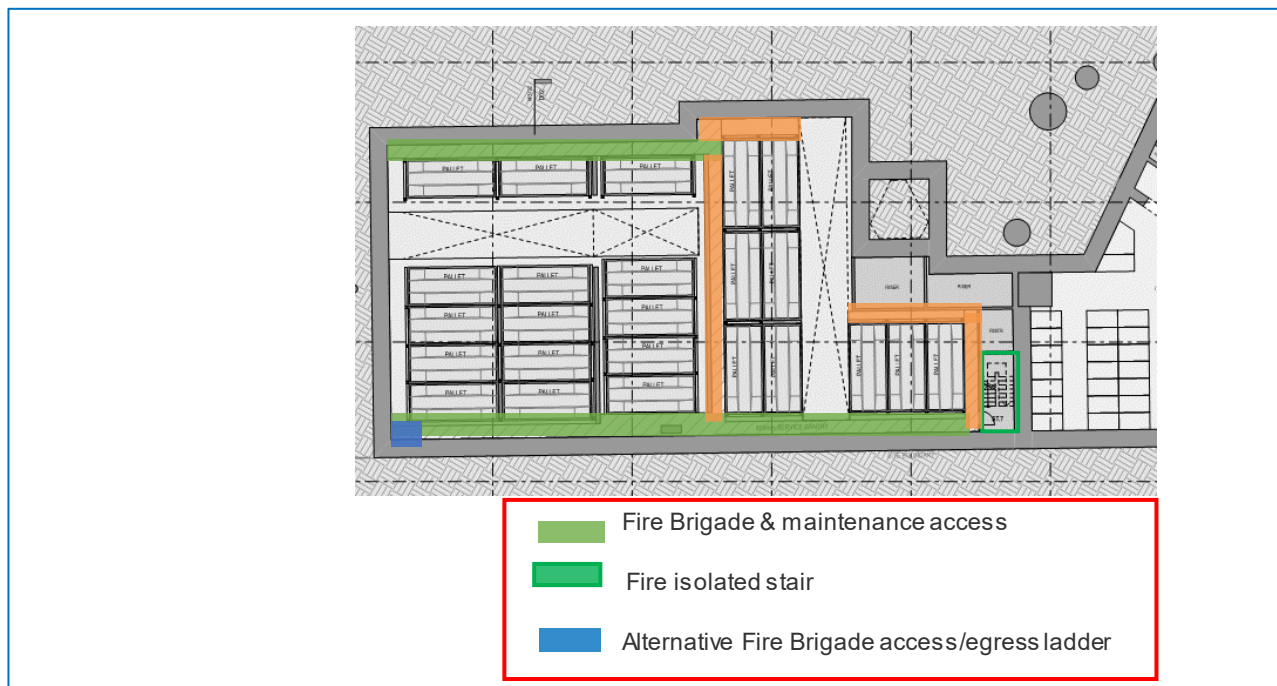


Figure 14: Section showing location of car stacker levels in relation to lower portion of building

A Block plan shall be provided within the fire isolated stair at each level displaying the car stacker layout including access route, void, sprinkler and mist zones etc. to assist the fire brigade intervention. A signage shall also be provided within fire stairs at each level stating **'ACCESS TO VEHICLE STORAGE UNIT – WARNING: FALL HAZARD AUTHORISED PERSONNEL ONLY – CONSIDER IMPLEMENTING WORKING FROM HEIGHTS PROCEDURES'**

Performance solution:

- ☒ A0.3(a)(i) - Comply with the performance requirements
- ☐ A0.3(a)(ii) - Be at least equivalent to the DtS provisions

Assessment methods:

- ☐ A0.5(a) - Evidence of suitability
- ☐ A0.5(b)(i) - Verification methods in the NCC
- ☒ A0.5(b)(ii) - Other verification methods
- ☐ A0.5(c) - Expert judgement
- ☐ A0.5(d) - Comparison with the DtS provisions

Assessment approach:

- | | | |
|---|---|---|
| ☒ Comparative | ☒ Qualitative | ☐ Deterministic |
| ☐ Absolute | ☐ Quantitative | ☒ Probabilistic |

IFEG sub-systems used in the analysis:

- | | |
|--|---|
| ☐ A – Fire initiation and development and control | ☒ D – Fire detection, warning and suppression |
| ☐ B – Smoke development and spread and control | ☒ E – Occupant evacuation and control |
| ☐ C – Fire spread and impact and control | ☒ F – Fire services intervention |

Acceptance criteria and factor of safety:

It needs to be demonstrated that the proposed water mist system is an appropriate fire suppression method to mitigate the risk of fire hazard within the car park stacker area. Car stacker shall be designed and installed in accordance with the *Melbourne Fire Brigade - Guidelines No -32* to provide the required fire safety to the fire brigade while undertaking their intervention.

Fire scenarios and design fire parameters:

N/A

Describe how fire brigade intervention will be addressed or considered:

Fire Brigade intervention is a key criterion for developing an acceptable solution for the use of mist system within car park stack area. Given this is being tabled to FRNSW for comment here, their input on this solution is considered a key component of the design. These comments will then be incorporated in the final design. The design shall also be carried out in accordance with the MFB guidance paper.

Verification/validation analyses:

- | | | | |
|--|---|--|-------------------------------|
| ☐ Sensitivity studies | ☐ Redundancy studies | ☐ Uncertainty studies | ☐ None |
|--|---|--|-------------------------------|

N/A

Provide details on proposed modelling/assessment tools:

CFD shall be used to show conditions within the car stacker compartment while the smoke exhaust system is in operation based on a capped fire size of 3 MW based on BRE 368 Table 3.3 (single car fire).

Issue number: 10 Access to fire control room

Details of departures from DtS provisions:

Specification E1.8 requires that the Fire Control Rooms (FCR) are required to be accessible from the main entrance of the building as well as via a fire-isolated passageway directly to a road or open space, and that egress is available without a level change of more than 300 mm.

The proposed building design provides egress from the FCR with a level change of approximately 500 mm (+/- 4 steps). It also provides access to the FCR via an area near one of the main entrances, and another via a fire-isolated passageway directly to a road or open space. In addition to this, the FCR is relatively remote from the multiple main entries to the site. This solution is therefore intended to address this shortfall through the provision of suitable mimic panels in key locations to mitigate the risk of FRNSW being delayed in any way should they look to enter the site at the wrong point.

The location of the FCR can be found in Figure 15 below.

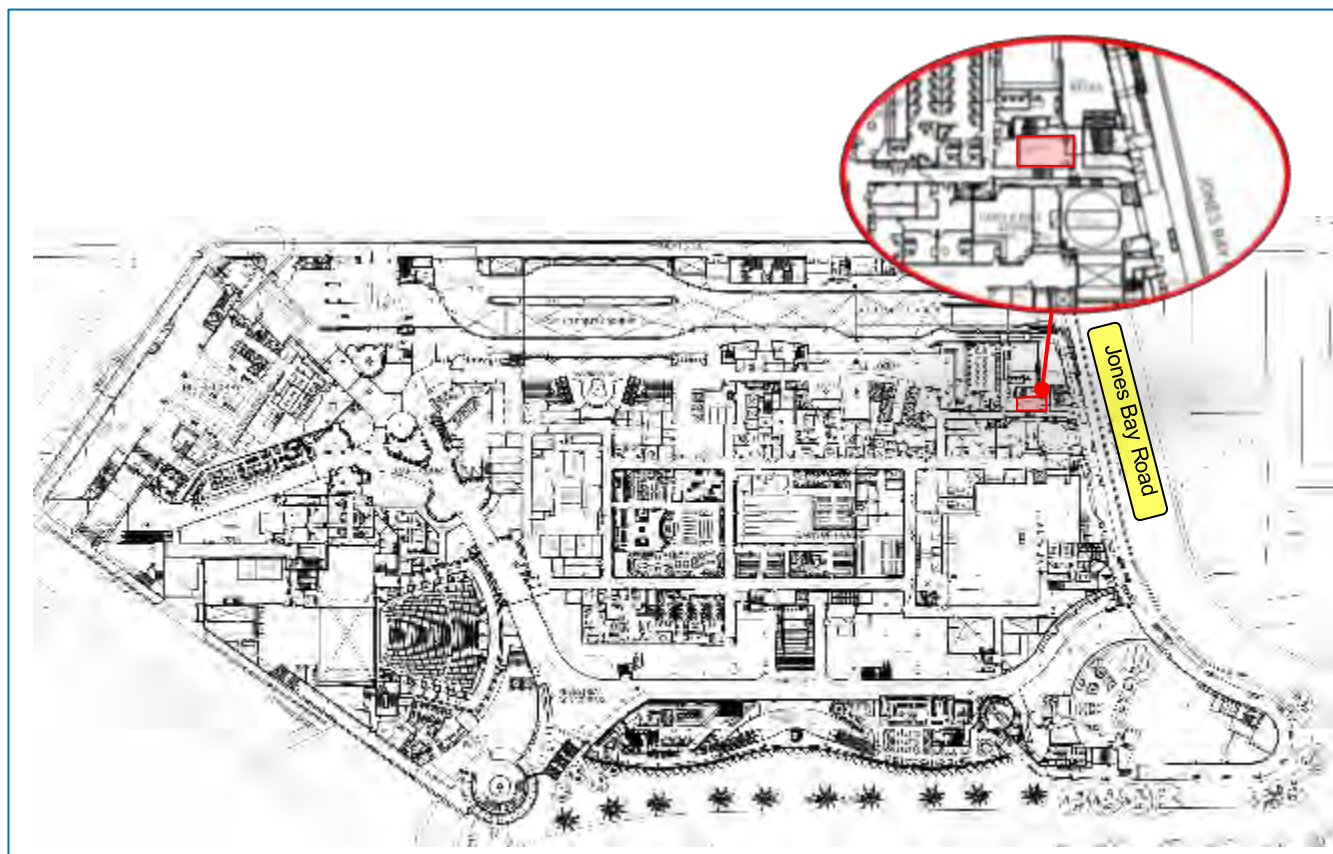


Figure 15: Fire Control Room

Applicable DtS provisions:	E1.8, Spec E1.8, E2.2	Performance requirements:	EP1.6
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List key fire safety measures:

Refer to Trial Design Requirements detailed in Section 6 of this FEBQ for the fire safety measures relevant to this development. Fire safety measures specific to this alternative solution are detailed below:

- The main Fire Control Room (FCR) serving the building which is located on Jones Bay Road is permitted to be >300 mm above street level at this side of the building.
- A mimic panel is to be provided in the hotel entry foyer on Basement 2 level (street level on the Pirrama Road side of the building). This panel shall be purely for notification purposes.

