Macquarie Telecom Intellicentre 3 West (IC3 Super West)
17-23 Talavera Road North Ryde NSW

Performance Based Design (Fire) Strategy

Prepared For:

Macquarie Telecom Pty Ltd c/- Giddis Project Management
Report No. 21159-R01
Issue No. 4
Issue Date: 26 October 2022

INNOVA FIRE SAFETY SPECIALISTS

QUALITY SYSTEM

Report Register

Reference	Remarks	Date	Prepared By
21159-R01-01	Initial issue	21 October 2021	TDD
21159-R01-02	Revised issue incorporating DPIE feedback	7 February 2022	TDD
21159-R01-03	Update for new architectural scheme	10 October 2022	TDD
21159-R01-04	Minor modifications relating to design development	26 October 2022	TDD

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1.0 EXECUTIVE SUMMARY

This Fire Safety Strategy has been prepared by Innova Services Australia (ISA) Pty Ltd for Macquarie Telecom Group Pty Ltd and relates to construction of Intellicentre 3 West Data Centre, located at 17-23 Talavera Road, Macquarie Park NSW 2113.

ISA has been commissioned to prepare a preliminary fire safety strategy to provide confidence to project stakeholders that the documentation being readied for issuance of the planning permit is capable of achieving compliance with the National Construction Code (NCC) Building Code of Australia 2022 (BCA).

The design has been observed to exhibit a number of non-conformances with the prescriptive provisions of the BCA. Subsequently, it will be necessary for the method of compliance with the building regulations to incorporate a Performance Based approach as supported by the NCC BCA.

ISA have reviewed the architectural design drawings and proposes a fire safety strategy that relies on active and passive measures to maintain levels of safety for occupants and fire fighters for consideration.

We can confirm that based on the strategy documented herein, that an assessment can be undertaken by a C10 Accredited Fire Engineer in consultation with project stakeholders (including the Principal Certifying Authority), to demonstrate that the building will comply with the Performance Requirements of the BCA. This may be via a combination of the following:

- Becoming Deemed-to-Satisfy by way of design development.
- Comparison to the BCA Deemed-to-Satisfy Provisions to demonstrate equivalence.
- Compliance with the BCA Performance Requirements.

It is considered that the preparation of the Performance Solutions and corresponding fire safety measures that are likely to be documented therein will not result in significant changes to the building design presented in the schematic drawings reviewed for the feasibility stage and planning permit.

2.0 INTRODUCTION

2.1 GENERAL

The areas of departure from the Deemed-to-Satisfy (DtS) provisions of the Building Code of Australia (BCA) identified for the building are related to:

- Type of Construction
- Fire separation
- Compartmentation
- Egress
- Smoke hazard management
- Special Hazards

The preliminary fire safety strategy documented in this report has been developed with the intent of commencing the process that is necessary in order to meet the Performance Requirements of the BCA.

Achievement of compliance with the Performance Requirements is dependent on documentation of a Performance Based Design Brief and Fire Engineering Report that is presented to all stakeholders and approved by the Authority Having Jurisdiction. This occurs post planning approval and as such has not yet been undertaken. Subsequently, the contents documented herein is subject to further refinement and definition as it is resolved to satisfy stakeholder needs and requirements.

2.2 PURPOSE OF REPORT

The purpose of this report is to document the currently identified departures from the DtS provisions of the BCA that are proposed to be satisfied by way of a Performance Solution and to identify the fire safety features that are considered to be required in order to achieve compliance with the relevant Performance Requirements of the BCA.

Demonstration that this design achieves compliance with the relevant Performance Requirements of the BCA will be undertaken as part of the fire engineering assessment at a later date.

2.3 SCOPE OF REPORT

The scope of this report is limited to the specification of a Trial Design for the departures from the DtS provisions of the NCC BCA identified herein.

This preliminary fire safety strategy does not consider potential property damage to the building. The strategy has been developed based on the objectives of the BCA being that of:

- Occupant life safety;
- Facilitate fire brigade intervention; and
- Protection of adjoining property.

Being consistent with the objectives and limitations of the BCA means that the effects of arson (e.g., from multiple fire starts), terrorism, explosive devices, use of accelerants, and sabotage of fire safety systems and equipment are considered outside the scope of this report. If there is a heightened risk of these events due to the nature of the facility those concerns should be identified during developed of the Performance Based Design Brief.

'Absolute' or '100%' safety is not attainable, and there will always be a finite risk of injury, death or property loss. Also, fire and its effects on people and property are complex and variable. Thus, all stakeholders should understand that a fire safety system may not effectively cope with all possible scenarios.

2.4 BASIS OF REPORT

The content of this Report is based on the following documentation:

- National Construction Code (NCC) Building Code of Australia 2019, Volume 1 Amendment 1.
- National Construction Code (NCC) Building Code of Australia 2022 Volume 1.
- *NSW Environmental Planning & Assessment Act 1979.*
- *NSW Environmental Planning & Assessment Regulation 2021.*
- Australian Fire Engineering Guidelines, 2021 Edition.
- International Fire Engineering Guidelines, 2005 Edition.
- Guide to the BCA 2019 Amendment 1, ABCB.
- Architectural plans prepared by HDR Architects Pty Ltd.
- Preliminary BCA Assessment prepared by Modern Building Certifiers Pty Ltd.

2.5 EXCLUSIONS

This Report does NOT cover the following:

- A detailed BCA assessment of the development.
- Access for people with disabilities (Part D3 of the BCA).
- System or engineering design of any part of the development.
- Operational checks of fire safety equipment, verification of construction techniques, fire resistance levels or the witnessing of fire drills.
- Compliance or conformance audit for any fire safety system inside the subject development.
- Arson (other than as a source of initial ignition), multiple ignition sources, acts of terrorism.
- Protection of property (other than adjoining property).
- Business interruption or losses or personal or moral obligations of the owner / occupier.
- Occupational Health and Safety, and Work Cover Authority Regulations.
- Fire Safety Study, dangerous goods storage, or emergency planning for the subject development

2.6 ASSUMPTIONS AND LIMITATIONS

This strategy is preliminary only and all parameters suggested herein are subject to detailed analysis and consultation with stakeholders during the Performance Based Design Brief process.

Demonstration that the specified preliminary performance based (fire) strategy for the building will comply with the identified Performance Requirements will be the subject of a fire engineering assessment to be undertaken later, using fire safety engineering methodologies in accordance with the Australian and International Fire Engineering Guidelines.

Should the assessment reveal that the proposed systems do not satisfy the performance criteria, additional fire safety systems or modifications to the trial design followed by further assessment would be required.

All of the fire safety systems are assumed to operate as designed unless specifically stated otherwise.

With the exception of the departures from the DtS provisions identified herein, it is assumed that the remainder of the building works will otherwise comply with the fire safety DtS provisions of the BCA.

This strategy is only applicable to the completed building, and is not suitable, unless approved otherwise, to the building in a staged handover.

2.7 REGULATORY FRAMEWORK

Compliance with the BCA is achieved by satisfying the Performance Requirements. Clause A2.1 of the BCA states that the Performance Requirements can be satisfied by:

1. *Performance Solution; or*
2. *Deemed-to-Satisfy Solution; or*
3. *a combination of (1) and (2).*

Clause A2.2(1) of the BCA states that a Performance Solution is achieved by demonstrating:

(a) compliance with all relevant Performance Requirements; or

(b) the solution is at least equivalent to the Deemed-to-Satisfy Provisions,

Clause A2.2(2) of the BCA states that a Performance Solution must be shown to comply with the relevant Performance Requirements through one or a combination of the following Assessment Methods:

(a) Evidence of suitability in accordance with Part A5 that shows the use of a material, product, plumbing and drainage product, form of construction or design meets the relevant Performance Requirements.

(b) A Verification Method including the following -

(i) the Verification Methods in the NCC; or

(ii) Other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements.

(c) Expert judgment.

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

Clause A2.2(3) of the BCA states Where a Performance Requirement is satisfied entirely by a Performance Solution, in order to comply with (1) the following method must be used to determine the Performance Requirement or Performance Requirements:

(a) Identify the relevant Performance Requirements from the Section or Part to which the Performance Solution applies.

(b) Identify Performance Requirements from other Sections or Parts that are relevant to any aspects of the Performance Solution proposed or that are affected by the application of the Performance Solution.

Clause A2.2(4) of the BCA states Where a Performance Solution is proposed to be satisfied by a Performance Solution, the following steps must be undertaken:

(a) Prepare a performance-based design brief in consultation with relevant stakeholders.

(b) Carry out analysis, using one or more of the Assessment Methods listed in (2), as proposed by the performance-based design brief.

(c) Evaluate results from (b) against the acceptance criteria in the performance-based design brief.

(d) Prepare a final report that includes-

(i) All Performance Requirements and/or Deemed-to-Satisfy Provisions identified through A2.2(3) or A2.4(3) as applicable; and

(ii) Identification of all Assessment Methods used; and

(iii) Details of step (a) to (c); and

(iv) Confirmation that the Performance Requirement has been met; and

(v) Details of conditions or limitations, if any exist regarding the Performance Solution.

2.8 PROJECT STAKEHOLDERS

The relevant project stakeholders for the development are listed in Table 1.

Table 1: Project Stakeholders

Name	Company	Role
Matt Giddy James Edwards	Giddis Project Management Pty Ltd	Client Representative
Paul Christensen	Macquarie Telecom Pty Ltd	Owner / End-User Representative
David McKay Cathal McLogan	HDR Pty Ltd	Architect
Jamie Guajardo		Fire Protection Services
Eric Bailey	Modern Building Certifiers Pty Ltd	Principal Certifying Authority
Heath McNab Rebecca Kilty		BCA Consultant
	Fire & Rescue NSW	Referral Agency
Trent De Maria	Innova Services Australia Pty Ltd	Fire Safety Engineer

3.0 DEVELOPMENT DESCRIPTION

3.1 GENERAL LAYOUT AND CONSTRUCTION

The site is located at 17-23 Talavera Road North Ryde NSW, approximately 15 km northwest of the Sydney central business district.

It is legally described as Lot 527 in DP752035.

The allotment sits on the southern side of the road and is rectangular in shape. It has frontage to Talavera Road and vehicle access is provided from that roadway via an internal access road that circumnavigates the building.

An existing data centre stands on the allotment with on grade car parking.

The remaining boundaries are bound by commercial premises to the east, west and south.

Figure 1: Existing building as viewed from Talavera Road (Source: Google Maps)

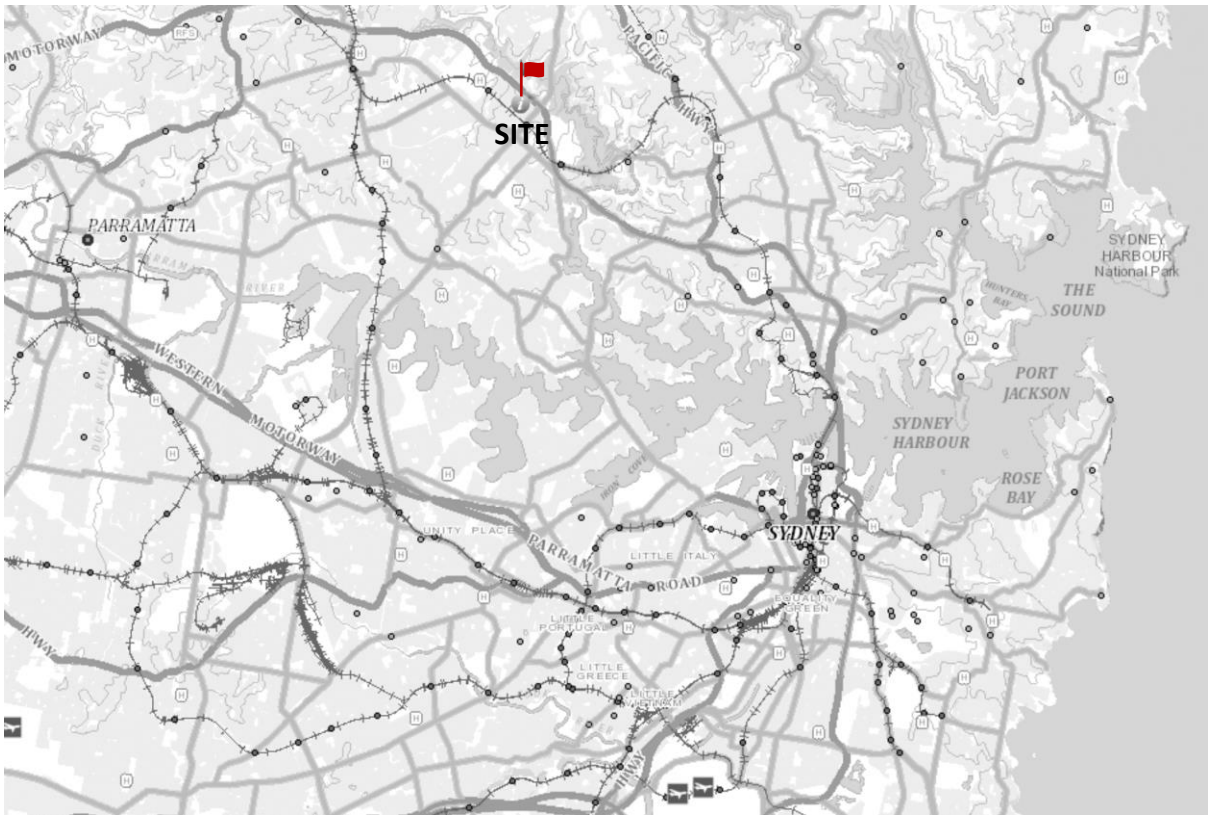

Figure 2: Locality Plan

This report relates to construction of Intellicentre 3 West, known as IC3 Super West (IC3W).

Figure 3: Northern Elevation (Source: HDR)

IC3W proposes the construction of a seven (7) storey addition to the existing united building for the purpose of accommodating a high-tech industrial use, landscaping, car parking, and associated infrastructure.

Figure 4: Artist's impression (Source: HDR)

IC3W is connected to the existing six (6) storey portion of IC3, known as IC3 East (IC3E). IC3 is connected to IC2, however considered separated for the purposes of Parts C, D and E of the BCA due to the existence of a fire wall compliant with Clause C2.7 of the BCA.

IC3W occupies the western portion of the allotment, abutting the existing building to the north - IC2 and the west of IC3E, as seen in Figure 5.

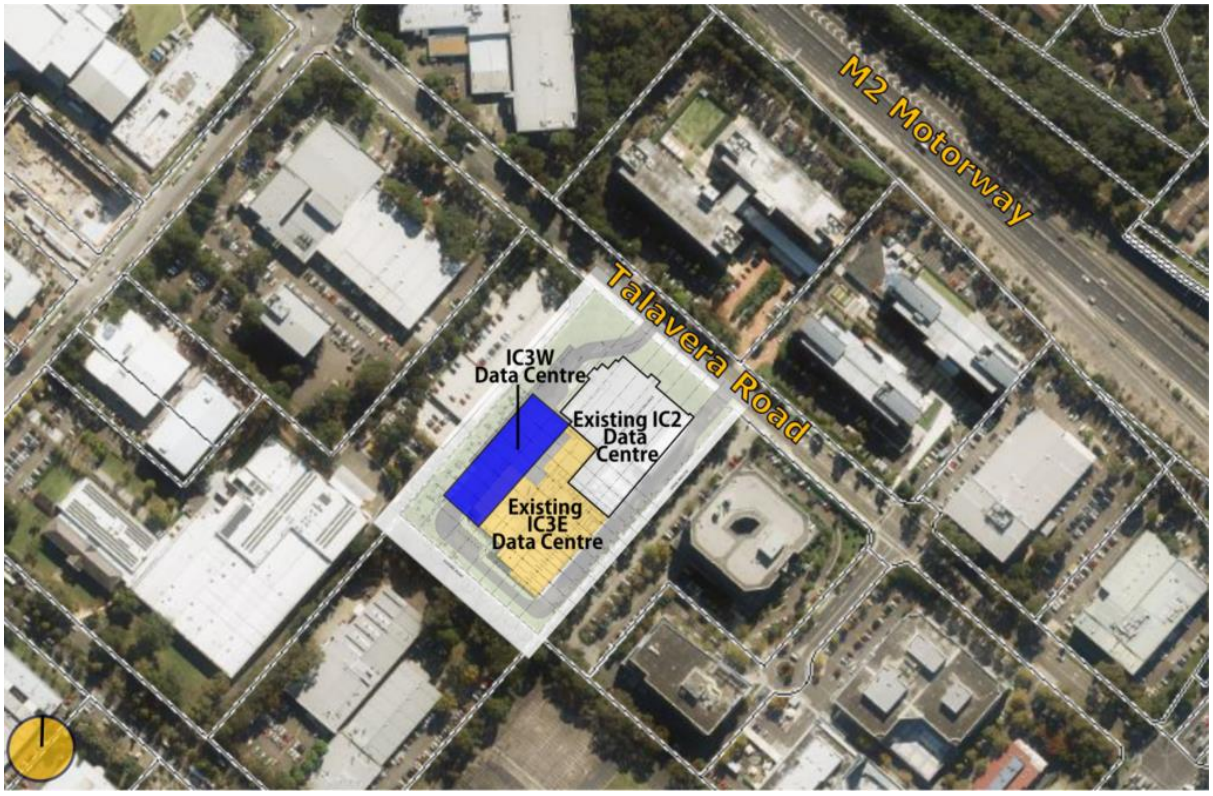

Figure 5: Aerial view (Image from www.sixmaps.nsw.gov.au)

Figure 6: Separation of IC2, IC3E and IC3W

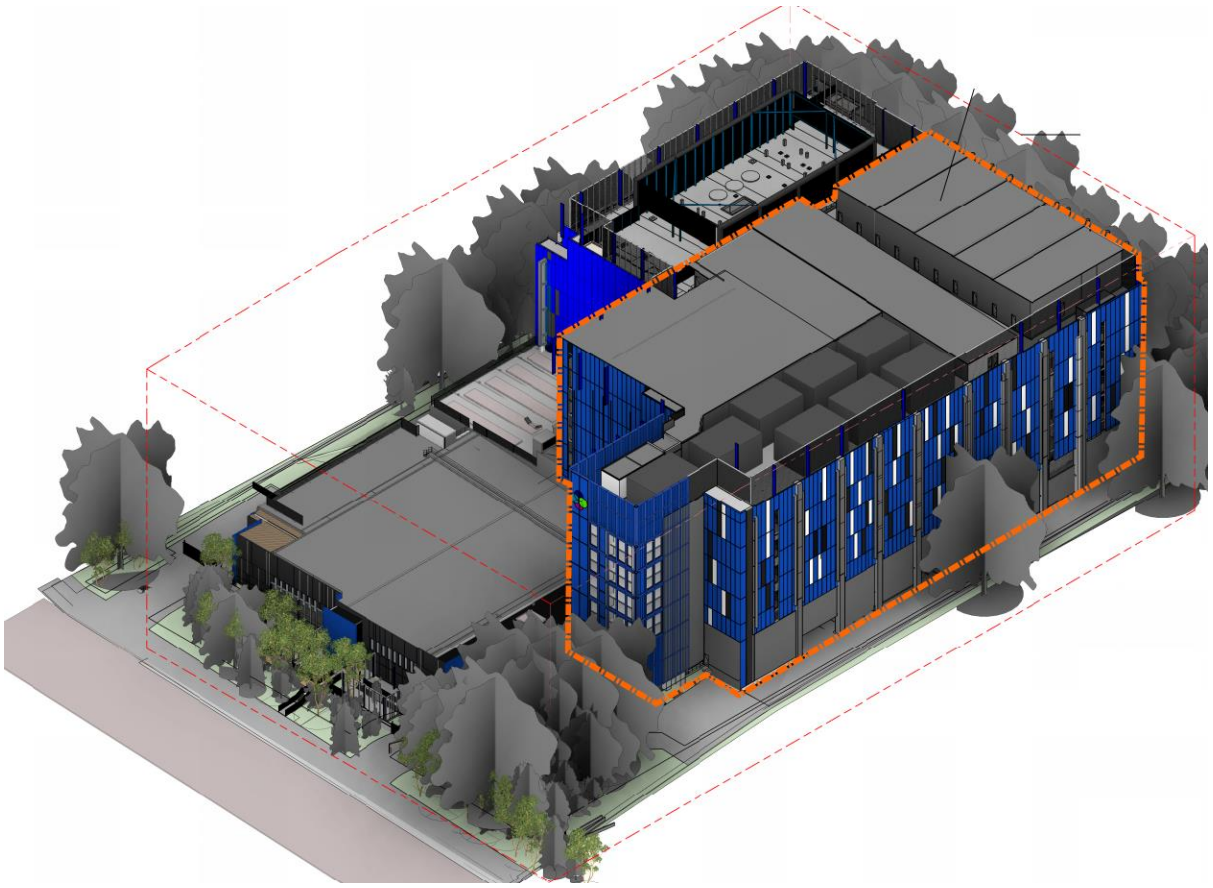

Figure 7: Perspective view. New building outlined (Source: HDR).

Egress from the building is facilitated by fire isolated exits and external stairs that discharge direct to open space and fire isolated stairs from the floors above which discharge to open space.

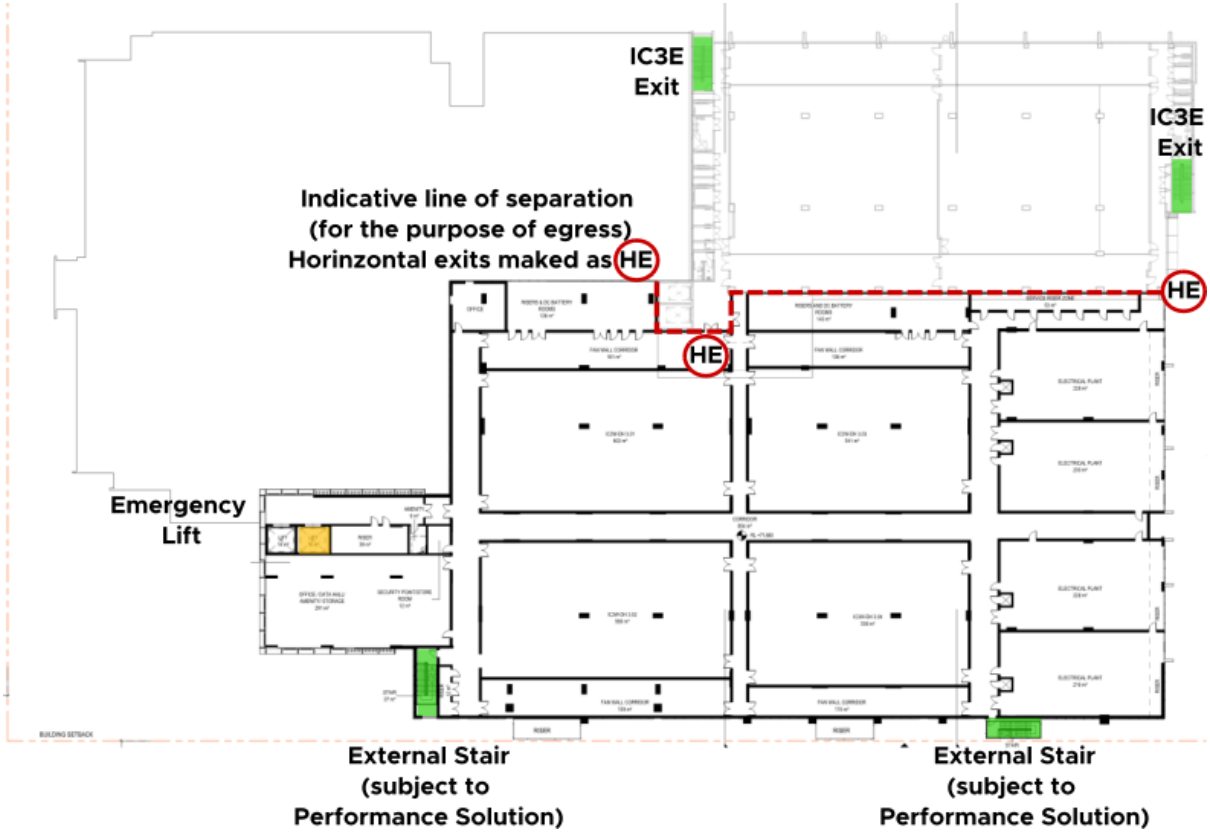

Figure 8: Level 3 Preliminary Egress Arrangement

Throughout the building the data protection requirements result in the construction of a number of non-required horizontal exits due to the bounding construction provided.

In other words, each data hall, and critical infrastructure and equipment is separated from the remainder of the floor plate by fire rated construction (this includes 120/120/120 (or -/120/120 fire walls, and 240/240/240 slabs and columns). This allows for occupants to pass from one compartment to the next.

Access throughout the building is also provided vertically by way of a bank of two (2) lifts access from the lobby on the western side of the building.

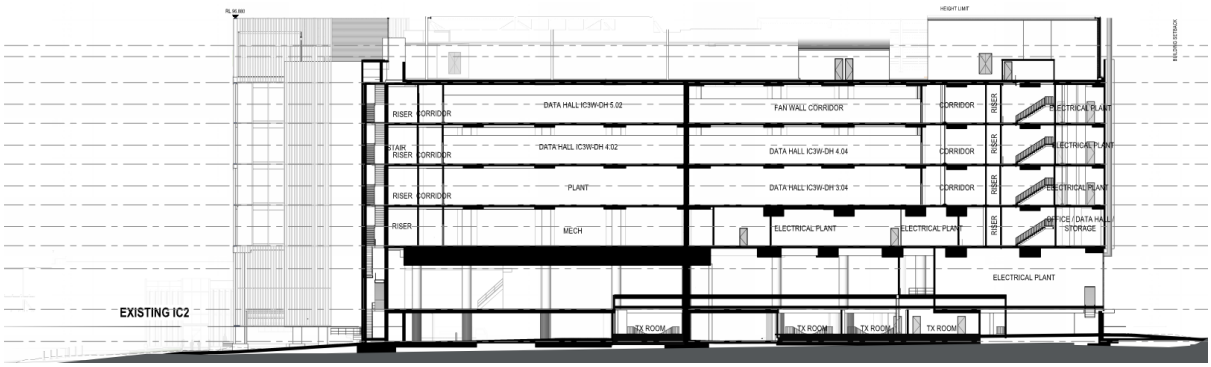

Figure 9: North-South Section

The building is provided with access for emergency appliances and vehicles around its perimeter. Perimeter access is subject to a Performance Solution, as a result of the proximity of the building overhang along the western façade.

The fire hydrant booster assembly is located on Talavera Road, and the sprinkler booster and suction point is located on the opposing side of the driveway (refer to Figure 12). Connection to the sprinkler booster hard suction is facilitated by appliance parking space adjacent to the sprinkler pump room on the road (refer to Figure 12).

The works include supplying hydrant supply at 30 litres/second with tank capacities of 270,000 litres (hydrant – with quick infill) plus 85,000 litres (sprinkler) with FM Global approved pumpsets (conforming with the requirements of Datasheet DS.3-7). The sprinkler system to each storey and each data is separately valved. The roof level generators are provided with AS 4587 (of NFPA equivalent) mist suppression system, with separate water supply sized to allow for operation of two (2) system activations i.e. 2 of 10 systems operating simultaneously.