Proposed alternative solution:

It is considered that the proposed means of access to and egress from the FCR is sufficient for Brigade access due to the following:

- The steps up to the level which the FCR is accessed will be BCA compliant, meaning the size of each step, the nosing / slip resistance of these, and handrails will be provided. All of these items will assist Brigade members with walking down them while carrying their equipment.
- The proposed design contains a level difference of only 500 mm, in lieu of the permissible 300 mm. It is suggested that the additional 200 mm does not pose an unacceptable level of risk.
- The Brigade booster is located remote from the FCR (at street level), meaning any hoses associated with connecting to the booster will not be required to be carried up this flight of steps.
- The BCA Guide states that the intent of BCA Spec. E1.8 (3) is to "require that a fire control centre be conveniently placed to allow egress". The travel distance from the FCR is less than 20 m to a road or open space.
- The FCR is accessible via two separate doors: A door leading to a fire-isolated passageway, which leads directly out into a road or open space and a door from an area close to the main entrance of the building.
- Local Brigade personnel (Pymont Fire Station) are well versed on the configuration of The Star in relation to where the FCR and boosters are, given the frequency of false alarms which occur here each year. A mimic panel is being provided in the new hotel entry foyer on the Pymont Street side of the building, but essentially they will be fully aware that the main Brigade entry point to the building is on the Jones Bay Road (northern) side of the building.

Performance solution:

- ☐ A0.3(a)(i) - Comply with the performance requirements
- ☒ A0.3(a)(ii) - Be at least equivalent to the DtS provisions

Assessment methods:

- ☐ A0.5(a) - Evidence of suitability
- ☐ A0.5(b)(i) - Verification methods in the NCC
- ☐ A0.5(b)(ii) - Other verification methods
- ☐ A0.5(c) - Expert judgement
- ☒ A0.5(d) - Comparison with the DtS provisions

Assessment approach:

- | | | |
|---|---|---|
| ☒ Comparative | ☒ Qualitative | ☒ Deterministic |
| ☐ Absolute | ☐ Quantitative | ☐ Probabilistic |

IFEG sub-systems used in the analysis:

- | | |
|--|--|
| ☐ A – Fire initiation and development and control | ☐ D – Fire detection, warning and suppression |
| ☐ B – Smoke development and spread and control | ☐ E – Occupant evacuation and control |
| ☐ C – Fire spread and impact and control | ☒ F – Fire services intervention |

Acceptance criteria and factor of safety:

The acceptance criteria for this assessment will be based on ease of access for the attending fire brigade to reach the main building lobby without causing a significant delay.

Fire scenarios and design fire parameters:

n/a

Describe how fire brigade intervention will be addressed or considered:

n/a

Verification/validation analyses:

- ☐ Sensitivity studies ☐ Redundancy studies ☐ Uncertainty studies ☒ None

Provide details on proposed modelling/assessment tools:

n/a

FRNSW Comment: In principle support is provided subject to the analysis in the FER demonstrating compliance with the performance requirements of the NCC.

FRNSW recommends copies of the fire service block plans be provided with the mimic panel.

Issue number: 11 Performance based smoke control and egress provisions

Details of departures from DtS provisions:

The effective height of the building is more than 25 m and the stairs in the basement levels serve more than two storeys below the ground levels. The fire isolated stairs in the tower are proposed to only pressurise the portion serving the basement levels and the neighbourhood centre portion from Level 4 down to street level. The upper levels of the tower (Level 5 upwards) will be served by a mechanical smoke exhaust system within the corridor in lieu of stair pressurisation. This system will be designed to control smoke spread in the residential and hotel corridors and prevent smoke migration to the fire-isolated stairs. The areas proposed to contain stair pressurisation and those which are not are identified in the following diagram.

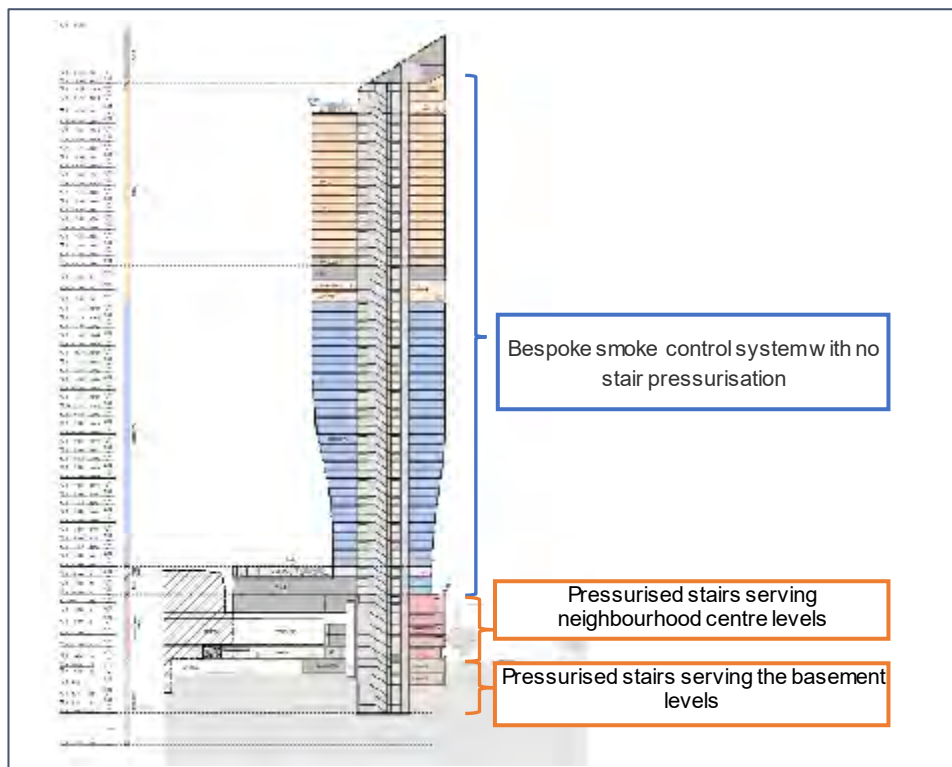


Figure 16: Bespoke smoke control system and pressurising provided for the fire isolated stair

In addition to above, it is also proposed to justify a number of travel distance non-compliances through the same CFD assessments. These distances are as follows and have also been depicted in the diagrams following this:

- Travel distance to an exit up to 10 m in lieu of 6 m within low plan residential units
- Travel distance to an exit up to 9.5 m in lieu of 6 m within mid plan residential units
- Travel distance to an exit up to 11 m in lieu of 6 m within high level residential units
- Travel distance to an exit up to 14 m in lieu of 6 m within hotel levels
- Travel distances to a point of choice up to 34 m in lieu of 20 m within sky lobby (level 39)
- Travel distances to a point of choice up to 32 m in lieu of 20 m within sky lobby mezzanine (level 40)
- Travel distances to a point of choice up to 26 m in lieu of 20 m within club lounge library (level 59)