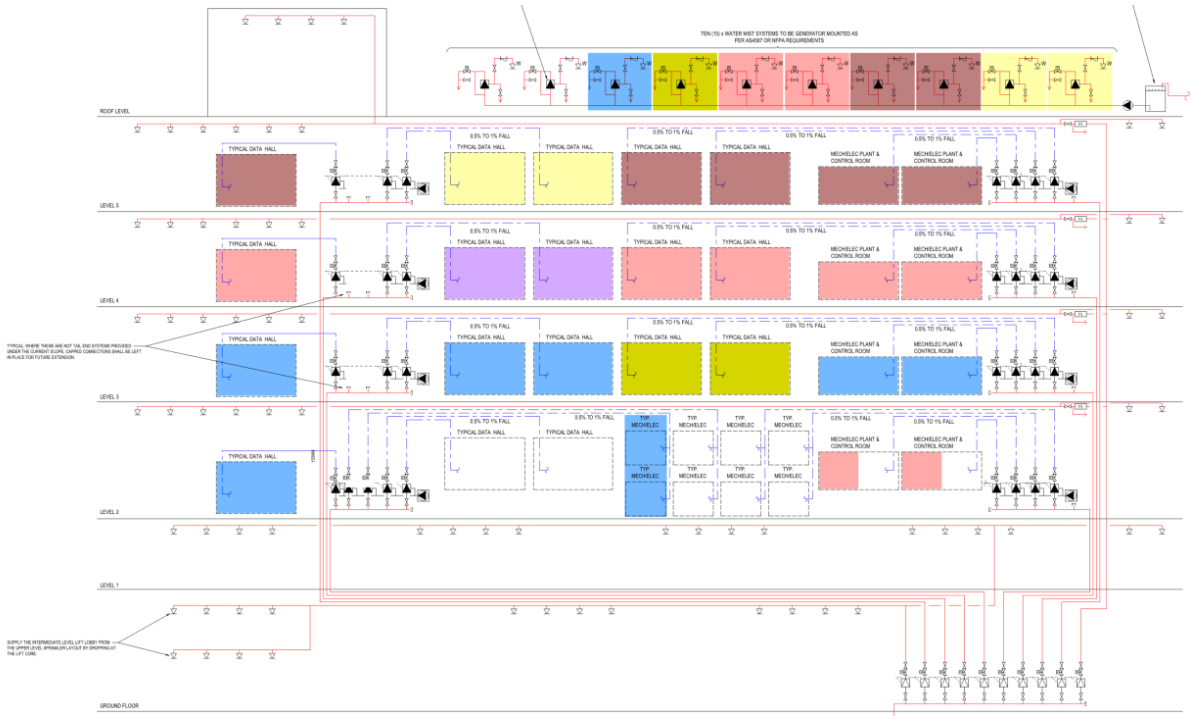

Figure 10: Sprinkler Schematic

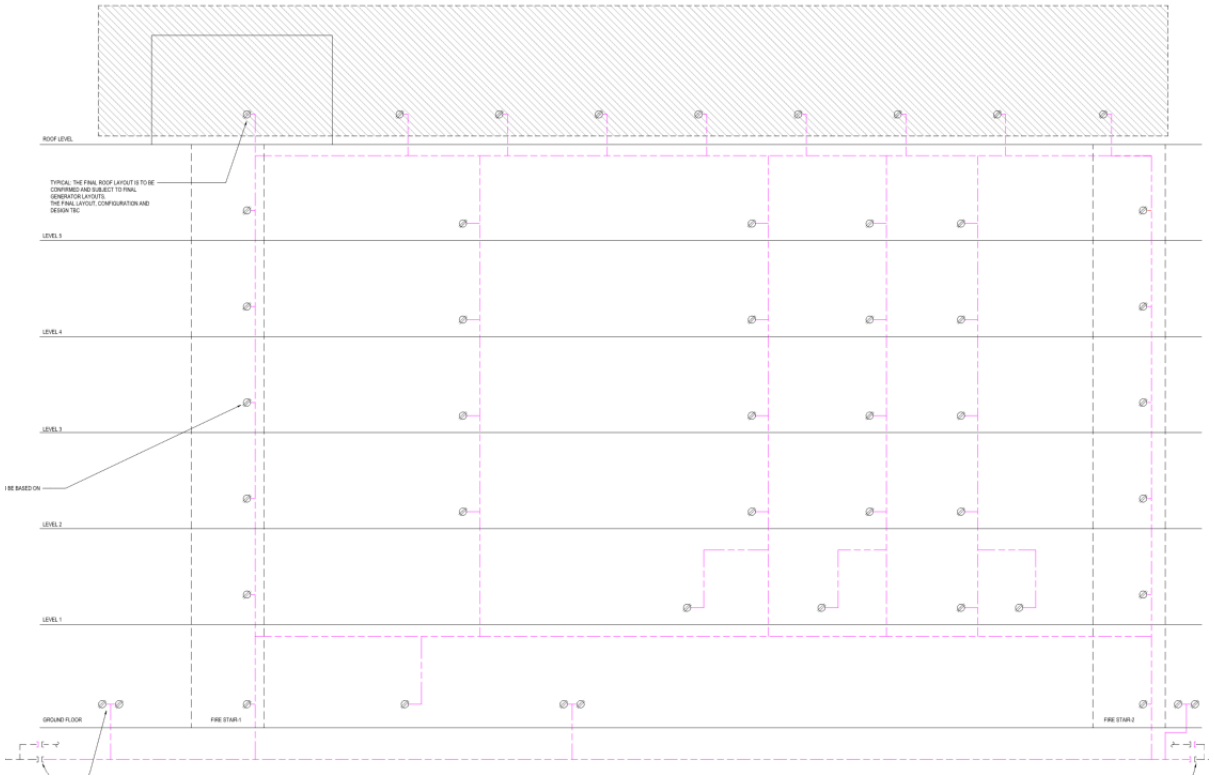

Figure 11: Hydrant Schematic

A main fire indicator panel and a fire fan control panel will be located in a fire control centre on the western side of the building (refer to Figure 12). This is the main entry to the building.

Figure 12: Location of Fire Brigade Infrastructure

It is expected that the fire brigade will react to a call in a timely manner with notification occurring via direct monitored alarm. Based on the response time data from the fire brigade and the Fire Brigade Intervention Model, it is suggested that the following activities generally outline the likely timing of the Fire Brigade's response.

1. *Time for notification and travel to site*

   The closest fire stations (© 2019 Google) are as considered to be:

   - Ryde Fire Station (216-218 Blaxland Road Ryde); and
   - Gordon Fire Station (966 Pacific Highway Gordon).

   Whilst the response time obviously depends on the distance to the building from the fire station and the density of traffic. It can be seen from the FRNSW Annual Report (2016/2017) that the 50th percentile response time is around 7 minutes and the 90th percentile is less than 12 minutes. As the building contains sprinklers the 90th percentile response time is adopted.

2. *Locate an appliance adjacent to booster connections*

   The boosting of the fire-fighting water supply is important to ensure that there is adequate flow and pressure and is normally undertaken by one of the responding appliances. This activity is related to 5 and 6 and can be considered to occur independently of the other activities.

3. *Dismount vehicle and put on breathing apparatus and prepare for activities*

   This is estimated as being typically between 2—3 minutes.

4. *Enter building to FIP*

   This time can be short (e.g. 60 secs) as the location of the FIP in relation to the vehicular entrance to the site is considered to be readily apparent. There will also be interaction between security staff and the fire brigade and it is likely that the staff will initially have a better understanding of the location of the fire.

5. *Remove, connect and charge 65 mm hose from hydrant to appliance*

   See comment under 6

6. *Remove, connect and charge 65mm hose from appliance to boosters*

   Estimated elapsed time for Tasks 2 and 5 is between 3—4 minutes.

7. *Gather information from FIP and tactical fire plans*

   This is when the Officer-in-Charge (OIC) considers the available information and directs crews. It is estimated as taking up to 2 minutes and is improved by the presence of staff.

8. *Travel to set-up area with equipment (hose lines etc.)*

   This is a function of the distance to the fire area and whether it is on ground level or the levels above. Assuming a fire on the top most level the estimated travel time is ~230 seconds (~150 metres a 0.65 m/s)

9. *Connect and charge hose lines*

   Connection, layout and charging of hose lines is estimated to take about two minutes.

10. Gather additional information and provide feedback

This action (by the OIC) is aimed at providing additional information in relation to the best strategy for fighting the fire and takes place concurrently with the first application of water.

Table 2: Time to supply water to the fire

Activity	Activity time (secs)	Elapsed time (secs)
1. Time for notification and travel to site	720	720
2. Locate an appliance adjacent to booster connections	Included in activity 6.	-
3. Dismount vehicle and put on breathing apparatus and prepare	120	840
4. Enter building to FIP.	60	900
5. Remove, connect and charge 65 mm hose from hydrant to appliance (included in 6. Below)	Included in activity 6.	-
6. Remove, connect and charge 65mm hose from appliance to boosters	240	1,140
7. Gather information from FIP and tactical fire plans	120	1,260
8. Travel to set-up area with equipment (hose lines etc.)	230	1,490
9. Connect and charge hose lines	120	1,610
10. Gather further information and feedback	Ongoing	-
Total	-	26 minutes 50 seconds

In summary, from the time of alarm approximately 27 minutes will elapse before fire fighters are in a position where they may direct water onto the fire. If staff offer support in terms of direction, it is possible that the above times could be reduced.

3.2 BCA Assessment Data

The classifying information from the NCC BCA that is used for the identification of the BCA DtS provisions and Performance Requirements that are applicable to the building are summarised in Table 3.

Table 3: Relevant BCA Assessment Data

BCA Reference	BCA Assessment
Classification	Class 5 (Office) Class 7a (carpark) Class 7b (storage)
Rise in Storeys	Seven (7) (tbc)
No. of Levels Contained	Seven (7) (tbc) The inclusion of the three (3) office mezzanine levels may increase the number of levels contained by the same.
Minimum Type of Construction Required	Type A
Effective Height	34.93 m (Level 06 RL 88.16 – Ground Level RL 53.23)
Compartment Area	~32,159 m^2

4.0 DOMINANT OCCUPANT CHARACTERISTICS

4.1 POPULATION AND DISTRIBUTION

The building occupants will comprise of staff and visitors.

The data halls will generally be unoccupied except during fitout and/or maintenance. During occupation it is likely that maintenance personnel and contractors will be present.

Only the office areas will have a permanent staff presence.

The population level can be calculated by using the population densities in Table D1.13 of the Building Code of Australia (NCC Vol. 1), or via any other suitable means of assessing its capacity (Clause D1.13(c)). The population density is assumed to be based on information provided by the client, as permitted by Clause D1.13 of the BCA.

The prescribed occupant levels reported in the BCA Report by MBC Group assume a total of 1,071 people with the maximum population on any floor being taken as 187 (assumed for the rooftop). This is not expected. Despite this, until otherwise confirmed by the client the documented population levels are assumed.

4.2 STATE, PHYSICAL AND MENTAL ATTRIBUTES

The staff profile will be that of working age adults with no expected skew in relation to gender, age or physical attributes. Staff are likely to be awake and generally unaffected by drugs and/or alcohol during occupied hours. Staff members are also expected to require minimal response time in the event of an emergency.

Similarly, visitors to the warehouse and/or office and areas are expected to be awake and have a range of physical attributes as would be displayed by the general public.

External contractors are expected to be mobile with normal hearing and visual abilities and occupants in this group are considered to take and implement decisions independently and require minimal assistance during evacuation in a fire emergency. The contractors are always expected to be awake and generally aware of their surroundings when inside the building.

Fire fighters are expected to be equipped with safety equipment and will be educated in firefighting activities and the dangers associated with fire incidents. This occupant group would be expected to be able to assist other occupants requiring assistance to evacuate. It is not expected that fire fighters would be present in the building at the time of fire ignition; however, they are expected to enter the building at a later stage to assist with the evacuation of occupants, if required, and to undertake fire suppression activities.

4.3 FAMILIARITY WITH THE BUILDING

Staff are expected to be familiar with the building layout and the location of exits. Whilst other occupants are expected to be generally familiar with the building layout and the location of exits that they utilized on entry to the building.

Visitors to the development are not considered to be familiar with the overall site and building layout, however, site visitors are generally expected to be accompanied by staff, and wayfinding within the building is straightforward.

Despite this, due to there being clear sightlines between exits or along corridors, the relatively straight line of sight between exits with minimal directional changes, wayfinding is not considered to be complex.

The provision of exit signage is expected to assist occupants identify the location of the exits, and the path of travel to the exits.

4.4 LEVEL OF ASSISTANCE AND EMERGENCY TRAINING

Fire wardens are expected to be present - though they may not be present on each floor plate at all times - as required by the Workplace Health and Safety legislation enforced by the State, i.e. emergency management planning in accordance with AS 3745.

Wardens are expected to have received at least some level of fire safety training which may include the use of first aid firefighting equipment. But most of the occupants are not assumed to have received fire safety training or training to use first aid fire-fighting equipment such as fire hose reels and portable fire extinguishers.

4.5 PERSONS WITH DISABILITIES

The data halls shall be subject of an exemption under Clause D3.4. It shall be demonstrated that the area or function of the space is inappropriate and or would pose a health or safety risk to persons with a disability. This shall be supported by a statement from an accredited access consultant.

Despite this, it is not unexpected that there will exceptions occasionally for disabled persons or alternatively that a proportion of the population in the office and administration areas may be impaired (cognitively and/or physically) or will present some level of limitation related to injury, illness poor health, or other medical conditions.

Those people that are affected by a disability are more likely to require a greater preparation time before moving. Their movement will be significantly influenced by the nature of their disability and specific building elements such as doors, ramps and stairs. These factors are considered in the assessment of movement time, where that movement time is quantified.