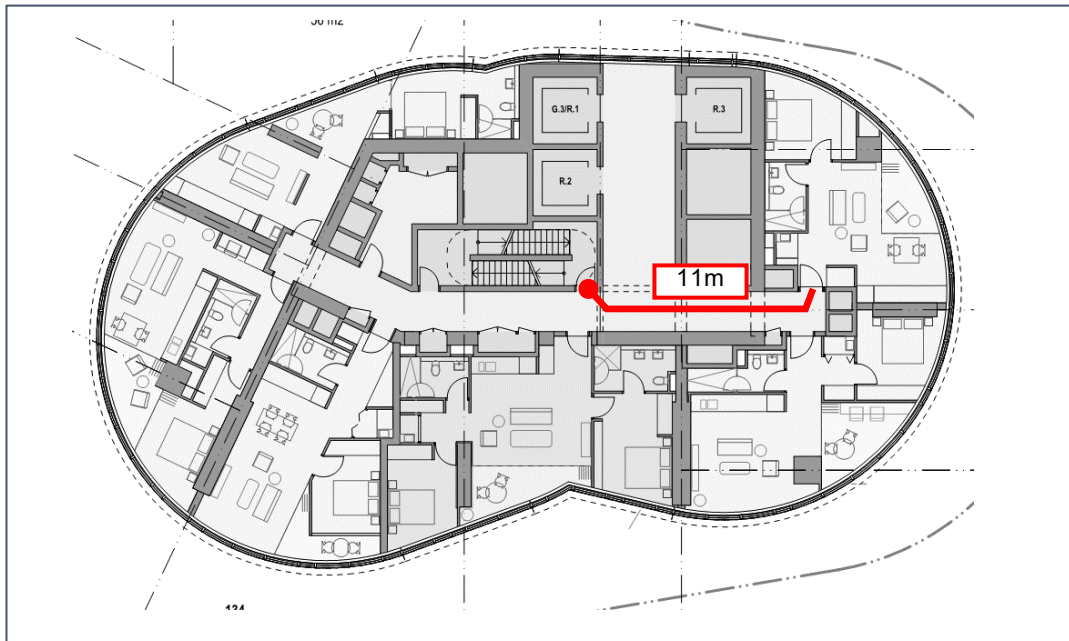


Figure 17: Extended travel distances at typical residential levels



Figure 18: Extended travel distance in Hotel levels

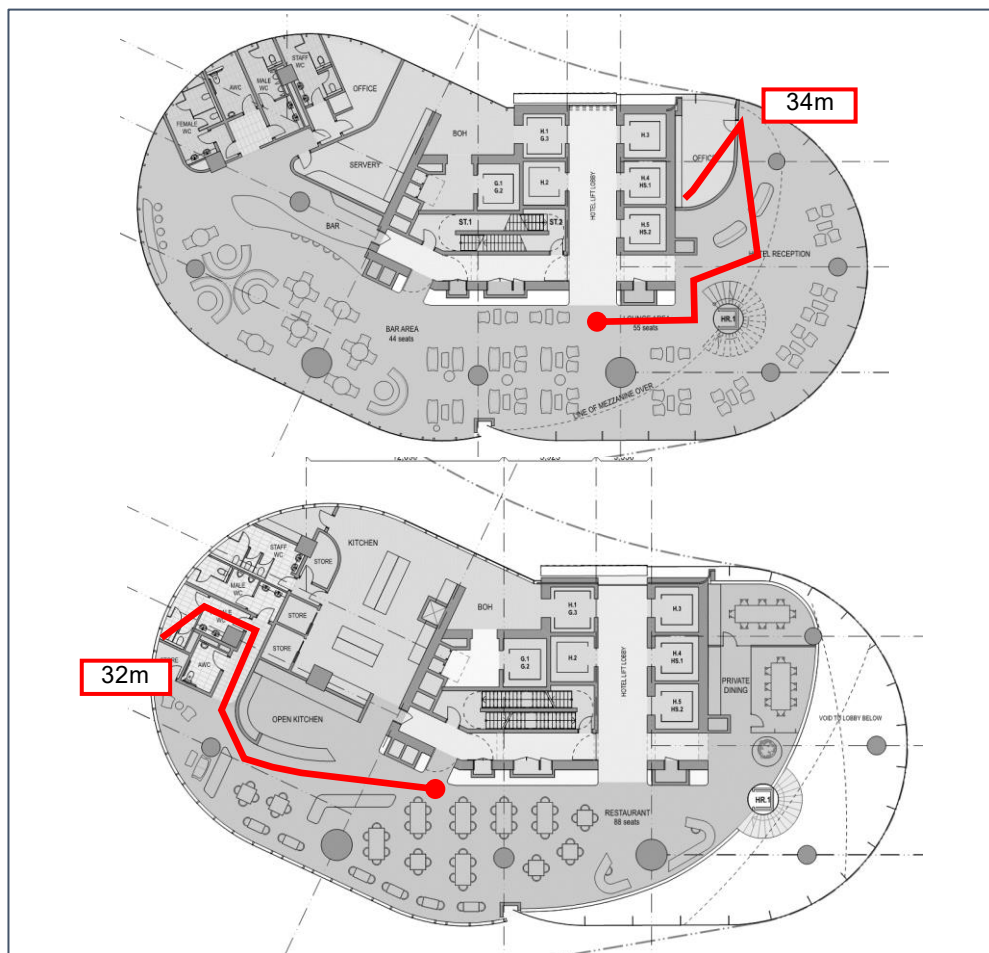


Figure 19: Extended travel distances at Levels 39 & 40

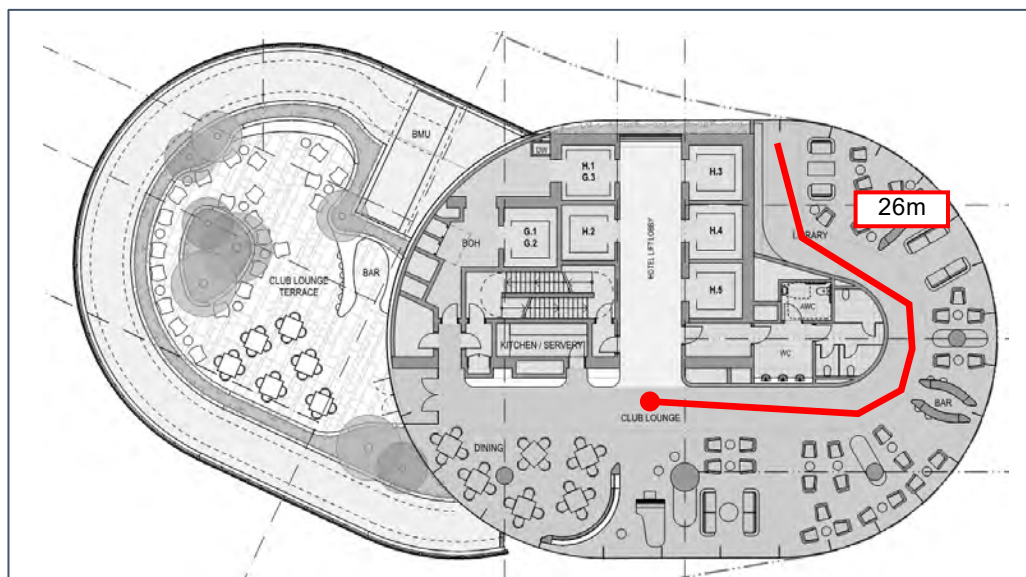


Figure 20: Extended travel distance in Club Lounge library (level 59)

Public corridors within Class 2 and 3 buildings are also required to be divided into intervals of not more than 40 m by smoke proof walls. The proposed corridors on a typical hotel plan exceeds 40 m, with corridors having been measured at 41 m (1 m over the DtS Provisions). As a result of the corridor exhaust system proposed within this building, these smoke doors must be omitted from the design. This non-compliance will be justified as part of this solution also



Figure 21: Extended travel distance in Club Lounge

The final portion of this assessment will address performance based smoke exhaust provisions to the Community Centre (Level 0 – Level 4) where it is proposed to rationalise the exhaust rates provided and the way in which smoke is controlled within this space.

Applicable DtS provisions:	C2.14, D1.4, E2.2, E2.3, Part G3, G3.8, Spec G3.8	Performance requirements:	CP2, DP4, EP2.2
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List key fire safety measures:

Refer to Trial Design Requirements detailed in Section 6 of this FEBQ for the fire safety measures relevant to this development. Fire safety measures specific to this alternative solution are detailed below:

- The building will be provided with an automatic sprinkler system, in accordance with AS 2118.1. Sprinklers in are to be 68 °C fast response sprinkler heads (subject to ambient temperature) with a RTI of 50 m^{1/2}s^{1/2} or less. Flush mounted sprinkler heads are not to be used unless first deemed acceptable by the fire engineer for use in the nominated area.
- The building will be provided with a smoke detection and alarm system, in accordance with AS 1670.1 (10 m grid spacing throughout occupied space areas).
- A Sound System and Intercom System for Emergency Purposes (SSISEP) shall be installed throughout the entire building, in accordance with AS 1670.4.
- The basement levels of the Mod 13 development up to the uppermost floor of the neighbourhood centre (Level 4) shall be provided with stair pressurisation in accordance with BCA Clause E2.2 and AS 1668.1 (2015).
- Fire doors shall be provided within the scissor stairs to separate the flights between Level 4 and Level 5 from one another to enable only the lower floors to be provided with stair pressurisation. Level 5 upwards is to be provided with a performance based smoke exhaust system as detailed below.
- The essential services serving the subject building shall be provided with back-up generator power. In the event of a general power failure on site, this system shall support all life safety systems within both the Mod 13 and existing portions of the site.
- The residential and hotel levels (Level 5 up to roof level) will be provided with a performance based smoke exhaust system in lieu of a staircase pressurisation system as detailed below:

- o A mechanical smoke exhaust system is to serve all residential and hotel levels from Level 5 upwards. This system is to be capable of exhausting and supplying a minimum required extraction rate (typically 4 - 5 m³/s) from two locations as highlighted in Figure 27.
- o The above smoke exhaust system is to be designed with a riser at each end of the corridor. Inside each riser there will be both an exhaust and supply fan which serves this system. In the event of a fire being detected on a floor, an exhaust fan is to operate in the riser closest to the fire, and the supply fan is to provide make-up air to this system at the opposite end. The detection system serving each floor is to be split into two zones to allow such a design to operate as required.
- o The supply fan in each riser shall be provided with a Variable Speed Drive (VSD) mechanism to assist in final testing and commissioning of this system. The supply is anticipated to be provided at around 10% less than the exhaust rate for the purposes of creating a negative pressure differential in the corridor.
- o Fan operation shall be monitored, and if the nominated fan does not start, the system is to automatically switch over to the fan at the opposite end of the corridor for N+1 redundancy.
- o On detection of smoke in the corridor, the dampers of both shafts open on the level of fire origin and the fan at the head of the shaft nearest to where smoke was detected activates to draw smoke from the corridor out through the shaft, with make-up air being drawn in via the second shaft with the fan at top free spinning. The dampers on the other floors are to remain closed to mitigate smoke migration through the building. The zoning of this system is shown in **Figure 23**, with the schematic representation of how this operates shown in **Figure 22**.

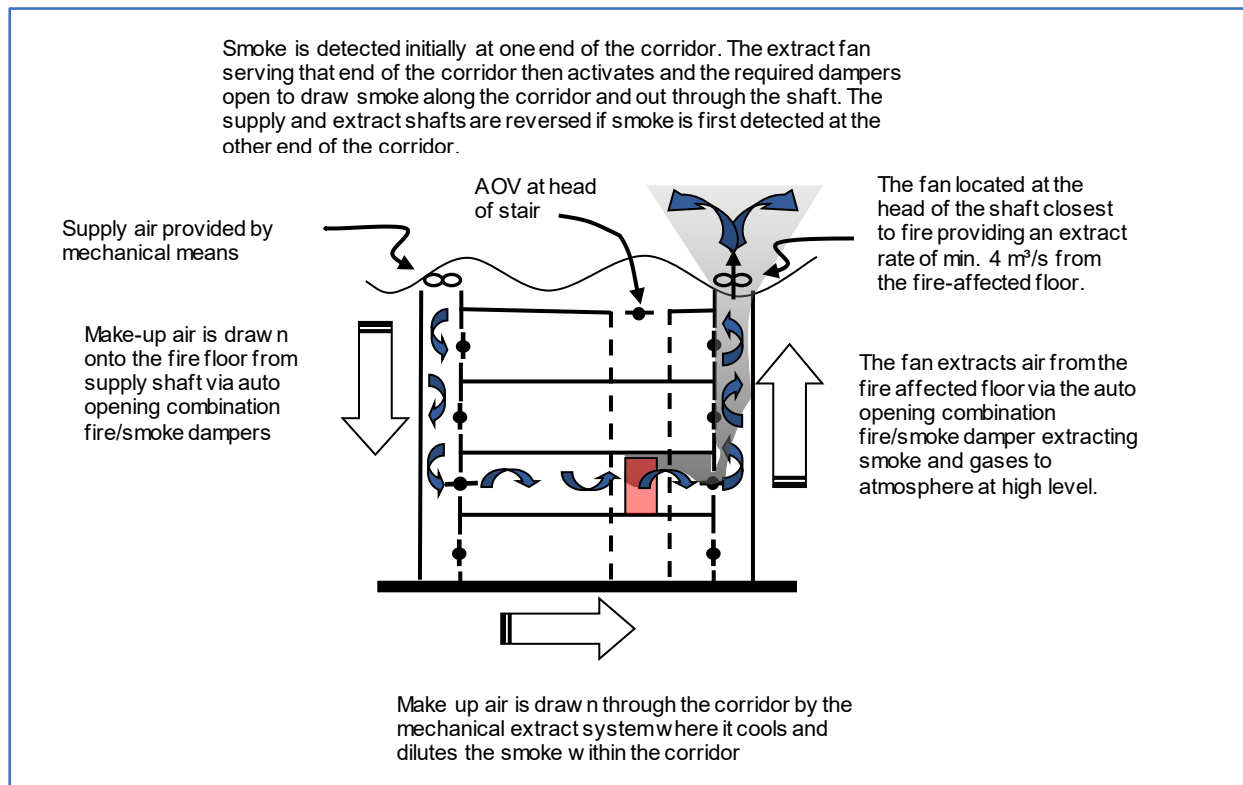


Figure 22: Schematic representation of proposed corridor extraction system.