It is sensible and appropriate to assume that employees will have been assessed as being fit for duty and the relevant tasks that they are undertaking (as a WHS employer obligation), and therefore will also be capable of responding appropriately in the event of an emergency. Those occupants with physical or cognitive disabilities which render them unable to evacuate of their own volition are expected to be assisted by able-bodied carers or staff. Management of the evacuation of these occupants relies on management systems, procedures and training, all of which are outside the scope of the BCA, but can substantially contribute to the overall evacuation efficiency of the building.

Subsequently, egress for occupants with a disability should be addressed in the emergency evacuation plan and management procedures developed.

5.0 HAZARD IDENTIFICATION

5.1 GENERAL

In identifying potential fire hazards, the following factors are considered:

- General building layout and construction
- Building activities
- Potential ignition sources
- Combustible contents

5.2 GENERAL BUILDING LAYOUT AND CONSTRUCTION

There are extended travel distances within the building.

However, these are mitigated by compartmentation of the building so as to provide safe refuges for horizontal evacuation.

The provision of aspirated smoke detection and sprinkler protection and the low occupant density, also reduces the risk.

Given the regular shape of the floor plate dead end corridors are minimised, and there will typically be good sightlines and clear wayfinding paths between exits.

The building is assumed to comply with the relevant provisions for Type A construction, except where addressed as a Performance Solution in this Report.

5.3 BUILDING ACTIVITIES

Given the nature of the building hazardous activities are likely to be performed by staff.

These activities include:

- Planned maintenance and repair work
- Unplanned maintenance and repair work
- Administrative activities
- Construction during fitout

These risks will be managed to the degree expected in any other development with scheduled and unscheduled maintenance of equipment and machinery, maintenance of workplace health and safety requirements and compliance with relevant statues for health, safety and fire compliance.

5.4 POTENTIAL IGNITION SOURCES AND AREAS OF FIRE ORIGIN

NFPA (Hall, 2012) reported the following ignition sources as the leading cause of fires in computer rooms and electronic equipment areas:

- Electronic equipment (~33%);
- Heating, ventilating or air conditioning equipment (~16%);
- Electrical distribution and lighting equipment (~29%); and
- Intentionally lit fires (~4%).

The risk of fires originating in digital equipment (servers, storage units) is low because there is little energy available to any fault and little combustible material within the equipment, especially when listed.

Some internal components run hot due to high component densities and fast clocking rates, with most of these mounted on heat sinks or other devices and some including individual fans to improve cooling.

In many cases, components are likely to incorporate on-board temperature measuring devices such as thermistors that can shut down the equipment before excessive temperatures cause the component to malfunction. Since these approaches would result in equipment shutdown before any fire could be ignited (if there was combustible material present), they help minimise fire risk.

In half the fires where the first ignited item is known and specified (that is, excluding unclassified items), wire or cable insulation is the first item ignited. It is reasonable to estimate that the insulation is usually part of the same equipment providing the heat source. Other leading items first ignited are examples of fixed combustibles (interior wall covering, structural member or framing) or moveable combustibles (papers) that may be located too close to overheated equipment. Appliance housings and casings could be part of the equipment that is the heat source or could be part of a portable device left too close to the equipment that is the heat source.

Other hazards include Lithium-ion (Li-ion) batteries.

IC3W is proposed to rely on ~203,400 kg of Li-ion batteries to provide a consistent power source to the site. The battery installation is expected to be developed in two stages, with the first stage containing a maximum battery storage capacity of 15 MVA and the second stage containing a maximum battery storage of 45 MVA. These Li-ion batteries are classified as Class 9 miscellaneous DGs as they may pose a risk of thermal runaway.

We know that Lithium-Ion batteries can pose severe risk if a cell begins to operate abnormally, resulting in an increase in temperature, which if not addressed could lead to a thermal runaway event. Thermal runaway would normally start in a single cell before thermal propagation creates a domino effect into adjacent cells, causing an increase in temperature in each of those cells.

One of the early warning signs of a problem is the production of off-gases, and if detected early enough can allow actions to be taken that may prevent such a catastrophic event.

Within the building a system is employed to monitor the batteries and detect these off-gases/toxic vapors in order to provide an early warning detection.

The system is seeking to detect the presence of off-gases, indicating the early stages of battery cell malfunction prior to thermal runaway. The system will communicate with the battery management system, to shut down the failing batteries and provide local and remote alarms to inform personnel and the local fire brigade.

In addition, the power supply is supplemented by 18 roof mounted containerised generators. Diesel (418,000 L) is stored in four (4) bulk tanks and eighteen (18) local day tanks in order to supply the generators with fuel. The diesel supply is stored in accordance with the relevant statutory requirements.

5.5 COMBUSTIBLE CONTENTS

The structural elements of the building (walls, floors, roofs, ceilings, beams, etc.) are non-combustible and therefore will not serve as potential fuel sources in the event of a fire. The interior finishes on walls and ceilings will be likely fuel sources and are to be selected by the specifier to ensure compliance with the prescriptive provisions of Building Code of Australia (NCC Vol. 1) Clause C1.10 and its Specification.

The highest proportion of fires is likely to be associated with the ignition of the building's contents. The fuel load associated with the Data Hall's (est. at ~400MJ/m^2 (ABCB, 2005)) is relatively low when compared to other occupancies. Fuel loads within the building include:

- Wiring and cables
- Servers and server componentry
- UPS
- Li-ion batteries
- Diesel fuel
- Computer equipment, monitors, printers and copiers

To ensure that the risk is appropriately mitigated the following relevant safety measures are proposed:

- Dangerous Goods and Hazardous Substances are to be separated in accordance with the relevant provisions of AS 1940. This includes the enclosure of large fuel quantities in fire rated construction.
- Class 9 (miscellaneous) dangerous goods and articles shall comply with the relevant provisions of AS/NZS 4681.
- Safety requirements for secondary lithium cells and batteries, for use in industrial applications in accordance with the relevant provisions of AS IEC 62619:2017.
- Hazardous areas shall be separated into fire compartments with floor areas and volumes not exceeding that permitted by Table C2.2 of the Building Code of Australia (NCC Vol. 1), thereby exceeding the minimum requirements of the BCA.

6.0 DESIGN OBJECTIVES

6.1 REGULATORY OBJECTIVES

The main objectives of the BCA include the following:

- safeguard people from illness or injury due to a fire in a building; and
- safeguard occupants from illness or injury while evacuating a building during a fire; and
- facilitate the activities of emergency services personnel; and
- avoid the spread of fire between buildings; and
- protect other property from physical damage caused by structural failure of a building as a result of fire.
- provide facilities for occupants and the fire brigade to undertake fire-fighting operations; and
- safeguard occupants from illness or injury by warning them of a fire so that they may safely evacuate.

The objectives of the BCA are met when the relevant Performance Requirements of the BCA are satisfied. Thus, a Performance Solution will comply with the BCA if it satisfies the relevant Performance Requirements of the BCA.

6.2 PERFORMANCE REQUIREMENTS

The Performance Requirements were identified in accordance with the methodology outlined in Clause A2.2(3) of the BCA (BCA 2022 in *italics*).

The relevant Performance Requirements are identified below.

CP1 (C1P1) *A building must have elements which will, to the degree necessary, maintain structural stability during a fire appropriate to -*

(a) the function or use of the building; and
(b) the fire load*; and*
(c) the potential fire intensity*; and*
(d) the fire hazard*; and*
(e) the height of the building; and
(f) its proximity to other property*; and*
(g) any active fire safety systems *installed in the building; and*
(h) the size of any fire compartment*; and*
(i) fire brigade *intervention; and*
(j) other elements they support; and
(k) the evacuation time*.*

CP2 (C1P2) *(a) A building must have elements which will, to the degree necessary, avoid the spread of fire -*

(i) to exits; and
(ii) to sole-occupancy units and public corridors; and
(iii) between buildings; and
(iv) in a building.

(b) Avoidance of the spread of fire referred to in (a) must be appropriate to -

(i) the function or use of the building; and
(ii) the fire load; and
(iii) the potential fire intensity; and
(iv) the fire hazard; and
(v) the number of storeys in the building; and
(vi) its proximity to other property; and
(vii) any active fire safety systems installed in the building; and

(viii) the size of any fire compartment; and

(ix) fire brigade intervention; and

(x) other elements they support; and

(xi) the evacuation time.

CP8 (C1P8) *Any building element provided to resist the spread of fire must be protected, to the degree necessary, so that an adequate level of performance is maintained -*

(a) where openings, construction joints and the like occur; and

(b) where penetrations occur for building services.

CP9 (C1P9) *Access must be provided to and around a building, to the degree necessary, for fire brigade vehicles and personnel to facilitate fire brigade intervention appropriate to—*

(a) the function or use of the building; and

(b) the fire load; and

(c) the potential fire intensity; and

(d) the fire hazard; and

(e) any active fire safety systems installed in the building; and

(f) the size of any fire compartment.

DP2 (D1P2) *So that people can move safely to and within a building, it must have -*

(a) walking surfaces with safe gradients; and

(b) any doors installed to avoid the risk of occupants -

(i) having their egress impeded; or

(ii) being trapped in the building; and

(c) any stairways and ramps with -

(i) slip-resistant walking surfaces on -

(A) ramps; and

(B) stairway treads or near the edge of the nosing; and

(ii) suitable handrails where necessary to assist and provide stability to people using the stairway or ramp; and

(iii) suitable landings to avoid undue fatigue; and

(iv) landings where a door opens from or onto the stairway or ramp so that the door does not create an obstruction; and

(v) in the case of a stairway, suitable safe passage in relation to the nature, volume and frequency of likely usage.

DP4 (D1P4) *Exits must be provided from a building to allow occupants to evacuate safely, with their number, location and dimensions being appropriate to -*

(a) the travel distance; and

(b) the number, mobility and other characteristics of occupants; and

(c) the function or use of the building; and

(d) the height of the building; and

(e) whether the exit is from above or below ground level.

DP5 (D1P5) *To protect evacuating occupants from a fire in the building exits must be fire-isolated, to the degree necessary, appropriate to -*

(a) the number of storeys *connected by the* exits*; and*

(b) the fire safety system *installed in the building; and*

(c) the function or use of the building; and

(d) the number of storeys *passed through by the* exits*; and*

(e) fire brigade *intervention.*

DP6 (D1P6) *So that occupants can safely evacuate the building, paths of travel to exits must have dimensions appropriate to -*

(a) the number, mobility and other characteristics of occupants; and

(b) the function or use of the building.

EP1.1 (E1P1) *A fire hose reel system must be installed to the degree necessary to allow occupants to safely undertake initial attack on a fire appropriate to -*

(a) the size of the fire compartment*; and*

(b) the function or use of the building; and

(c) any other fire safety systems *installed in the building; and*

(d) the fire hazard*.*

EP1.3 (E1P3) *A fire hydrant system must be provided to the degree necessary to facilitate the needs of the fire brigade appropriate to -*

(a) fire-fighting operations; and

(b) the floor area *of the building; and*

(c) the fire hazard*.*

EP1.4 (E1P4) *An automatic fire suppression system must be installed to the degree necessary to control the development and spread of fire appropriate to -*

(a) the size of the fire compartment; and

(b) the function or use of the building; and

(c) the fire hazard; and

(d) the height of the building.

EP1.6 (E1P6) *Suitable facilities must be provided to the degree necessary in a building to co-ordinate fire brigade intervention during an emergency appropriate to -*

(a) the function or use of the building; and

(b) the floor area of the building; and

(c) the height of the building.

EP2.2 (E2P2) *(a) In the event of a fire in a building the conditions in any evacuation route must be maintained for the period of time occupants take to evacuate the part of the building so that -*

(i) the temperature will not endanger human life; and

(ii) the level of visibility will enable the evacuation route to be determined; and

(iii) the level of toxicity will not endanger human life.

(b) The period of time occupants take to evacuate referred to in (a) must be appropriate to -

(i) the number, mobility and other characteristics of the occupants; and

(ii) the function or use of the building; and

(iii) the travel distance and other characteristics of the building; and

(iv) the fire load; and

(v) the potential fire intensity; and

(vi) the fire hazard; and

(vii) any active fire safety systems installed in the building; and

(viii) fire brigade intervention.

6.3 FIRE BRIGADE OBJECTIVES

Each fire agency throughout Australia has a fundamental set of legal obligations, which are defined under the Fire Agency Act for each State or Territory.

The objectives of the fire brigades involve the protection of life, property and the environment. The BCA outlines DtS provisions for buildings in relation to fire resistance, egress, and services and equipment (such as fire hydrants) to enable the objectives of the fire brigades to be fulfilled during fire brigade intervention activities.

To satisfy the Performance Requirements of the BCA, fire fighters must have reasonable time to enter and exit a building to undertake fire brigade intervention activities before untenable conditions occur and prior to building collapse. The proposed Performance Solutions will be assessed against the objectives of the fire brigades during fire brigade intervention activities. Where the relevant Performance Requirements of the BCA refer to Fire Brigade Intervention, the objectives of the fire brigades will be considered.

7.0 NON-CONFORMANCES WITH THE DTS PROVISIONS OF THE BCA

The non-conformances from the DtS provisions of the BCA that are proposed to be addressed by the Performance Based Design (Fire) Strategy are listed below. The identified items are those which have been established in the design to date. As the design is in only at the concept stage, the variations to the DtS provisions are expected to be adjusted as the design progresses.