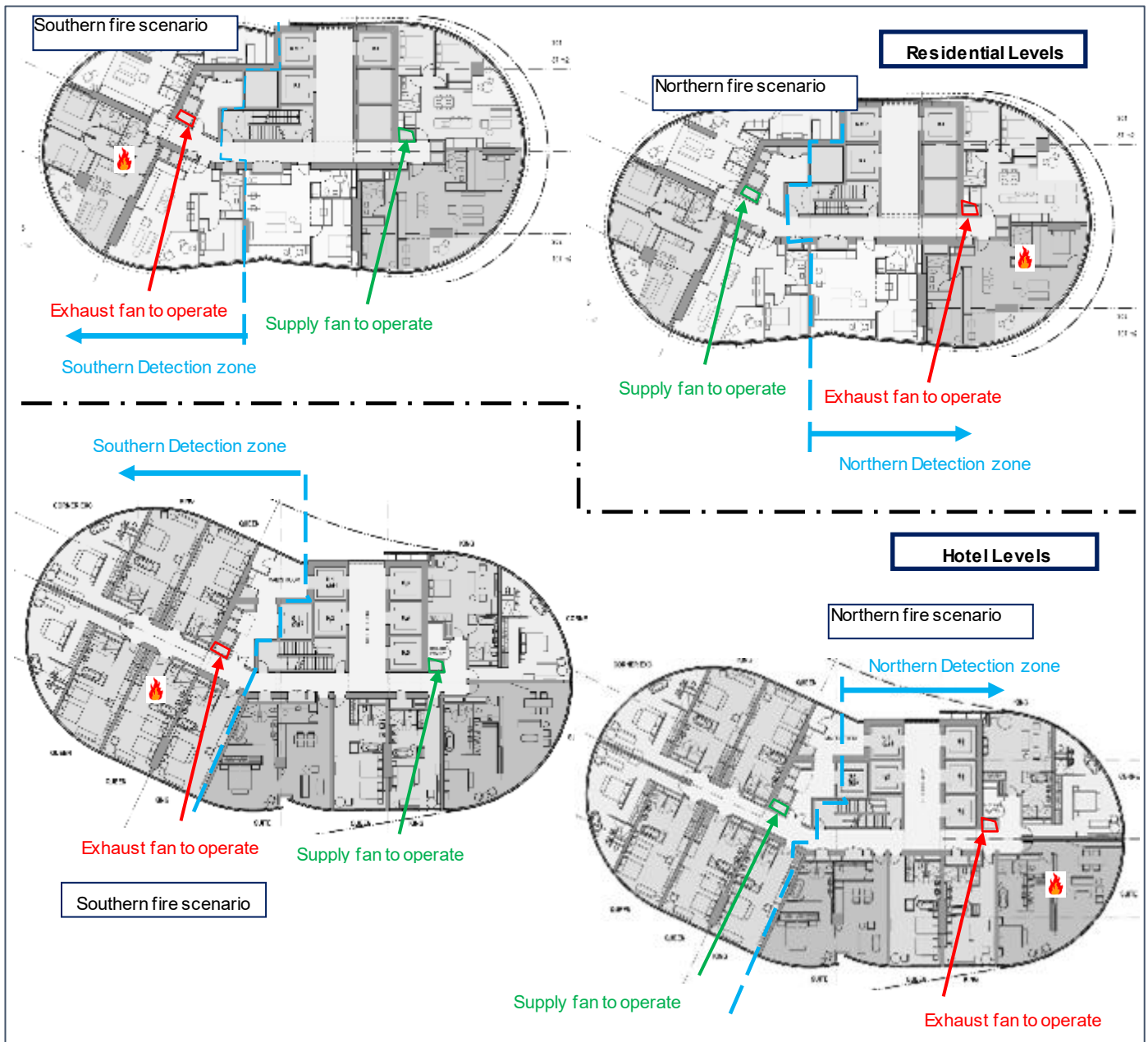


Figure 23: Typical Hotel and Residential levels showing smoke control strategy during north/south fire scenario

- o Power to the Mechanical Services Switch Board (MSSB) which control these systems shall be from the essential services supply. This enables this system to continue to operate after the Brigade cut the power to non-required systems at the main switchboard upon attendance on site. This system shall also be connected to the site's emergency generator power for the purposes of enabling continued operation in the event of a power outage.
- o The smoke exhaust fan is to be designed as smoke-spill fans in accordance with AS 1668.1 and be rated for operating for a period of minimum 2 hours at a smoke temperature of 200°C. The fan is to start up upon any smoke detector or sprinkler head activation on any floor. The fans are to be sized with the necessary allowances for leakage through ducting, dampers and the like to achieve the design requirement specified.
- o The dampers serving the hotel / residential corridor smoke exhaust system are to be electronically controlled smoke dampers which have the same temperature and time rating as the smoke fans noted above.
- o The position of the dampers relative to the operational mode will be automatically monitored and the system will be interfaced with the FIP to provide notification of any fault.
- o The proposed configuration of the fire and smoke dampers be included as an Essential Fire Safety Measure for the building, with the Annual Fire Safety Schedule either referencing the document or

outlining the details of the damper system setup, activation, and its other unique features. The intent is to ensure that the robustness of the system is maintained throughout the life of the building, provided that the analysis demonstrates that the proposed trial design meets the relevant Performance Requirements of the BCA.

- o All dampers on each floor will be controlled by a local control unit located on that specific floor; i.e. controls will be independent between floors so that there is no single point of failure. The control unit on each floor will be provided with battery backup or generator backup.
- o Power supply and control wiring to dampers, automatic opening louvres and fans serving the performance based mechanical systems must comply with AS1668.1. The wiring routes are to be in a protected space and not subject to any possible mechanical damage.
- o S-shaped subducts are to be provided in the shafts as a passive means of smoke control. Flanges will be fitted to the subject subducts to improve airflow in the shaft (refer **Figure 24**).

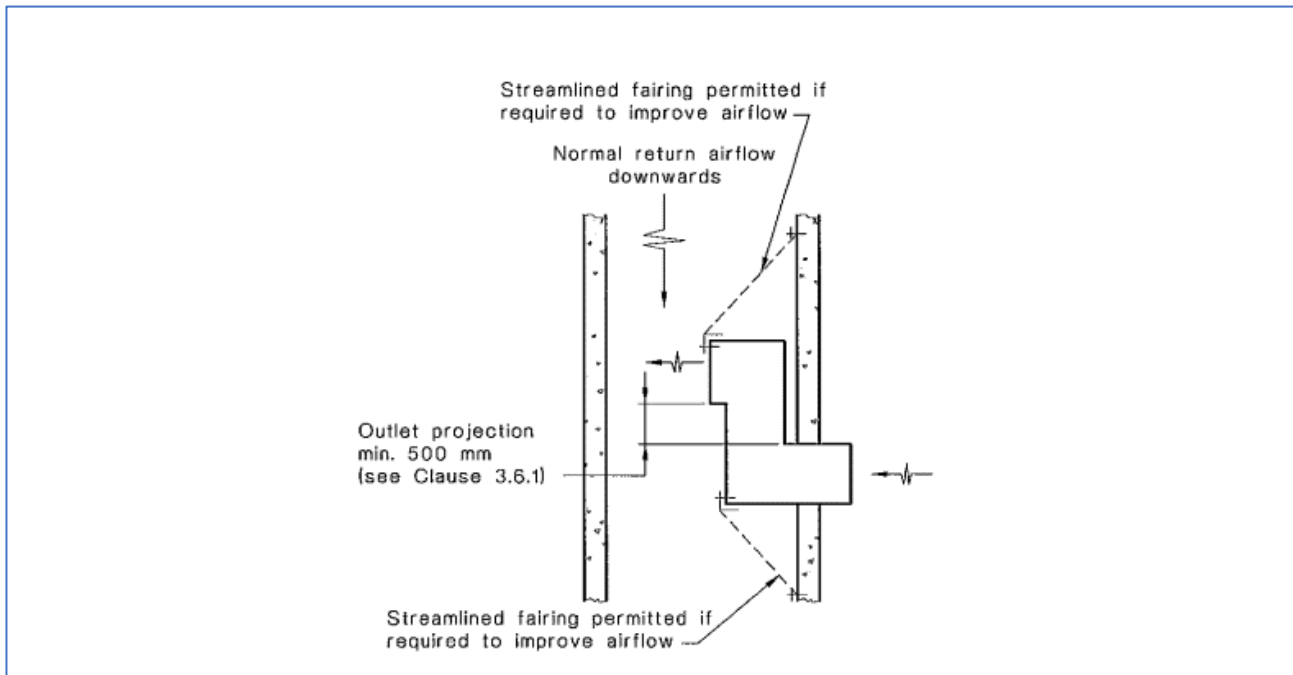


Figure 24: S-shaped sub-duct when airflow in normal operations is downwards

- o Final testing and commissioning of the smoke exhaust system is to be undertaken in accordance with AS 1668.1 Appendix F. The performance criteria which this system must adhere to be as follows:
 - Extract rate at most disadvantaged floor served by this exhaust system shall be no less than that specified.
 - The doors into each fire stair on the floors served by this system shall be openable when the exhaust system is extracting air through that floor with a door force of no greater than 110 N.
- o Smoke seals are to be fitted to all doors opening onto the corridor.
- o A 1 m² fresh air automatic opening vent to be provided at the top of each fire stair shaft to allow air to be drawn across the door threshold while the exhaust system is operating.
- The Neighbourhood Centre will be provided with a performance based smoke exhaust system:
 - o A Fire Curtain with an FRL of -/120/- is to be installed around the non-fire-isolated stair on Level 3. Fire barriers will be provided above the fire curtains within any concealed ceiling space along the line of the fire curtain. The fire curtain will be fully tested in accordance with AS 1905.2 and AS 1530.7 (and provided with fail-safe close on power/motor failure).
 - o The fire curtains are required to resist the passage of flames and hot gases for a minimum of 120 minutes as specified in AS 1530.4.
 - o The fire curtain will be capable of withstanding any adverse deflection of the curtain due to the pressure differentials created by the smoke exhaust system operating on Level 00 – 04.

- o The floor covering of the landing floor area of the fire curtain, the internal stair and the landing area of the stair are to be of non-combustible material.
- o A red strobe light will be provided within proximity of the interconnecting stair at the rising stairs on level 2 and the top of the stair on level 3. This light will activate upon alarm activation to signal that the fire curtain is lowering.
- o Additional exit signage on the inside of the fire curtain on Level 3 is required to read "EXIT ON LEVEL BELOW". The fire curtain will be activated for a fire on Levels 00 – 04 (the above text is not relevant to fire location).
- o The fire curtain will have a staged closing procedure. On alarm activation the fire curtain will close to a point of 2 m above floor level for 60 seconds to afford occupants time to move from the area to the fire isolated stairs. After 60 seconds the fire curtain will then drop to the floor level.
- o The following provisions shall be included in the management in use plan:
 - The area surrounding the interconnecting stairs on Level 3 is required to be clear and free of combustible materials or any storage of any object that could interfere with the safe operation of the fire curtain. This is a requirement for a distance of 1 m of the fire curtain. Signage to be provided to advise occupants of these requirements.
 - The area under the interconnecting stairs is required to be clear and free of combustible materials on level 3. Signage to be provided to advise occupants of these requirements.
- o Each level in the neighbourhood centre will be provided with two smoke extract points (2 x 10m³/s) and a means of mechanical supply air (10 m³/s). For a fire within the neighbourhood centre at Levels 00, 01 and 02, the fire affected floor requires extraction and pressurisation of the level above. For a fire at Level 3 and Level 4, the extraction and make up air supply will be provided in a similar manner.

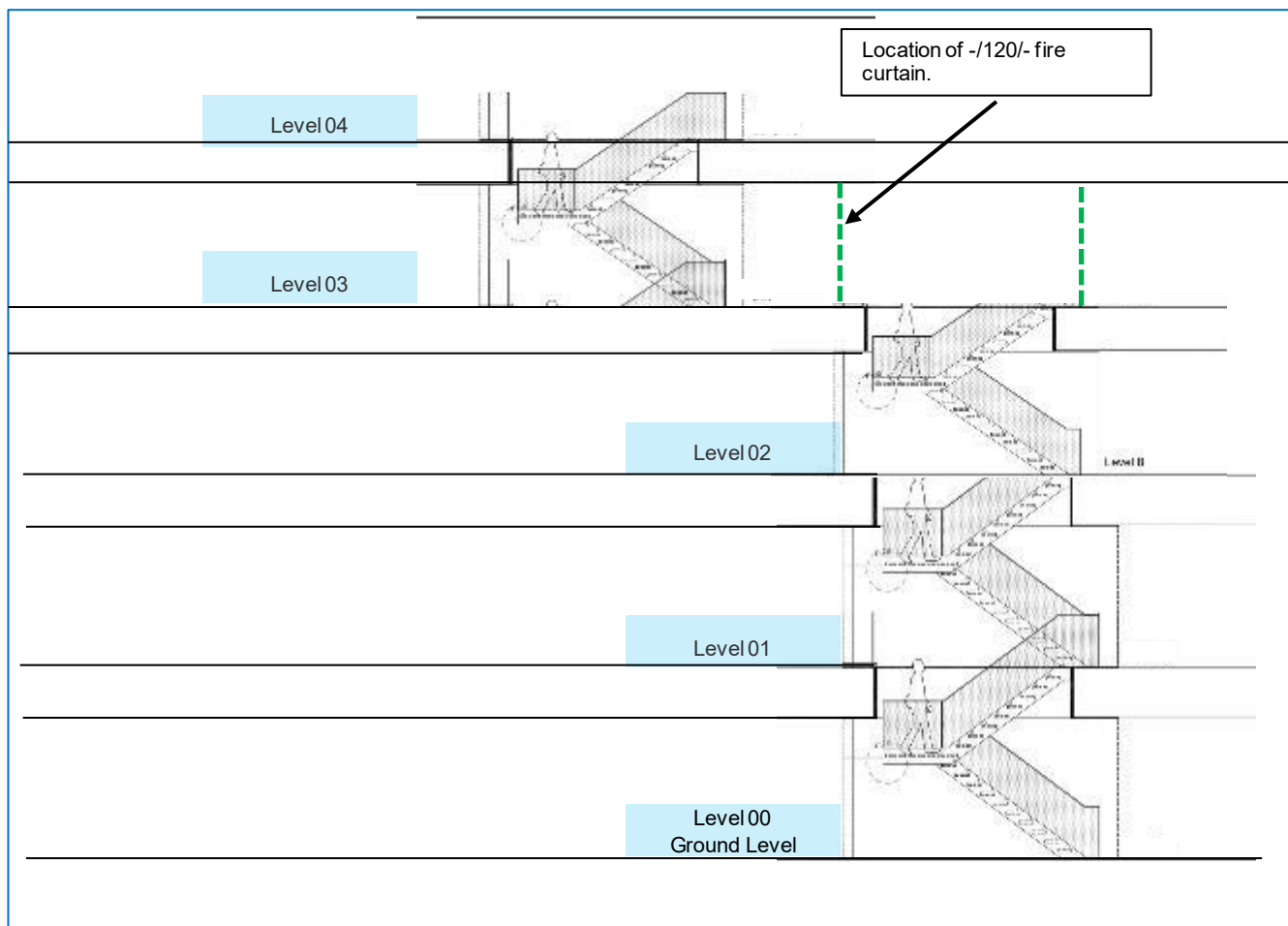


Figure 25: Neighbourhood centre levels fire curtain configuration

Proposed alternative solution:

Hotel / Residential Levels - Bespoke smoke control system in lieu of stair pressurisation

The intent of the proposed design is to limit smoke spread from a fire in an apartment or hotel units into the fire isolated stairs and to maintain tenable conditions. It is proposed to demonstrate through CFD modelling and evacuation modelling that tenable conditions within the corridor will be maintained for the period necessary to evacuate the fire-affected floor, and to provide access for the fire brigade to initiate fire suppression activities.

In a residential and hotel building, occupants may be asleep or subject to the effects of alcohol or other substances. In the event of a fire they are more likely to start escape later compared to non-sleeping occupancies. It is essential to provide earlier warning to occupants enabling earlier evacuation to occur.

The DtS Provisions require smoke detectors be installed in serviced apartments and hotel areas. In the event of a fire within a unit, occupants within other units will rely on the smoke detectors in the unit of fire origin or the corridor to detect a fire and activate the building fire alarm such that they are notified of the occurrence of a fire, or on operation of the sprinkler system when the fire grows large enough.

The corridor exhaust system will incorporate two smoke extraction shafts with openings into the shafts on each of the floors fitted with smoke dampers and S-shaped sub-ducts in accordance with AS 1668.1 for smoke spill systems. This type of system has been successfully used in high rise residential and hotel developments internationally and has been shown to be very effective in ensuring that stairs remain smoke free. It has also been shown to maintain tenable conditions for occupant egress as well as providing tenable operating conditions for Brigade personnel. This will be proven through the use of CFD modelling. The diagram below clearly indicates where the two risers sit on a typical floorplate. It will also demonstrate that the minor increase in residential corridor lengths (41 m in lieu of 40 m) will not have any negative impacts on life safety on these floors.

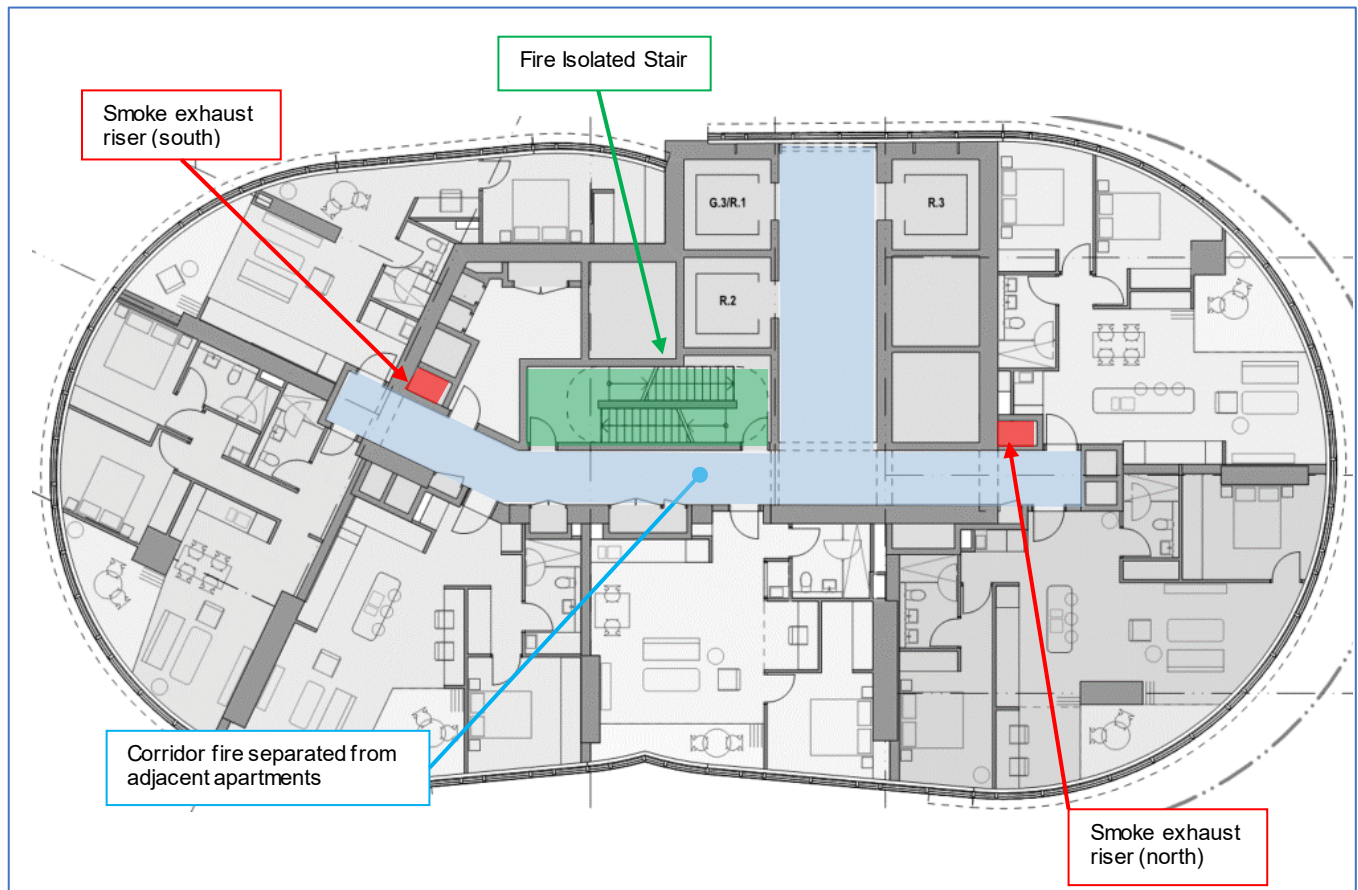


Figure 26: Typical Residential Level Showing Proposed Mechanical Exhaust System

Each shaft will be fitted with a smoke exhaust fan. Both shafts will be provided with sub-ducts in addition to smoke dampers to alleviate FRNSW review risk. The corridor itself will then be zoned into north and south portions. Which fan operates will be determined by the location of the zone which the actuated smoke detector sits within. The fan within the shaft closest to the detector will then run, and the fan within the other shaft will provide ~90% of the supply to create a negative pressure differential in the corridor space, although VSDs will be installed on these fans for the purposes of assisting with door opening forces during final commissioning.

The proposed system is designed to be simple and reliable with straightforward commissioning, maintenance requirements and operation. The proposed system is therefore expected to be at least as reliable as a stair pressurisation system specified in the BCA which is relied upon to protect the fire-isolated stairs from smoke ingress in a DtS compliant building.

The system operates to generally move the smoke in the direction away from the staircases, depending on which smoke detector in the corridor activates. An indicative mark-up of how this system will work can be found in Figure 23.

- The following is the proposed sequence of events, which will be used in the assessment:
 - o The fire is assumed to ignite inside the room of fire origin and continues to grow according to the design fire.
 - o The smoke alarm inside the room of fire origin was calculated to activate at approximately 45 seconds. Conservatively, 60 seconds was used as a set time for detector activation and the initiation of the fire alarm.

FRNSW Comment: Please clarify is the above is for both Class 2 and 3 SOUs. Is detection in accordance with AS1670.1-2015 provided to Class 2 SOUs or to common areas only?