Table 4: Identified BCA DtS Nonconformances

No.	DtS Provisions (BCA 2022 Reference in *italics*)	Variations to DtS Provisions	Performance Requirements (BCA 2022 Reference in *italics*)
1.	Clause C1.1 *(C2D1)* **Fire Resistance Levels**	Table 3 of Specification C1.1 requires Class 7b parts to have a time grading of 240 minutes for structural adequacy, integrity and insulation (as the case requires). Throughout the building it is proposed to rationalise the time grading in minutes for the structural adequacy, integrity and insulation, for the fire walls separating IC3E and IC3W, and compartmentation of the data halls to have a time grading of not less than 120 minutes. *Note:* *Columns and slabs are to be DtS i.e. 240 min for structural adequacy, integrity and insulation as the case requires.* In addition, at Level 01, the accessway to the electrical plant rooms is provided with an imperforate floor.	CP1 and CP2 *(C1P1 and C1P2)*
2.	Clause C2.3 and Clause C2.4 *(C3D4 and C3D5)* **Emergency vehicle access**	Clause C2.3(b) requires a large-isolated building with a floor area and volume of more than 18,000 m^2 or 108,000 m^3 to be provided with perimeter access complying with C2.4(b), being a roadway not less than 6 m wide not more than 18 m from the building which is unobstructed overhead. On the eastern side of the building a portion of the perimeter access path passes beneath the structure overhead. On thew western side of the building the pathway is ~5.7 m wide in lieu of 6 m.	CP9 (*C1P9)*
3.	Clause C3.3 *(C4D3)* **Separation of external walls and associated openings in different fire compartments**	Clause C3.3 requires the distance between parts of external walls and any openings within them in different fire compartments to be not less than that set out in Table C3.3, unless— ▪ those parts of each wall have an FRL not less than 60/60/60; and ▪ any openings protected in accordance with C3.4. At Ground and Level 1 there is exposure between adjoining fire compartments (IC2 and IC3) that are to be treated as part of the Performance Solution.	CP2 and CP8 *(C1P1 and C1P8)*
4.	Clause C3.5 *(C4D6)* **Doorways in fire walls**	Clause C3.5 states that the doorways in a fire wall must be fire doors and must be self-closing or automatic closing. A number of double doors will be fitted with bolts that would affect the self-closing action of the door if the bolt is engaged at the time of closing.	CP2 and CP8 *(C1P2 and C1P8)*

No.	DtS Provisions (BCA 2022 Reference in *italics*)	Variations to DtS Provisions	Performance Requirements (BCA 2022 Reference in *italics*)
5.	Clause C3.15 and C3.16 *(C4D15 and C4D16)* **Service Penetrations and Construction Joints**	Clause C3.15 and Specification C3.15 specify relevant fire stopping requirements for electrical, electronic, plumbing, mechanical ventilation, air-conditioning or other services that penetrate a building element (other than an external wall or roof) that is required to have an FRL with respect to integrity or insulation. Invariably the requirements specify that the service is to be protected in accordance with Clause C3.15 and its Specification and/or as detailed in AS 1530.4 or AS 4072. Likewise, Clause C3.16 states that construction joints, spaces, and the like in and between building elements required to be fire-resisting with respect to integrity and insulation must be protected in a manner identical with a prototype tested in accordance with AS 1530.4 to achieve the required FRL. In this building there are a number of building elements that have a fire rating of 240 minutes for integrity and insulation. There is no prescriptive method using Specification C3.15, nor Australian Standard 1530.4 and Australian Standard 4072.1 that achieves an FRL of 240 minutes for integrity and insulation. Subsequently the services shall be protected by systems that achieve a time grading of not less than 120 minutes for integrity and insulation as the case requires.	CP2 and CP8 *(C1P2 and C1P8)*
6.	Clause D1.2 and Clause D1.11 *(D2D3 and D2D16)* **Number of exits required | Horizontal Exits**	Clause D1.2 states that as the building has an effective height of more than 25 m not less than 2 exits (not being horizontal exits) must be provided from each storey. Clause D1.11 requires not more than half of the required exits from any part of the floor plate to not be horizontal exits. On Ground Level, Level 1 and Level 1 Mezzanine the administration area in the northern portion of the floor plate is provided with a single exit. That exit is a horizontal exit that opens into IC2.	DP2 and DP4 *(D1P2 and D1P4)*
7.	Clause D1.4 *(D2D5)* **Travel distances**	Clause D1.4 requires the travel distances to a point of choice or a single exit to be not more than 20 m. If a second exit is provided the distance to the exit must not be more than 40 m. The following travel distances have been observed: ▪ Up to 30 m (tbc) to a point of choice or single exit in lieu of 20 m; and ▪ Up to 75 m (tbc) to the nearest exit in lieu of 40 m.	DP4 and EP2.2 *(D1P4 and E2P2)*

No.	DtS Provisions (BCA 2022 Reference in *italics*)	Variations to DtS Provisions	Performance Requirements (BCA 2022 Reference in *italics*)
8.	Clause D1.5 *(D2D6)* **Travel between alternative exits**	Clause D1.5 states that exits that are required as alternative means of egress must be not more than 60 m apart. The following non-conformances have been observed: ▪ Up to 110 m (tbc) between alternative exits when measured through the point of choice (in lieu of 60 m); and ▪ An inability to measure the distance between alternative exits through the point of choice in all instances.	DP4 and EP2.2 *(D1P4 and E2P2)*
9.	Clause D1.6 *(D2D8)* **Dimensions of exits and paths of travel to exits**	Clause D1.6 states that in a required exit or path of travel to an exit, the unobstructed width of each exit or path of travel to an exit must be not less than 1 m. The unobstructed width of travel path between equipment shall be in the order of 650 mm (data racks) and 800 mm (TX rooms) in lieu of 1,000 mm (tbc).	DP4 and DP6 *(D1P4 and D1P6)*
10.	Clause D1.7 *(D2D9)* **Discharge from fire isolated stairs**	Clause D1.7 states that the discharge pathway from a fire isolated stair must not pass within 6 m of unprotected openings in the external wall. At Ground Floor the northern stair passes within 6 of the dripline from the carpark.	
11.	Clause D1.8 (*D2D13)* **External stairways or ramps in lieu of fire-isolated exits** Clause E2.2 *(E2D4)* **Fire-isolated exits**	Clause D1.8 states that an external stairway or ramp may serve as a required exit in lieu of a fire-isolated exit serving a storey below an effective height of 25 m. Clause E2.2 requires stairs serving an effective height of more than 25 m to be pressurised. The northern stair is proposed to be constructed as an external stair (and not pressurised) despite serving storeys having an effective height of >25 m.	DP5 and EP2.2 *(D1P5 and E2P2)*
12.	Clause D1.9 *(D2D14)* **Travel via non-fire isolated stairs**	Clause D1.9 requires a non-fire-isolated stairway serving as a required exit must provide a continuous means of travel by its own flights and landings from every storey served to the level at which egress to a road or open space is provided. At Level 02, Level 03 and Level 04 a non-fire isolated stair provides access to an office mezzanine. The stair does not provide egress to the level at which egress to a road or open space is provided.	DP4 and EP2.2 *(D1P4 and E2P2)*
13.	Clause D2.22 *(D3D27)* **Re-entry from fire isolated stairs**	Clause D2.22 requires the doors of fire isolated stairs in a building having an effective height of more than 25 m to not be locked from the inside unless the doors automatically upon activation of a fire alarm and an intercommunication system is provided in the stair. The doors do not unlock automatically on fire alarm.	DP2 and DP4 *(D1P2 and D1P4)*

No.	DtS Provisions (BCA 2022 Reference in *italics*)	Variations to DtS Provisions	Performance Requirements (BCA 2022 Reference in *italics*)
14.	Clause E1.3 *(E1D2)* **Fire hydrant**	Clause E1.3 states that a fire hydrant system must be provided in accordance with AS 2419.1. Clause 3.2.3.1 of AS 2419.1 states that internal hydrants must be located so that all points on the floor are within reach of a 10 m hose stream issuing from a nozzle at the end of a 30m length of hose laid on the floor connected to the fire hydrant outlet. Following fitout of the data halls coverage of the floor plate will require a second hose length to reach all parts of the floor.	EP1.3 *(E1P3)*
15.	Clause E1.4 NSW Variation *(E1D3)* **Fire hose reels**	Clause E1.4 states that a fire hose reel system must achieve the coverage specified in AS 2441 throughout any fire compartment with a floor area greater than 500 m^2. Due to the high electrical content of the building portable fire extinguishers are to be provided in lieu of fire hose reels throughout the building	EP1.1 *(E1P1)*
16.	Clause C2.6, Clause E1.5 *(C3D7 and E1D4)* **Spandrels and Sprinklers**	Clause E1.5 requires the sprinkler system to be provided throughout the building in accordance with Australian Standard 2118.1:2017. At handover of the building not all floors will be occupied i.e., they will be fallow. In other words, the fitout will not have been undertaken. It is proposed to complete the sprinkler works for each fallow floor as, and when the fitout is undertaken in order to avoid abortive works. Leading on from the above, if sprinklers are not installed spandrels are required under Clause C2.6. The external wall achieves an FRL of 60/60/60 from the outside only, meaning it does not strictly comply with the abovementioned requirement.	CP2 and EP1.4 (*C1P2 and E1P4*)
17.	Clause E1.8 *(E1D15)* **Fire control centres**	For the purposes of Part C, D and E of the BCA the extension is considered to be a separate building. Clause E1.8 and its Specification E1.8, requires, by proxy the fire control centre to be located at the main entrance to the building. The fire control centre for the new works will be located adjacent to the existing Fire Detection Control and Indicating Equipment in the main office on the western side of the building	EP1.6 *(E1P6)*

No.	DtS Provisions (BCA 2022 Reference in *italics*)	Variations to DtS Provisions	Performance Requirements (BCA 2022 Reference in *italics*)
18.	Clause E2.2, E1.5 *(E2D6 and E1D4)* **Smoke hazard management & Sprinkler Activation**	The building forms part of a large-isolated building having a floor area of more than 18,000m^2. Clause E2.2, Table E2.2a requires: ▪ a large isolated building to have an automatic smoke exhaust system or smoke and heat vents in accordance with Specification E2.2b, or an automatic smoke and heat vent system compliant with Specification E2.2c is required; and ▪ a building having an effective height of >25 m to be provided with zone smoke control; and ▪ Specification E2.2a(8) states that the installation of a smoke detection that activates a smoke exhaust system must be connected to a fire alarm monitoring system connected to a fire station or fire station dispatch centre. The building is not provided with either smoke exhaust nor smoke control. Further, as a result of the omission of the smoke hazard management system the fire alarm monitoring system activates via the fire sprinkler system in lieu of the smoke detection system.	EP2.2 and EP1.4 *(E2P2 and E1P4)*
19.	Clause E3.4 *(E3D5)* **Emergency Lift**	Clause E3.4(c) states that where two or more passenger lifts are installed and serve the same storeys at least two emergency lifts must be provided and where different shafts are provided at least one emergency lift must be provided in each shaft. The existing lifts serving IC3E and IC2 are not emergency lifts.	EP3.4 *(E3P2)*

8.0 TRIAL DESIGN

The non-conformances from the DtS provisions of the BCA that are intended to be addressed by the Performance Based Design (Fire) Strategy are listed below.

8.1 GENERAL

This assessment is supplied in addition to the fire engineering reports S110742_FER_05 dated 14 August 2012 (prepared by RAWFiRE Safety Engineering) and 18071-R01-07 dated 13 October 2021 (prepared by Innova Services Pty Ltd) and should be read in conjunction with those documents. In the event of conflicts or discrepancies among the documents, interpretation should be based on the following priorities:

- This Report, with those versions of later date having preference over those of earlier date,
- This Innova Services Pty Ltd Report, with those versions of later date having preference over those of earlier date,
- The RAWFiRE Safety Engineering Pty Ltd Report, with those versions of later date having preference over those of earlier date.

In the case of an inconsistency within documentation not clarified by this document, the applied resolution shall be provided in accordance with the Fire Engineer's interpretation.

It is noted that this Report is documented to BCA 2019 Amendment 1.

Any works covered by the Building Permit that regularises this report shall comply with the Deemed-to-Satisfy provisions of Section C, D and E of the BCA, except for design variations summarised in the abovementioned reports and as detailed herein.

> *NOTE:*
>
> *For the purpose of this assessment all BCA NCC Clause references are those applicable under BCA 2019 Amendment 1.*
>
> *Reference shall be made to the Fire Safety Schedule for the list of required fire safety systems and measures, and the relevant Standards of Performance.*

8.2 FIRE RESISTANCE

The building works shall comply with the DtS provisions of Section C of the BCA (Parts C1, C2 & C3) unless otherwise documented herein.

- When applying the provisions of Table 3 of Specification C1.1 of the BCA the maximum time grading for common walls and fire walls, internal walls for the new works may be 120 minutes for structural adequacy, integrity and insulation (as the case requires) instead of 240 minutes. This provision does not apply to the generator and fuel supply enclosures on the Ground Floor, floor slabs, columns and beams which shall comply with the prescriptive requirements of the BCA.
- IC3E and IC3W are to be separated by a fire wall achieving an FRL of 120/120/120 (load=bearing_ and/or -/120/120 (non-loadbearing) and otherwise constructed in accordance with Clause C2.7(a) of the BCA.

  An example of the separation is shown in Figure 13 and Figure 14.
- Each data hall, plant room (including battery rooms, electrical switch rooms and the like) shall be enclosed with fire resisting construction achieving an FRL of 120 minutes for structural adequacy, integrity, and insulation (as the case requires) and otherwise separated as per Clause C2.7(a) of the BCA.
- Battery and battery management systems/electrical switch gear are to be provided in separate rooms enclosed with fire resisting construction achieving an FRL of 120 minutes for structural adequacy, integrity, and insulation (as the case requires) and otherwise separated as per Clause C2.7(a) of the BCA.

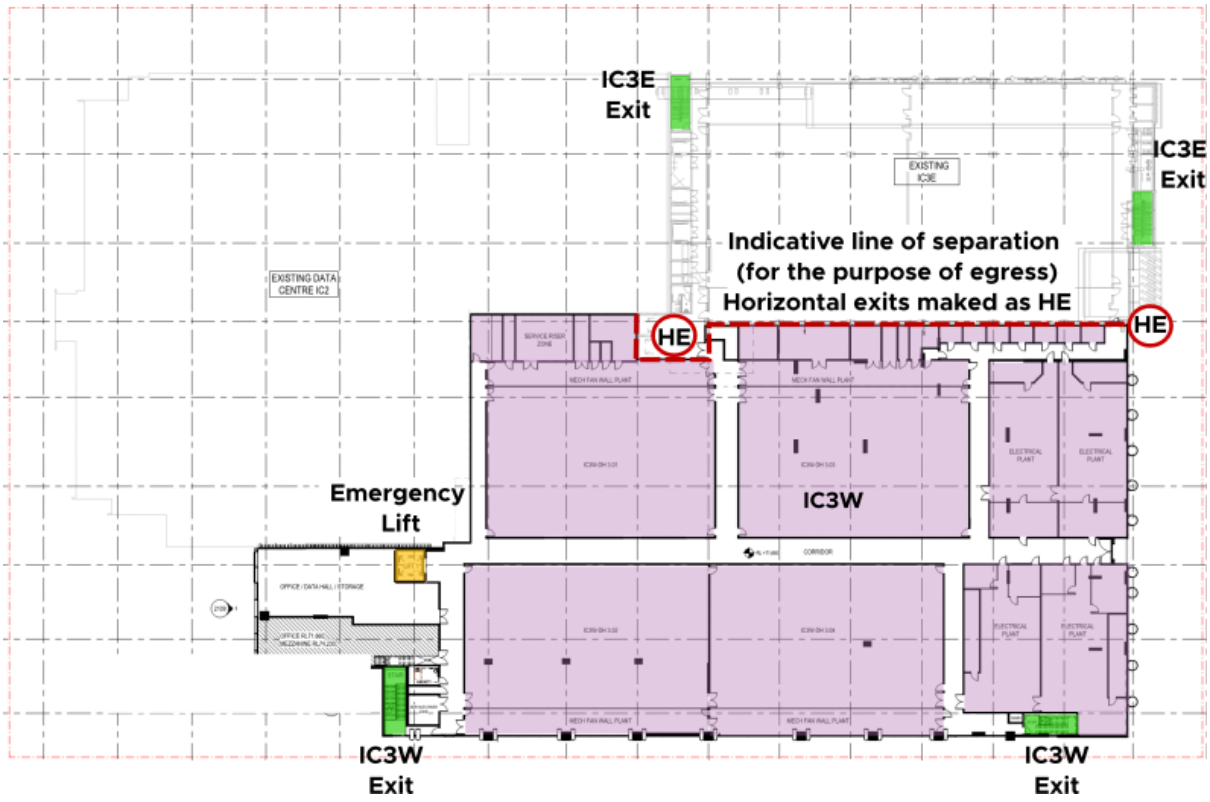

Figure 13: Indicative Compartmentation plan (Level 3 shown) – Option 1

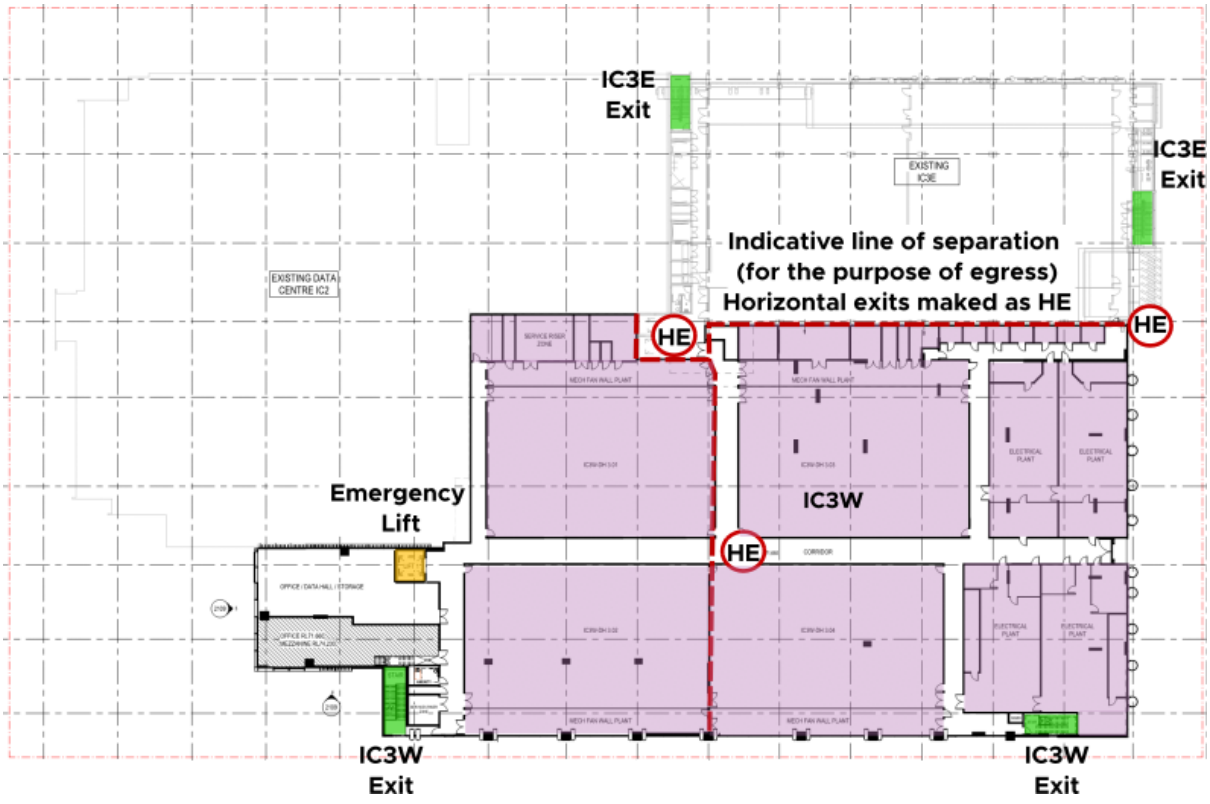

Figure 14: Indicative Compartmentation plan (Level 3 shown) – Option 2

- All openings and penetrations shall be protected in accordance with Part C3 of the BCA unless documented herein.

  Namely, penetrations and construction joints may a time grading of not less than 120 minutes for integrity and insulation in lieu of 240 minutes.

  Where a proprietary system in accordance with AS 1530.4 and AS 4072.1 is not adopted for water filled metal pipes the following variations to BCA Specification C3.15a may be applied:

  1. it is permitted to permit water filled pipes to pass through more than two (2) fire compartments; and
  2. no combustible material is to be closer than 200 mm to any combustible material or any other service penetration; and
  3. high temperature rockwool.

- The extent of IC3W that overhangs IC2 shall be constructed to achieve 120 minutes for structural adequacy, integrity and insulation (as the case requires) for a height of not less than 6 m above the roof of IC2.
- Where fire compartments are not separated externally in accordance with the prescriptive provisions of Clause C3.3 of the BCA (i.e., between the office of IC2 and IC3W as can be seen in Figure 15) the following requirements shall be met:

  1. The provision of fire rated external walls with an FRL of at least 120/120/120 to one compartment only, in lieu of fire rated external walls with an FRL of 60/60/60 to both compartments. The fire rated external walls will achieve an FRL of at least 120/120/120 in both directions, and will extend to the underside of the floor above or the roof covering; and/or
  2. The provision of passive fire protection and internal and external wall wetting sprinklers to the openings of one compartment only, in lieu of external wall wetting sprinklers to openings to both compartments provided that:
     a. Protected openings are to be permanently fixed in the closed position; and
     b. The wall wetting sprinklers are separately valved and supplied from the hydrant system or a separate sprinkler zone to the two compartments affected.

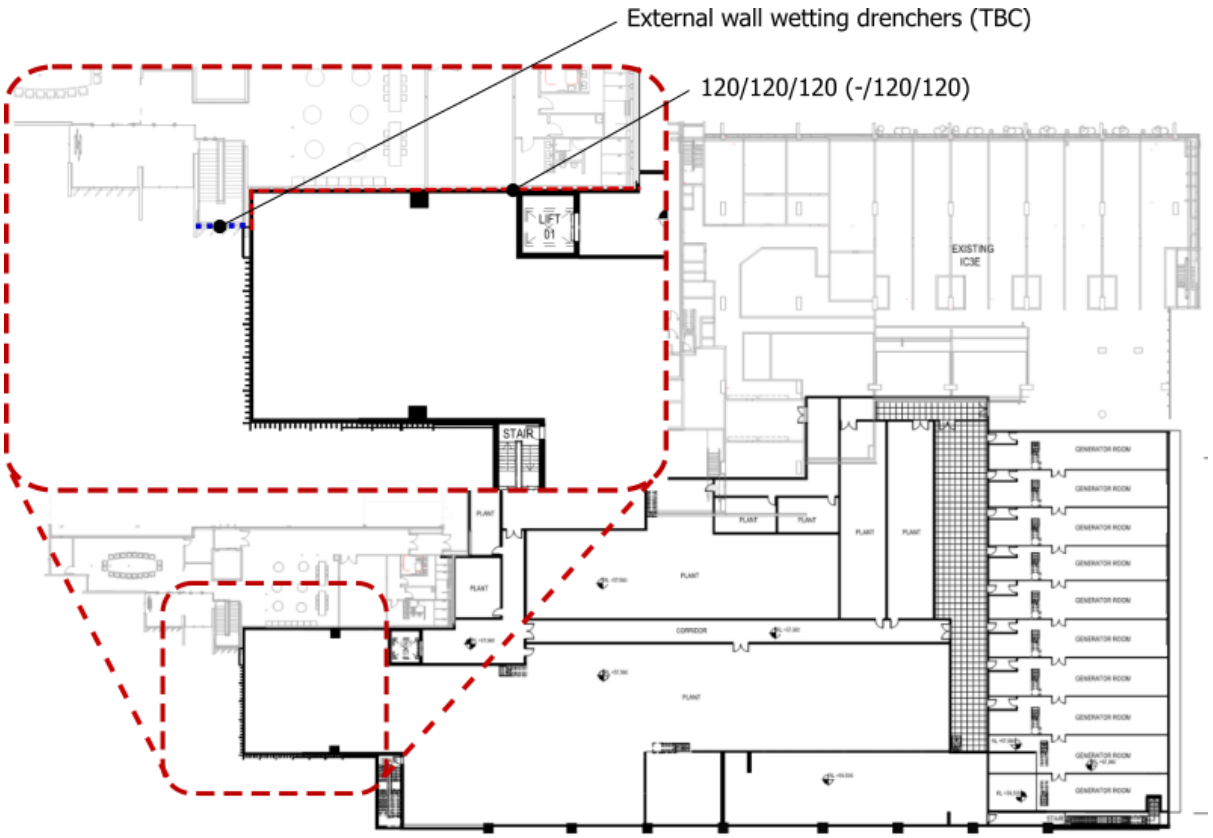

Figure 15: Exposure between administration areas of IC2 and IC3W

Fire Doors

- Self-closing fire doors protected in accordance with the Australian Government Security Zone 4 and 5 (TBC) may have:

    1. A slide bolt fitted on the secure side of the inactive leaf; and
    2. A lockable bolt on the secure side of the door;
    3. Provided that any variation to the tested specimen is assessed by the test authority in accordance with the provisions of Section 4 of AS 1905.1:2015; and
    4. All doors are to have a "Forced Door" and a "Door Open Too Long" alarm". These alarms are to be electronically monitored by the security system.

Smoke Seals

- Doors opening into the data halls are to be protected with self-closing (or automatic closing) fire doors protected with medium temperature smoke seals on all four sides of the doorway/door.

  The seals shall be approved for use on a fire rated doorset and shall comply with the relevant provisions of AS 6905-2007, in terms of the maximum allowable leakage rates for single door assemblies when tested to AS 1530.7:2007.

  The seals may be adjusted where door hardware required for Australian Government Security Zone 4 and Zone 5 (TBC) clearance are provided.

  Suitable seals include:

    1. Kilargo IS1212 Flexi-Wing ™
    2. Kilargo IS3015si Bottom Seal

  Note: This provision need be read and interpreted in concert with the ***Fire Doors*** provision.

8.3 ACCESS AND EGRESS

The building works shall fully comply with the Deemed-to-Satisfy provisions of Section D of the BCA (Parts D1, D2 & D3), except for the design variations permitted to travel distances, paths of travel and access to the roof top as summarised in the Performance Solution(s).

- ***Horizontal Exits***

  The design strategy is based on early detection and warning in order to preserve life by facilitating speedy evacuation from the building. Escape is generally considered in four distinct stages as follows:

  1. Stage 1 – escape from the room or area of fire origin
  2. Stage 2 – escape from the compartment of origin via the circulation route to a protected stairway or an adjoining compartment offering safe refuge
  3. Stage 3 – escape from the safe refuge by way of protected stairways
  4. Stage 4 – escape away from the building

  To facilitate this process and ensure that travel distances remain acceptable a number of horizontal exits will be required to be introduced.

  Indicative locations for two options nominating separation are shown in Figure 13 and Figure 14. Resolution of the location of the compartmentation is dependent on the method of measurement of travel distances to an exit and the expected fitout design.

  This needs to be resolved during detailed design.

- ***Travel via Non-Fire Isolated Stairs***

  At Level 2, Level 3 and Level 4 a non-fire isolated stair from each level provides access to an office mezzanine (<200 m^2). The access/egress to each mezzanine does not provide continuous access to ground level. Egress in this manner is deemed to be acceptable due to the small floor area and population load associated with that space. The Performance Solution shall be resolved during detailed design with the perceived risk likely to be offset by way of the inclusion of a detection and alarm system that exceeds the requirements of that which would be observed in a DtS building), and the potential for additional pass-through doors.