- o The occupants in the SOU room of fire origin will take approximately 60 seconds to reach the door of the apartment (including reaction time, pre-movement time, travel time, etc.) [C/v_m^2]
- o The occupants will then open the room of fire origin door for 3 seconds per occupant, as per Verification Method C/v_m^2 . While the door is opened, smoke from the room will spill out into the corridor. After the occupants have exited the room of fire origin, the auto-closing mechanism will automatically close the door and smoke will stop spilling into the corridor.
- o The occupants travel along the corridor towards the staircases.
- o Occupants will then open the door into the staircase. While the door to the staircase is opened, any smoke present inside the corridor is able to enter the staircase. After the occupants have entered the staircase, the auto-closing mechanism will automatically close the door.
- o The corridor extraction system is set to activate as soon as the detectors inside one of the SOUs or the corridor activates. The direction of the extraction vs. supply will be determined by the location of the activated detector. The design and location of the smoke detectors will be finalised during the FER stage.
- o A test will be built into the models; after all occupants have escaped from the floor, the door to the apartment is set to open for 60 seconds to flood the corridor with smoke. This will test the ability of the smoke extraction system to clear the corridor of smoke. The start time of this test in the model is arbitrary. It does not represent the escape of occupants or the intervention of the firefighters.
- o The door is set to close at the end of this test.
- o The system is then allowed 120 seconds to clear the smoke from the corridor, with all doors are closed. The results will show that the system effectively removes all smoke from the corridors, which would allow other occupants from other SOUs to evacuate.
- o The model then simulates the intervention from the fire brigade. The fire brigade enters the floor via the staircase door at ~600 seconds, which remains open for the remainder of the simulation.
- o The start time of the fire brigade intervention in the model is arbitrary. It does not represent the actual arrival time of the fire brigade. It is used just to demonstrate the smoke spread under steady state conditions during fire brigade intervention.
- o The fire brigade will open the door of the room of fire origin at 620 seconds. The door is set to remain open for the remainder of the model.
- o The model is set to run up to 800 seconds.
- The following is a typical graph showing the timeline of events (each scenario varies slightly so timelines and exhaust rates will be modified to reflect the text above in the final FER).

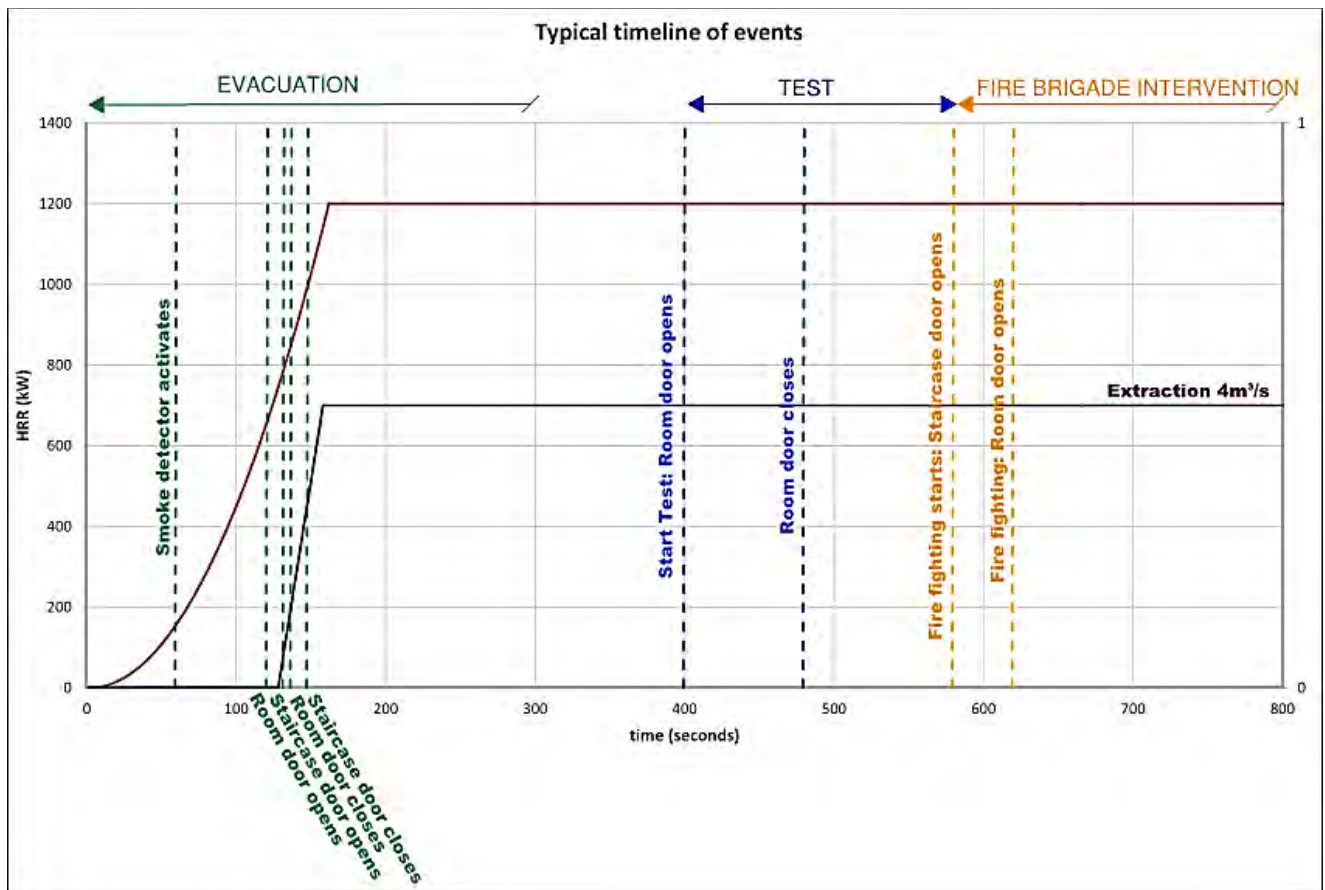


Figure 27: Typical timeline of events

Extended travel distances at residential/hotel levels, sky lobby and club lounge levels

Various fire scenarios will be assessed to simulate all credible fire scenarios & locations in the residential and hotel levels of the building using CFD modelling in relation to the omission of stair pressurisation from the Level 5 upwards in the tower. The results of this modelling will be used to justify travel distance non-compliances on these floors also. The acceptable tenability criteria will be used to determine the Available Safe Egress Time (ASET) from the subject areas. The evacuation of occupants will be modelled by Pathfinder to determine the Required Safe Egress Time (RSET). The time to escape the respective areas will be calculated based on:

- Detection Time – calculated based upon activation times of smoke detection and sprinkler systems. The constant temperature rise method will be used to determine the smoke detection time.
- Pre-Movement Time
 - o Residential Levels: taken as 60 s for occupants in enclosure of origin and 300 s remote from the enclosure of origin;
 - o Hotel bedroom: taken as 60 s for occupants in enclosure of origin and 600 s remote from the enclosure of origin;
 - o Sky lobby and lounge levels: taken as 60 s for occupants in enclosure of origin and 120 s remote from the enclosure of origin;
- Movement (travel) time – calculated based on the occupant flow rates through doors, i.e. 1.33 person/s/m and travel speeds of 0.8 m/s. Where travel time is based on queuing, boundary layers will be assumed and applied to exits, and the largest exit will be assumed to be blocked for conservatism. To account for the delay caused by travel through manually openable door leaves, a sensitivity flow of 50 persons/min/door leaf will be used for the calculation as recommended by the SFPE handbook 5th edition.
- An ASET/RSET analyses will be carried out to show that all occupants will be able to safely evacuate the building, before the conditions become untenable.
- In the proposed design, smoke detectors will be provided within each SOU. These smoke detectors will be connected to activate the building occupant warning system. This will notify the occupants in other units of the occurrence of a fire such that they can evacuate in the earlier stage of the fire. Therefore, in the event of a fire in a unit, it is expected that the proposed design would produce earlier warning to the occupants in other units than a DtS reference design. Hence, an earlier occupant evacuation would result in the proposed design compared to a DtS reference design.

- The provision of smoke seals to the unit doors in the subject areas would prevent leakage of smoke to the corridor after the door is closed. Therefore, the conditions within the corridor within the subject corridors would be better than a DtS compliant design in terms of occupant evacuation.
- Corridors exceeding 40 m will be demonstrated as acceptable as part of the CFD analysis.
- Based on the above analysis, it is considered that the risk of path of travel being blocked by a fire in the proposed design is at least equivalent to a DtS reference design and the conditions along the path of travel to the point of choice would be better than a DtS compliant design.

Neighbourhood Centre – Smoke control provisions

As detailed in the Design Requirements section of this Performance Solution; it is proposed for performance based smoke exhaust rates to be provided on each of the Neighbourhood Centre floors (Level 00 – 04). The assessment will treat Level 00 – 02 as one smoke zone and Level 03 – 04 as another. The exhaust system will work by providing an exhaust rate of between 10 m³/s and 20 m³/s on the fire affected floor and then supplying make-up air to match via a combination of supply air risers (i.e. those serving the corridor exhaust system on the upper levels) and outside air openings on the northern façade. CFD modelling will be used to demonstrate that evacuation can take place with a suitable safety factor incorporated (minimum of 1.5 x RSET for the base case scenarios).

Stair pressurisation will be provided on these floors so the above assessment will be solely to quantify the exhaust rates required to enable occupants to evacuate safely on these floors.

Performance solution:

- ☒ A0.3(a)(i) - Comply with the performance requirements
- ☐ A0.3(a)(ii) - Be at least equivalent to the DtS provisions

Assessment methods:

- ☐ A0.5(a) - Evidence of suitability
- ☐ A0.5(b)(i) - Verification methods in the NCC
- ☒ A0.5(b)(ii) - Other verification methods
- ☐ A0.5(c) - Expert judgement
- ☐ A0.5(d) - Comparison with the DtS provisions

Assessment approach:

- ☐ Comparative ☒ Qualitative ☒ Deterministic
- ☒ Absolute ☒ Quantitative ☐ Probabilistic

IFEG sub-systems used in the analysis:

- ☐ A – Fire initiation and development and control
- ☒ B – Smoke development and spread and control
- ☒ C – Fire spread and impact and control
- ☒ D – Fire detection, warning and suppression
- ☒ E – Occupant evacuation and control
- ☒ F – Fire services intervention

Acceptance criteria and factor of safety:

As an absolute assessment will be undertaken, it needs to be demonstrated that the proposed building design provides tenable conditions for means of escape and Brigade intervention in the corridor and fire-isolated stairs. The following occupant egress tenability criteria are used [PD 7974-6]: Occupant Tenability Criteria

Occupant Tenability Criteria	
Convective heat	Temperature < 60 °C when smoke layer is below 2.0 m
Radiant heat exposure	Radiant flux < 2.5 kW/m ² at 2.0 m, or smoke layer temperature < 200 °C when smoke layer is at or above 2.0 m
Visibility	Visibility (illuminated signs) > 10 m when smoke layer is below a height of 2.0 m for small spaces

Fire scenarios and design fire parameters:

This is discussed in the above Performance Solution

Describe how fire brigade intervention will be addressed or considered:

This is discussed in the above Performance Solution.

Verification/validation analyses:

☐ Sensitivity studies ☐ Redundancy studies ☐ Uncertainty studies ☒ None

Provide details on proposed modelling/assessment tools:

CFD and Pathfinder modelling will be undertaken to justify the proposed Performance Solutions. Details on the CFD inputs can be found in the CFD form included in this FEBQ submission.

FRNSW Comment: In principle support is provided subject to all analysis inputs and assumptions being detailed in the FER and agreed upon by all relevant stakeholders, and the analysis demonstrating compliance with the Performance Requirements of the NCC.

Issue number: 12 Performance based alarm configuration for Class 3 SOUs
Details of departures from DtS provisions:

It is proposed to install a smoke detection and alarm system in accordance with BCA Specification E2.2a Clause 4 throughout the building. However, based on the hotel operator's preferred management procedures, it is proposed to provide an Alarm Delay Facility (ADF) on the detection and alarm system to prevent site-wide evacuations from occurring in the event of a spurious alarm on site.