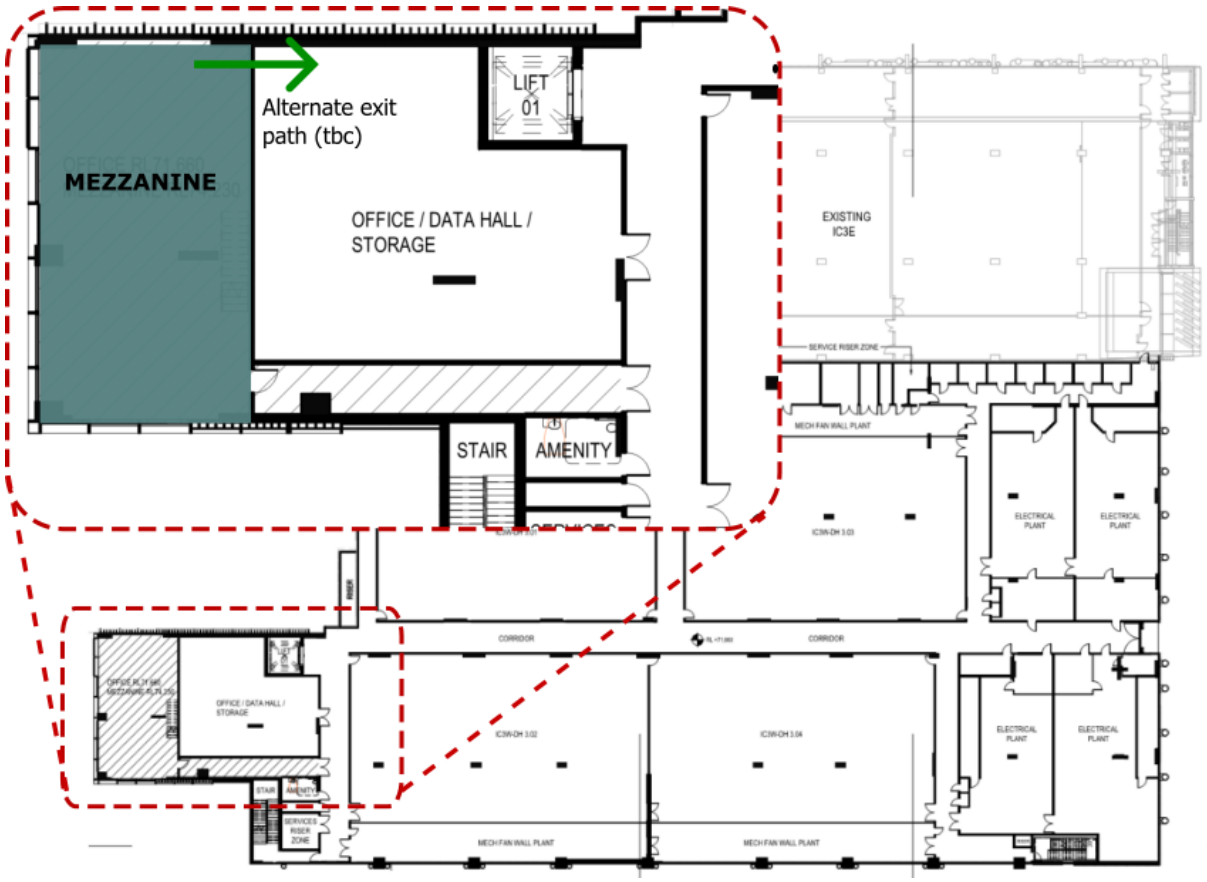

Figure 16: Location of non-conforming non-fire isolated stair serving Level 02, Level 03 and Level 4

- ***External Stairs in lieu of Fire Isolated Stairs***

  1. The northern most external stairs shall be allowed to serve IC3W as an external stair in lieu of a fire isolated pressurised stairway provided that the stairway is:

     a. Non-combustible throughout; and

     b. Protected in accordance with 3. where the stair is within 6m of and exposed to any part of the external wall of the building.

  2. For the purposes of this requirement:

     a. Exposure under 1.b. is to be measured in accordance with Clause 2.1 of Specification C1.1 of the BCA, as if the exit was a building element and the external wall of the building was a fire source feature to the exit except, that the FRL required must not be less than 60/60/60; and

     b. The plane formed at the construction edge or perimeter of the carpark (or other unenclosed building part) is deemed to be an external wall.

     c. For the purpose of this requirement openings in an external wall are determined in the same manner as that specified in Clause D1.8 of the BCA.

  3. The protection referred to in 1.b must meet the following:

a. The part of the external wall that the exit is exposed to must have:

   i. An FRL of not less than 60/60/60 (measured from the inside); and

   ii. No opening less than 3 m from the exit (except the doorway serving the exit protected by a -/60/30 fire door in accordance with C3.8(a)); and

   iii. Any opening between 3 m to 6 m from the exit protected by internal wall wetting sprinklers in accordance with C3.4 of the BCA.

b. The exit must be protected from:

   i. Any part of the external wall of the building having an FRL of less than 60/60/60 (measured from the inside); and

   ii. Any openings in the external by the construction of a wall, roof, floor or other shielding element as appropriate in accordance with c.

   Note: Refer to Figure 18.

c. The wall, roof, floor or other shielding element required by 3.b. must:

   i. Have an FRL or not less than 60/60/60; and

   ii. Have no opening less than 3 m from the external wall of the building (except the doorway serving the exit protected by a -/60/30 fire door in accordance with C3.8(a)); and

   iii. Any opening between 3 m to 6 m from the exit protected by internal wall wetting sprinklers in accordance with C3.4 of the BCA.

d. In addition to the head of the stair, at least one side of the stair is to be open to atmosphere. The open side shall have ventilation openings to the outside air which:

   i. Must not be enclosed on its open side above a height of 1 m expect by an open grille or the like have an effective free area of not less than 75% of its area; and

   ii. The grille shall be designed so that it obstructs the line of sight of occupants from a normal vantage point on the stair to ground level.

Figure 17: Portion of IC3W stairs above 25 m in effective height

- Access/egress to the roof top condenser decks is to be by way of ladders and platforms complying with AS 1657:2013.

  The point of access is to be from a public corridor or room off the public corridor that is separated from the remainder of the floor plate by construction having an FRL of 120 minutes for structural adequacy, integrity and insulation (as the case requires) in accordance with the relevant Deemed-to-Satisfy provisions of the Building Code of Australia (NCC Vol. 1). The construction shall achieve the following level of performance:

  1. Walls having an FRL of (120/120/120) in accordance with Clause C2.7a of the Building Code of Australia (NCC Vol. 1)
  2. Doors are to be self-closing (or automatic closing) and have an FRL of -/120/30 in accordance with Clause C3.5(b) of the Building Code of Australia (NCC Vol. 1)
  3. Signage on doors shall be applied in accordance with Clause D2.23 of the Building Code of Australia (NCC Vol. 1)
  4. Openings for service installations shall be protected in accordance with Clause C3.15 of the Building Code of Australia (NCC Vol. 1)

8.4 SERVICES AND EQUIPMENT

The building works shall fully comply with the Deemed-to-Satisfy provisions of Section E of the BCA (Parts E1, E2, E3 & E4), except for the design variations summarised in the Performance Solution, and the following specific requirements.

- Alarm Signaling Equipment – BCA Clause E1.5 and AS 1670.3:2004 | Fire Engineering Report
- Automatic Failsafe Devices – BCA Clause D2.21
- Automatic Fire Detection and Alarm System – BCA Clause E2.2a and the relevant provisions of AS 1670.1:2018 | Fire Engineering Report
- Automatic Fire Suppression Systems, BCA Clause E1.5, Specification E1.5 and AS 2118.1:2017
- Emergency Warning and Intercommunication System - BCA E2.2, E1.5, E4.9 and the relevant provisions of AS 1670.1:2018 and AS 1670.4:2018 | Fire Engineering Report
- Emergency Lift – BCA Clause E3.4 | Fire Engineering Report
- Emergency Lighting - BCA Clauses E4.2 and E4.4, AS/NZS 2293.1:2018
- Exit Signs - BCA Clauses E4.5, E4.6 and E4.8, AS/NZS 2293.1:2018
- Fire Control Centre – BCA Clause E1.8 | Fire Engineering Report
- Fire Doors – BCA Clause C2.10, C3.5, C3.7 C3.8, AS 1905.1:2015| Fire Engineering Report
- Fire Hydrants - BCA Clause E1.3, AS 2419.1:2005 | Fire Engineering Report
- Fire Seals – BCA Clause C3.15, Specification C3.15, AS 1530.4:2014, AS 4072.1:2005 | Fire Engineering Report
- Mechanical Air Handling Systems (Automatic Shutdown)- BCA Specification E2.2a, AS 1668.1:2015 | Fire Engineering Report
- Portable Fire Extinguishers - BCA Clause E1.6, AS 2444:2001

NOTE: Reference shall be made to the Fire Safety Schedule for the subject development for the list of required fire safety systems and measures, and the relevant Standards of Performance.

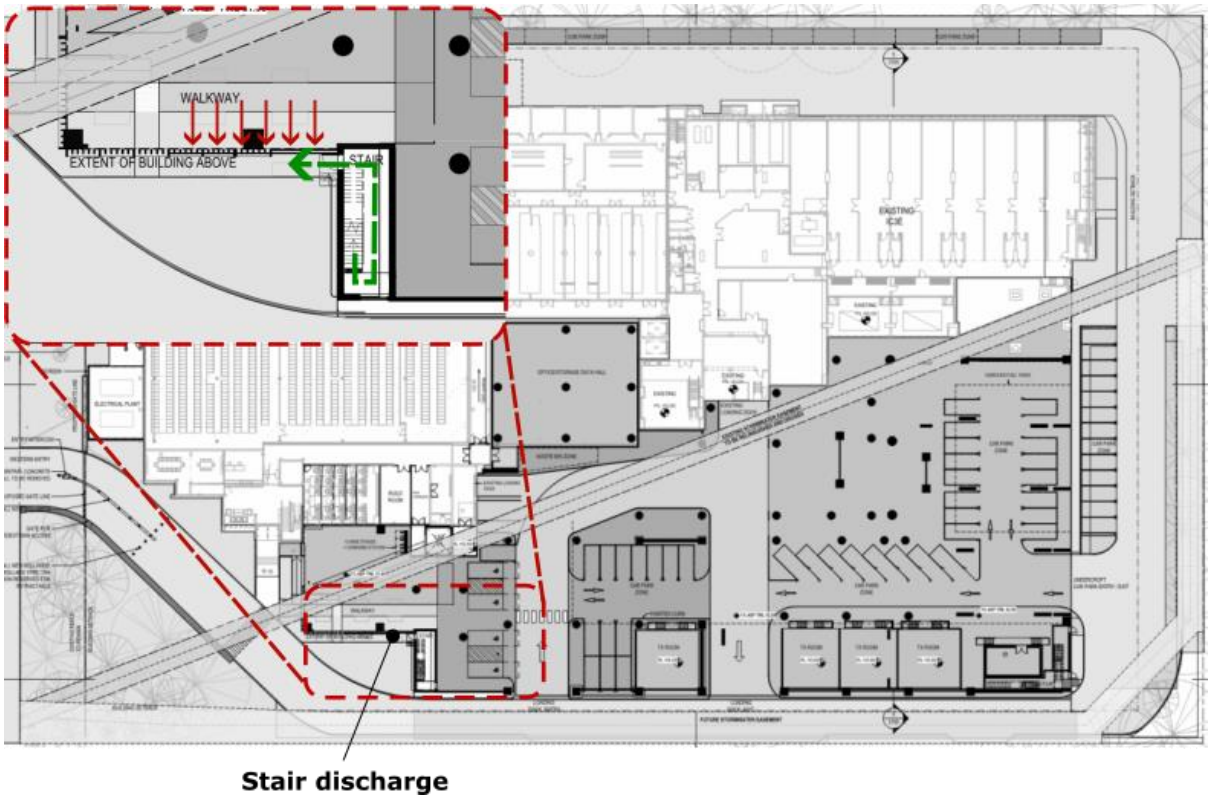

Figure 18: Discharge of northern stair adjacent to carpark

Fire Hydrants

- A fire hydrant system with ring main shall be installed in accordance with Clause E1.3 of the BCA, and the relevant provisions of AS 2419.1:2005 except as documented herein.
- The fire hydrant valves shall be fitted with Storz aluminium alloy delivery couplings manufactured and installed in accordance with Clauses 7.1 and 8.5.11.1 of AS 2419.1:2005. All hydrant valves shall possess a forging symbol and manufacturers mark, and shall comply with Fire & Rescue NSW Fire Safety Guideline Technical Information (D15/45534).
- Where an additional fire hydrant(s) is installed outside the fire stairs a durable, weather and fade resistant plan identifying the location of the additional fire hydrant(s) shall be provided. The location plan shall be a minimum size of A3 and shall be permanently affixed adjacent to each fire hydrant valve on the level affected. The plan shall include a '*You are here*" symbol and be oriented according to the way in which is mounted/erected.
- A placard of durable, weather and fade resistant material shall be placed at the booster and adjacent to the fire hydrant outlet(s). The placard shall state

'TWO HOSE LENGTHS REQUIRED FOR

HYDRANT COVERAGE to LEVEL 'X' of IC3'

or similar in 25 mm high capital lettering on a contrasting background.

Sprinkler System

An automatic sprinkler system shall be provided throughout the building in accordance with the requirements outlined in Specification E1.5 of the BCA and the relevant provisions of AS 2118.1:2017. The system shall:

1. Be designed with fast-response sprinkler heads with a Response Time Index (RTI) of not more than 50 $m^{0.5}$ $s^{0.5}$.
2. The automatic sprinkler system is to be connected to a fire alarm monitoring system connected to a fire station dispatch centre in accordance with AS 1670.3:2004.

Note: It is recommended that the sprinkler system be zoned such that it is identical to the detection system requiring shutdown to the mechanical air handling systems serving the data halls.