This configuration will generally be in accordance with AS 1670.1 (2015), but is being tabled here for clarity to FRNSW on the proposed alarm configuration on site to verify that they have no objections to the proposed strategy.

Applicable DtS provisions:	E2.2	Performance requirements:	EP2.1
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List key fire safety measures:

Refer to Trial Design Requirements detailed in Section 6 of this FEBQ for the fire safety measures relevant to this development. It is proposed to install the following measures to support the Performance Solution:

- Smoke detection and alarm system within Hotel SOU's shall be in accordance with BCA DTS requirements (Specification E2.2a Clause 4). Smoke detectors shall be installed and located within SOUs in accordance with BCA DTS Specification E2.2a Clause 3(c)(i) and operate as follows:
 - o The smoke detection system shall be configured in a double knock configuration on hotel and serviced apartment levels. In the event of two or more detectors (i.e. one in an SOU and one in the corridor), or any other alarm initiating device being activated (sprinklers, break glass alarm, etc.) then this shall override any ADF timer within the system.
 - o Detection of smoke only within an SOU will activate an alarm condition at the front desk and on the building manager's pager (or equivalent) to enable management to investigate further.
 - o The activation of an SOU smoke detector shall enable staff to acknowledge the alarm condition to commence the Alarm Delay Facility (ADF) countdown of between 120 and 300 seconds as per AS 1670.1 (2015) Clause 3.4.
 - o The detector in the alarm affected room will either be fitted with a sounder base which alerts those in the room of the alarm condition, or a floor-wide alarm shall commence during this preliminary alarm period.
 - o When smoke or steam is cleared from the detector, the localised / floor-wide alarm and the front desk alert shall stop.
 - o Should hotel management find that the alarm condition is a valid one, then the alarm will be raised manually at the front desk immediately.
 - o Where the smoke detector is still in alarm after a period of 120 - 300 seconds, this shall commence the SSISEP cascade sequence and shall call the Brigade out via the ASE.
- Note that the twin key SOUs shall be treated as one (1) SOU, thus activation of a smoke detector within one SOU shall also activate the alarm within the adjoining main SOU and vice versa.
- No further alarm verifications beyond the above are permitted.

Proposed alternative solution:

Performance Requirement EP2.1 of the BCA states that in a building providing sleeping accommodation, occupants must be provided with automatic warning on the detection of smoke so they may evacuate in the event of a fire to a safe place. The Alternative Solution tabled here includes the provision of either smoke detectors with a sounder base which activates upon identification of smoke within the subject area, or for a level-specific alarm to be activated only during the preliminary pre-alarm phase. In either scenario, the occupant of the room will immediately be made aware of the alarm condition which will enable them to either flee the room (should it be a valid alarm condition) or try and clear the cause of the spurious alarm.

During this preliminary alarm condition, an alarm will also be sounded at the hotel manager's office via the FIP. Hotel staff will then have the capability of acknowledging the alarm which will start a 2 - 5 minute delay timer. If the alarm condition clears within the designated time period, the building wide alarm system shall not activate. If it does

not, then the standard alarm tones and cascade sequence shall commence and notification will be sent to the Fire Brigade. The proposed modified smoke detection and alarm system still warns the occupants within the fire affected SOU in the first instance upon the detection of smoke (either through a localised sounder or a floor-specific alarm only) meaning the intent of Performance Requirement EP2.2 of the BCA is technically met.

Approximately 98 % of the automatic fire alarms that FRNSW respond are unwanted alarms which means there is no fire or other emergency at the time of the alarm activation. Unwanted alarms create complacency towards genuine alarms which can result in serious injury or loss of life. They also divert fire brigade resources that would otherwise be available for genuine emergencies [FRNSW]. FRNSW have not developed any guidelines for reducing the number of spurious alarms, however there are other guidelines developed such as [QFRS]. The guideline states in regards to residential buildings:

Cooking and showering are considered to be normal activities within residential buildings. Even though smoke detection is not installed in kitchens and bathrooms, the products from activities in those rooms, namely cooking fumes and steam from showers are the main causes of unwanted alarms.

Activations occur when airflow from a kitchen or a bathroom delivers products to another area of a unit that has smoke detection. Design teams should consider air circulation in a holistic manner to ensure that cooking fumes do not migrate from the kitchen and steam from showers does not migrate from the bathroom to other areas of the Sole Occupancy Unit (SOU) that have smoke detection.

In a DtS complaint solution, the SOUs within Hotel would have smoke detectors that activate the site's SSISEP and notifies the fire brigade. In this configuration, there is a risk of detectors being activated due to cooking or showering which then would notify all occupants of the building of the alarm condition and would call the Brigade to site, regardless of it being deemed a spurious alarm.

By providing an alternative smoke detection system, the likelihood of spurious alarms from SOUs through steam activation or other non-fire emergency conditions (such as occupants smoking within their hotel suite) is largely reduced. This provision is expected to improve the safety to occupants in the building by reducing the complacency towards genuine alarms.

The following bullet points outline the sequence of events which would occur should a smoke detector be activated within an SOU in relation to the proposed design.

1. Detector within the SOU will activate an alarm condition at the front desk and on the building manager's pager (or equivalent) to enable management to investigate further.
2. This will then enable staff to acknowledge the alarm condition to commence the Alarm Delay Facility (ADF) countdown of between 120 and 300 seconds as per AS 1670.1 (2015) Clause 3.4.
3. The detector in the alarm affected room will either be fitted with a sounder base which alerts those in the room of the alarm condition, or a floor-wide alarm shall commence during this preliminary alarm period.
4. When smoke or steam is cleared from the detector, the localised / floor-wide alarm and the front desk alert shall stop.
5. Should hotel management find that the alarm condition is a valid one, then the alarm will be raised manually at the front desk immediately. □ Where the smoke detector is still in alarm after a period of 120 - 300 seconds, this shall commence the SSISEP cascade sequence and shall call the Brigade out via the ASE.
6. In the event of two or more detectors (i.e. one in an SOU and one in the corridor), or any other alarm initiating device being activated (sprinklers, break glass alarm, etc.) then this shall override any ADF timer within the system.

Essentially, each hotel SOU is deemed to be its own fire compartment. As long as an alarm condition is raised in the fire affected room in the first instance to enable those within the vicinity of the fire to escape safely, delaying the site-wide alarm by between 120 and 300 seconds is not considered an issue as the fire would be contained for a period of no less than 60 minutes. This has been recognised by the latest edition of AS 1670.1 (as per the commentary above) meaning a precedent has been set in relation to this configuration. Given this building is also fully sprinkler protected, the likelihood of the fire migrating beyond the first compartment is reduced even further.

Performance solution:

- ☐ A0.3(a)(i) - Comply with the performance requirements
- ☒ A0.3(a)(ii) - Be at least equivalent to the DtS provisions

Assessment methods:

- ☐ A0.5(a) - Evidence of suitability
☐ A0.5(b)(i) - Verification methods in the NCC
☒ A0.5(b)(ii) - Other verification methods
☐ A0.5(c) - Expert judgement
☐ A0.5(d) - Comparison with the DtS provisions

Assessment approach:

- ☐ Comparative ☒ Qualitative ☒ Deterministic
☒ Absolute ☐ Quantitative ☐ Probabilistic

IFEG sub-systems used in the analysis:

- ☐ A – Fire initiation and development and control ☒ D – Fire detection, warning and suppression
☐ B – Smoke development and spread and control ☒ E – Occupant evacuation and control
☐ C – Fire spread and impact and control ☐ F – Fire services intervention

Acceptance criteria and factor of safety:

The solution is acceptable if the performance of the modified detection and alarm system is demonstrated to be at least equivalent to that of a DtS compliant building solution in regards to occupant safety.

Fire scenarios and design fire parameters:

N/A

Describe how fire brigade intervention will be addressed or considered:

Issue #11 details the corridor exhaust system which will be provided to each Class 3 level of the building. The CFD modelling associated with this system will demonstrate favourable conditions for the Brigade upon attendance of a fire on one of these floors.

Verification/validation analyses:

- ☐ Sensitivity studies ☐ Redundancy studies ☐ Uncertainty studies ☒ None

The hotel and serviced apartment levels are provided with a corridor exhaust system so the building also has considerably greater smoke control provisions serving the common corridors than would be the case in a DtS building with stair pressurisation only.

Provide details on proposed modelling/assessment tools:

No modelling proposed – qualitative assessment only.

FRNSW Comment: In principle support is provided subject to the analysis in the FER demonstrating compliance with the performance requirements of the NCC.

2 Construction, commissioning, management, use and maintenance

What considerations does the alternative solution require during the construction phase?

Mod 13 tower is a new build component of the overall site. The construction zone will be suitably separated from the existing portions during works to mitigate any risks during works.

How will the alternative solution affect commissioning of the systems (e.g. listed on fire safety schedule as essential or critical measure, combined new and old installations)?

All fire safety provisions nominated in the FER will be suitably referenced on the AFSS for testing each year.

How will the alternative solution be addressed for ongoing building management and use (e.g. details to be provided in a 'fire safety management plan' for the building manager)?

WSP are in the process of documenting the testing requirements for each FER we have provided to the site to date to building management to ensure the ongoing maintenance of the systems which the Performance Solutions are reliant upon is upheld. The Mod 13 tower will be included in this document once works are complete.

How will any restrictions on fuel load/use/populations within the alternative solution be managed and enforced (e.g. details to be provided in 'emergency management plan')?

Details will be provided in the site's Management in Use Plan, and shall form part of the critical fire safety measures which are listed in the AFSS for the building.

How will the alternative solution be addressed for maintenance (e.g. details included on fire safety schedule, location of fire engineering report on site, plain English summary adjacent to FIP)?

Testing will be in accordance with AS 1851 or other relevant standards post-works. Wherever this is modified in any way by the FER, this will be suitably documented in the aforementioned testing requirements document.

3 Additional comments

N/A

Note: Any in principle support extended for alternative solution issues through consultation is contingent upon all assumptions, analyses and conclusions in the fire engineering report being fully justified, and referenced as appropriate, to demonstrate how the relevant performance requirements have been satisfied to the extent required by the agreed acceptance criteria.

4 Scheduled charges

FRNSW charge for the provision of services performed in connection with statutory fire safety as per the schedule of charges identified in [clause 46](#) and [schedule 3](#) of the *Fire Brigades Regulation 2014*.

The charge applicable is \$2,600 for each day (or part of a day) spent by the Commissioner or a fire brigade member providing advisory, assessment or consultancy services.

Note: For a full description of the charges applicable including terms, payment options, applying for a waiver or reduction of the charges, please refer to the FRNSW website at firesafety.fire.nsw.gov.au.

5 Contact us

For further information contact the Fire Safety Branch on (02) 9742 7434 or email firesafety@fire.nsw.gov.au.

8 APPENDIX B – SUMMARY OF FRNSW COMMENTS AND WSP RESPONSES

The following pages summarise FRNSW's comments in relation to the FEBQ submitted, while also providing WSP's response to how these comments will be addressed during detailed design stage of the project.

A.1 FRNSW Feedback on FEBQ V01

Table 1 details the feedback and comments from FRNSW received by email on the 16/10/2017 on FEBQ V01 (submitted to FRNSW on the 15/09/2017). The below table discusses the items raised by FRNSW on their review of the FEBQ and WSP's commentary and actions undertaken with regards the FRNSW feedback.

Table 1: FRNSW feedback on FEBQ V01 and WSP commentary & actions undertaken

Location in FEBQ V01	FRNSW Comments	WSP Comment & Actions Undertaken
Page 2 <i>Proposed works</i>	In relation to this matter where FRNSW comments contradict or are not consistent with any condition of development consent, further consultation with FRNSW is required to refine the proposed fire safety strategy	Noted
Page 19 <i>Fire detection and alarm system</i>	Please confirm whether the above also applies to Class 2 SOUs.	Yes, Class 2 SOUs are technically serviced apartment so will have detection within them the same as a Class 3 SOU given they both contain a similar risk level (i.e. are occupied by largely transient guests who may not be familiar with their surroundings)
Page 20 <i>Manual Fire suppression Systems</i>	see alt sol #10 comments	See WSP comment in AS10
Page 31 <i>AS1 - Rationalisation of FRLs to the Class 6 and Class 7b portions</i>	FRNSW recommends the ventilation assumptions for the time equivalency analysis be detailed and justified. FRNSW recommends a maximum of 50% glazing breakage be considered. Anything above 50% should be appropriately quantitatively justified	Noted.
Page 36 <i>AS2 - Extended travel distances B04 – B00 & B7</i>	FRNSW Comment: In principle support is provided subject to all inputs and assumptions used in the quantitative analysis being included in Version 3 of this FEBQ (or FER as applicable). As a minimum, this should include: • Sprinkler/detector RTI for both fast and standard response heads; • Radial distance from fire source to sprinkler/detector; • Fire source location above floor level; and • Ceiling height	Noted and agreed. The FER will cover off these points in full.
Page 39 <i>AS 3 - Distance between alternative exits</i>	In principle support is provided subject to the analysis in the FER demonstrating compliance with the performance requirements of the NCC.	Noted

Page 43 AS 4 – <i>Utilizing lifts as part of the egress strategy for the tower</i>	In relation to the assessment proposed FRNSW have the following general concerns and recommend the following should be addressed: 1. All issues raised in the ABCB Handbook: Lifts Used during Evacuation (2013) should be addressed by the assessment. 2. EP2.2 should be addressed as the lifts shaft is considered part of the path of travel to an exit. 3. The assessment of the corridor smoke exhaust system is recommended to demonstrate that conditions within the corridor will be maintained to enable the lobby area to be used as a refuge during evacuation. 4. High Temperature and Lift Reliability: Lifts are intended to operate in temperatures of up to 40°C. Above 40°C, the reliability of lift equipment may be reduced, which increases the likelihood of malfunction. This is acknowledged in NCC BCA Spec E3.1 Part 4(a), European Lift Standard EN81-1:1998 Section 0.3.15 and Section 6.4.6, as referenced by AS1735.1-2003 Section A1. 5. Lift Capability: FRNSW recommend that confirmation should be provided by the lift manufacturer (and service provider) that the Alternative Solution is feasible. This confirmation should be provided to FRNSW as part of the FER. 6. Occupant Behaviour: The assessment is recommended to provide detail on how access to the lifts will be managed during evacuation. The assessment should address occupant behaviours (e.g. panic) which may be detrimental to the operation of the lift. For example, overloading and doors being held open for extended duration causes lifts to go into fault mode and shut down 7. Shut Down Procedure: The assessment should consider trapped occupants within the lift, as a result of shut down. 8. Management procedures for lift evacuation should be detailed in the FER.	Noted. FRNSW's concerns in relation to this solution will be addressed in full at the FER stage of works.
Page 47 AS 5 - Discharge of final exits	In principle support is provided subject to the analysis in the FER demonstrating compliance with the performance requirements of the NCC.	Noted

Page 48 AS 6 – <i>Aggregate egress widths from Levels 5 and 7</i>	Please confirm whether the egress width of the escalators has been included in the proposed egress width in the table below.	WSP can confirm that the egress width available to Level 5 includes the width of the escalators to arrive at the final figure (10 m). This information will be better reflected in the final FER document.
Page 49 AS 6 – <i>Aggregate egress widths from Levels 5 and 7</i>	Please see previous comments regarding the training of staff in the operation of escalators in fire alarm.	Noted
Page 50 AS 6 – <i>Aggregate egress widths from Levels 5 and 7</i>	FRNSW recommends this assumption be quantified to demonstrate that occupants are not exposed to untenable conditions during queuing.	Noted – however given Level 5 and 7 are both external spaces which are open to atmosphere, this is not deemed a risk.
Page 51 AS 7 – <i>Protection of openings in adjoining compartments</i>	Since the locations and distances of the subject openings have not been detailed FRNSW do not support the qualitative assessment presented. FRNSW recommends the assessment be quantified to demonstrate compliance with CP2. FRNSW recommends the above be quantified to demonstrate that fire spread will not occur for the fire scenarios. FRNSW recommends the assessment specify what and how the fuel load restrictions will be implemented.	Noted. Comments will be addressed at FER stage.
Page 54 AS 8 – <i>Retail units served by a single exit</i>	In principle support is provided subject to the analysis in the FER demonstrating compliance with the performance requirements of the NCC.	Noted
Page 58 AS 9 – <i>Community/Neighbourhood Centre</i>	FRNSW recommends the fire curtain be listed as a Critical Fire Safety Measure on the Fire Safety Schedule to be tested a minimum of every 3 months.	Noted. Comment will be addressed at FER stage.

Based on the information provided, FRNSW do not support the proposed design for the following reasons;

- The 'unassisted pressure' provided to level 3 would be significantly less than the required 700 kPa.
- It is unclear how level 4 is served by the proposed hydrant system.
- An inappropriate level of redundancy is provided within the design. For example, should the pumps on level 5 fail, FRNSW would be unable to boost the upper levels of zone 2. Similarly, with the failure of the pumps on level 41 FRNSW would be unable to boost the upper levels.

With consideration to the comments above and to ensure an appropriate level of redundancy to the system the following comments are offered;

Where a building has an effective height greater than 50 m, tank(s) shall be provided. The tank(s) shall—

- (a) be capable of providing the minimum required firefighting flow rate for not less than 30 min;
- (b) be capable of providing the required pressures either assisted (with pumps) or unassisted without pumps;
- (c) be taken into consideration when determining the required 4 h water supply where the tank serves as a reduced capacity tank with automatic inflow; and
- (d) not be taken into consideration when determining the capacity of the primary water supply unless the tank(s) serves as a reduced capacity tank(s) and is provided with automatic inflow from another water source.

Where a building incorporates more than three above-ground pressure zones, supply to the pressure zones above 135 m shall be from a high-rise tank located at or near the top of the uppermost pressure zone and intermediate tanks as required to ensure the maximum pressure in the supply pipework does not exceed 2400 kPa in accordance with Clause 2.3.2 and the pressure zone limits in Clause 8.12 are complied with.

Without adequate water supply from storage on the roof, FRNSW are unable to supply water to floors above 135m in the event of pump failure. Gravity fed systems are considered more reliable and are recommended in this instance.

Noted, responses in relation to these comments as following:

- Level 3 is fed directly from town main. As long as 250 kPa is achieved, this is DtS compliant.
- Level 4 does not exist in the building (4 is an unlucky number so is omitted from building)
- Noted. Design will consider this point and be revised accordingly.

Noted. Design to be revised to incorporate a roof top tank with pumps for redundancy as per the comments made here.

Noted. Refer bullet point response above re tank and pumps.

Noted. A rooftop tank will be incorporated in the design to address this concern.

	FRNSW recommends that the location of the booster connection for the proposed tower be clarified in any future submissions.	Noted. To be addressed at FER stage
Page 65 AS 11 – <i>Fire hydrant coverage to Level 5 areas</i>	Two lengths of charged lines are far heavier and difficult to drag and manoeuvre than one length. There appears to be no alternative solution presented for mid landing valves. FRNSW recommends that illustrations be provided as part of the assessment.	Noted. Noted, to be addressed at FER stage
Page 66 AS 11 – <i>Fire hydrant coverage to Level 5 areas</i>	FRNSW do not support the alternative solution. Given the difficulty in manoeuvring two lengths of charged lines and as supplementary (additional) hydrant valves are required in any case, FRNSW recommends that hydrant coverage be designed on the compliant 30 plus 10m coverage. FRNSW recommends that where additional hydrants (as per Clause 3.2.3.3 of AS2419.1-2005) are proposed, floor specific block plans (minimum A3 in size) should be installed adjacent to the internal fire hydrants located within the fire isolated stairwells. The sole purpose of these floor specific block plans is to assist fire-fighters to locate the additional internal hydrants on that level. The floor specific block plans should be permanently mounted and oriented in such a manner so as to reflect the aspect of the installation as it is presented to the reader and be incorporated into the fire safety schedule.	Noted. Solution will be removed from Mod 13 design unless full floor coverage can be provided solely from fire stair landing valves and we can demonstrate that the use of two hose lengths will be of benefit to Brigade intervention.
Page 69 AS 12 – <i>Omission of Fire Hose Reels</i>	In principle support is provided subject to the analysis in the FER demonstrating compliance with the performance requirements of the NCC.	Noted

Page 73 AS 13 – <i>Water mist within the basement car stacker</i>	FRNSW recommends the water mist system zoning (with the use of flow switches) should be considered in conjunction with fire brigade access points to enable accurate identification of the location of the fire and appropriate access point. The structural stability of the automated racking machinery should be assessed in conjunction with a Fire Brigade Intervention Model (FBIM). Power isolation and automatic shutdown procedures should be clearly defined, including whether the car stacker will finish the racking cycle prior to shutdown. FRNSW recommends that shutdown occur after the car in transit is located to an area of adequate sprinkler coverage.	Noted. To be incorporated in final design. Noted. To be incorporated in final design. Noted. To be incorporated in final design.
Page 78 AS 14 – <i>Access to fire control room</i>	In principle support is provided subject to the analysis in the FER demonstrating compliance with the performance requirements of the NCC. FRNSW recommends copies of the fire service block plans be provided with the mimic panel.	Noted – report updated to suit.
Page 88 AS 15 – <i>Performance based smoke control and egress provisions</i>	Please clarify is the above is for both Class 2 and 3 SOUs. Is detection in accordance with AS1670.1-2015 provided to Class 2 SOUs or to common areas only?	Refer comments in relation to Page 19
Page 91 AS 15 – <i>Performance based smoke control and egress provisions</i>	In principle support is provided subject to all analysis inputs and assumptions being detailed in the FER and agreed upon by all relevant stakeholders, and the analysis demonstrating compliance with the Performance Requirements of the NCC.	Noted and agreed.
Page 94 AS 16 – <i>Performance based alarm configuration for Class 3 SOUs</i>	In principle support is provided subject to the analysis in the FER demonstrating compliance with the performance requirements of the NCC.	Noted.