Note: *We know that large battery fires are often intense and difficult to control.*

Testing and research is ongoing but unfortunately there is limited publicly available test data that proves any particular type of active fire protection can prevent or control thermal runaway. In addition to the immediate fire and electricity risks fire fighters are exposed to, battery fires also present toxic fumes, exposure to hazardous materials and building decontamination issues. In some instances, the only feasible fire-fighting action may be to contain the fire and essentially leave it to burn itself out.

Whilst only the fire brigade can provide expert advice in relation to firefighting matters advise a prudent approach is to ensure that fire fighters are provided with an increased water supply. As such consideration should be given to:

1. *The number of hydrants required to flow simultaneously.*
2. *The number of operating sprinkler heads.*
3. *The suppression system water supply duration.*

Smoke Detection

- Smoke detection and alarm system is to be installed throughout the building works in accordance with Clause E2.2 of the BCA and the relevant provisions of AS 1670.1:2018.

  Spacing of the detection system is to be in accordance with Section 5 of AS 1670.1:2018 throughout the building with an aspirating smoke detection system (ASD) in data halls and areas accommodating battery storage. The

- Red flashing Visual Alarm Devices (VAD) or Visual Warning Devices (VAW) of adequate intensity complying with AS 1670.1:2015 is to be provided in a prominent location on the roof top condenser decks.

- In addition to cell voltage measurement and temperature sensors, a battery off-gas monitoring and sensor network system is to be provided for Lithium-Ion battery storage. The system shall be integrated with the fire detection system.

Lithium-Ion Detection and Monitoring

- A battery monitoring system are to be provided to the lithium-ion battery stores.

- The battery monitoring system shall include a set of sensors, including voltage, temperature, flammable gas and pressure to monitor the direct and indirect features of thermal runaway and provide early warning.

- The system shall incorporate, or be accompanied by a gas monitoring system that samples the ambient environment and battery rack air for changes of Lithium-Ion off-gassing compounds e.g. CO2, H2, CO and/or VOCs. The system shall provide both local and remote alarms to inform site personnel and the fire brigade during early stages of battery failure i.e. prior to thermal runaway.

- The monitoring systems shall be commissioned in accordance with the manufacturer's recommendations by a competent person and calibrated with calibration gas whose composition is certified by a qualified laboratory.

- All calibrations, re-calibrations and related test work should be recorded, with the dates and names of persons conducting the work and kept available at the operating site for inspection.

- Lithium battery Class 9A labels shall be provided on the face of the door providing access to the Li-Ion Battery Store. In addition, the words "CAUTION – LITHIUM-ION BATTERY STORAGE" or similar, in a minimum 25 mm font shall be provided on the door.

- The monitoring system and signage is be listed as an Essential Fire Safety Measure.

Emergency Warning

- Emergency Warning and Intercommunication System (EWIS) is to be provided in the building in accordance with AS 1670.4:2018.

  The extent of integration with IC3E and IC2 is to be determined thought it is expected that the following, at a minimum will be required:

  1. The evacuation sequence for IC3E and IC2 shall be adjusted to align with the IC3W evacuation sequence.
  2. WIP phones to be omitted from the building from all but the following locations in accordance with AS 1670.4-2018:
     - At the designated building entry point (DBEP) if remote from the Emergency Intercom Control and Indicating Equipment (EICIE);
     - Within designated emergency lifts;
     - Within the fire hydrant and sprinkler pump/valve rooms; and
     - Adjacent to the Fire Detection Control and Indicating Equipment (FDCIE) if it is remote from the EICIE.

Portable Fire Extinguishers

- Portable fire extinguishers are to be provided throughout the building. Extinguisher placement shall be in accordance with Clause E1.6 and the relevant provisions of AS 2444:2001. In addition, a 4.5kg ABE type portable fire extinguisher is to be located as follows:
    1. Adjacent to an internal fire hydrant (other than one within a fire isolated stair); and
    2. Within 4m of an exit; and
    3. Located on paths of travel to an exit so that no portable fire extinguisher is more than 40 m from the nearest portable fire extinguisher; and
    4. Located on the path of travel to an exit should the point of choice exceed 20 m. The portable fire extinguisher shall be located at a point not more than 20m from the furthest extremity of the floor plate.

Mechanical Air Handling

- An air-handling system (excluding any critical cooling system within a data hall) which does not form part of a smoke hazard management system in accordance with Table E2.2a or Table E2.2b and which recycles air from one fire compartment to another fire compartment or operates in a manner that may unduly contribute to the spread of smoke from one fire compartment to another fire compartment must—
    1. incorporate smoke dampers where the air-handling ducts penetrate any elements separating the fire compartments served; and
    2. be arranged such that when a fire is detected in a fire compartment the mechanical ventilation serving that compartment is to shut down and the smoke dampers are activated to close automatically by smoke detectors complying with clause 7.5 of AS 1670.1 (or activation of any other installed fire detection and alarm system including a sprinkler system complying with Specification E1.5 of the BCA); and
    3. for the purposes of this provision, each fire rated enclosure is treated as a separate fire compartment; and
- The mechanical ventilation system shall be provided to the battery stores designed in accordance with AS1668.1:2015 as a smoke exhaust system. The extraction capacity compliant with Clause 4.5.5(c) of AS 1940:2017. Power supply must be from an essential power supply in accordance with AS1668.1:2015.

8.5 FIRE BRIGADE ACCESS

- A designated hardstand area shall be provided adjacent to the fire sprinkler tank suction connection(s) in accordance with FRNSW Policy Guide Sheet No. 5 i.e. a clear path is to be located around the hardstand.

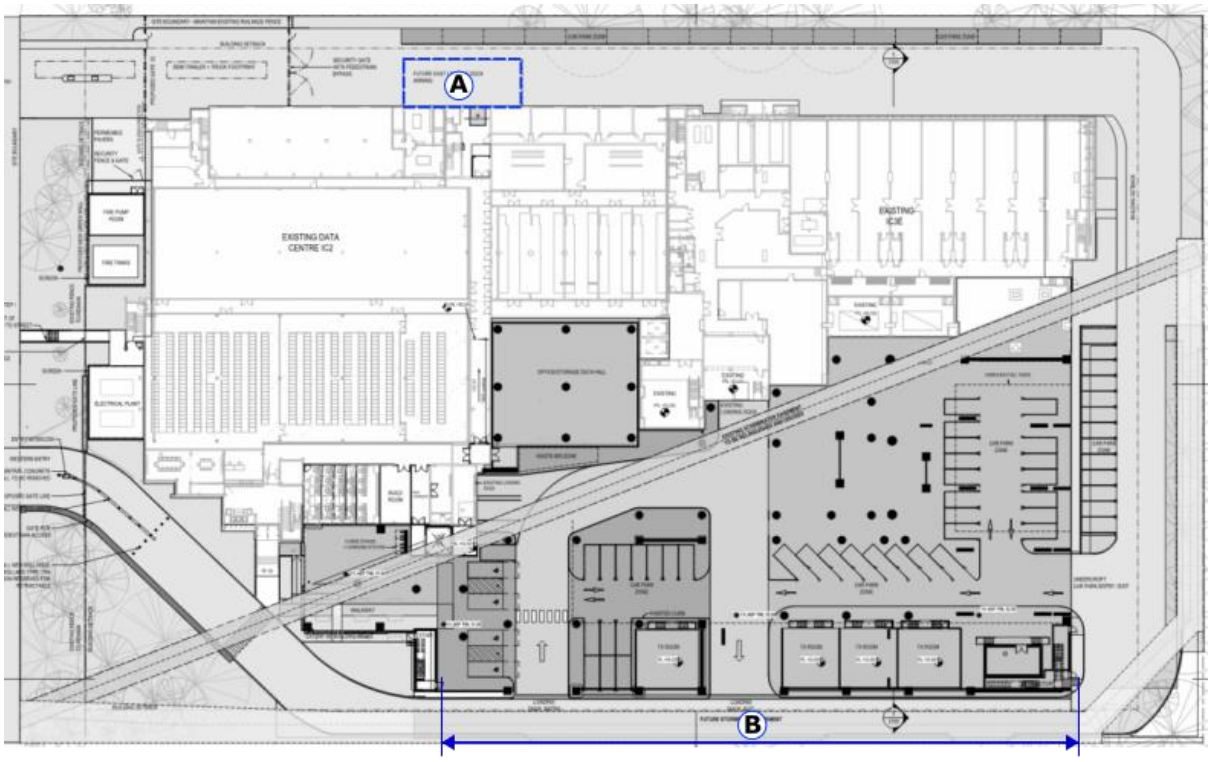

Figure 19: Overhang over the emergency vehicle path (shown at Point 'A')

- The obstructions shown in Figure 19 shall maintain a minimum clearance height of 4.5 m as seen in Figure 20**,** measured from ground to the underside of the awning.

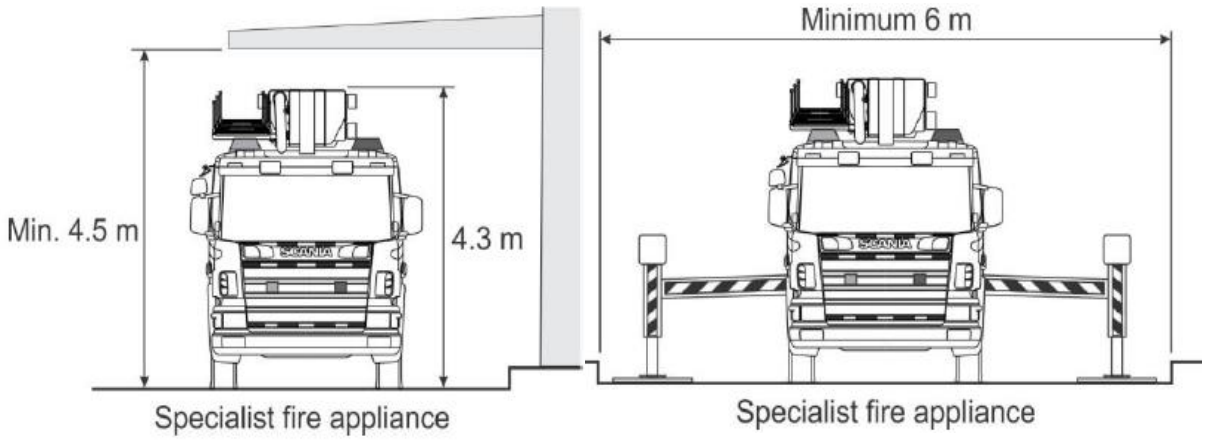

Figure 20: Overhead and width clearance requirements (from FRNSW fire safety guidelines v05)

- Gates, barriers and bollards in the emergency vehicle travel path are to be either removable, retractable or foldable to enable fire brigade access. Gates that are locked should be secured with a non-hardened metal chain and lock. All locks should be keyed alike with a copy of the key kept in the security office. Any electrically operated vehicle access gate or security device should incorporate either mechanical override, fail safe open or activation by site security to enable access.

Figure 21: Northern Elevation | Awning overhang on the eastern side of the building

- The site is to drain to an onsite firewater retention tank. The detention tank shall have a capacity equal to 1 hr flow from the sprinkler supply plus 36,000 L/s (equivalent to flow from a single hydrant valve at 10 L/s).

  The overflow shall be connected to the stormwater system and be protected by an automatic fire water isolation point (i.e. penstock valve) which closes automatically upon activation of a sprinkler head.

8.6 Management and Use

- Storage of combustible and flammable liquids shall be in accordance with Australian Standard AS 1940 Flammable Liquids Storage and Handling.
- Safety requirements for secondary lithium cells and batteries shall be applied in accordance with the relevant provisions of AS IEC 62619:2017.
- An emergency management plan (EMP) shall be prepared in accordance with AS 3745:2010. The EMP shall incorporating first attack firefighting training for the Emergency Planning Committee and Emergency Control Organisation members and emergency procedures which reinforce containment of fires only where safe to do so.
- The Data Halls and Roof are to be provided with a form of access control that monitors and records unauthorised access during normal operating conditions. Entry of authorised occupants shall be recorded. This may be in the form of an entry permit system, or a door access log recorded from proximity or smart cards in lieu of keys.
- The building is to be monitored by on-site security staff, that operate twenty-four (24) hours a day, seven (7) days a week.
- Access into the site is controlled via a security gate, which requires access cards or arranged authorisation from security staff.
- The site is to be monitored by CCTV.
- The building's WHS systems are to include induction for personnel accessing the rooftop. The induction shall include details and information relating to:

  1. Emergency evacuation procedures which include:
     - The location of the access/egress points; and
     - The location of emergency equipment.
  2. The submission of Safe Work Method Statements or other activity-based risk assessments by personnel undertaking work on the rooftop.

- An Emergency Services Information Package and Tactical Fire Plans prepared in accordance with FRNSW Guideline Version 01 (dated 1 September 2017) are to be provided in the fire control centre.
- Emergency preparedness procedures specific to the potential for Li-Ion battery fires are to be documented as part of the emergency management planning for the site. The system shall include temporary measures to control run-off in the event of a 'major fire' must be part of preparedness activities (i.e. included in pre-incident planning). This may involve but is not limited to:
    1. sand, earth and proprietary absorbents – used to soak up spillages and chemicals
    2. sealing devices and substances – pads, clamps and putties
    3. drain seals – for drainage grids or pipes. They must be kept in a readily accessible location; care must be exercised to avoid exposure to hazardous materials when installing seals
    4. booms – absorbent or plastic physical barriers, for use on watercourses to isolate drains or to divert or contain spillages.

8.7 INTERIM FALLOW FLOOR STRATEGY

Fuel Load Control & Occupancy

- The fallow data halls shall not be utilised for storage, nor shall they be occupied for any purpose until such time that an occupancy permit is issued and the items detailed herein become redundant.
- At handover it is expected that smoke detection, occupant warning, emergency lighting and exit signage and EWIS systems shall be installed.

Notification

- It is recommended that the building occupants, the relevant insurer, the fire service provider company and the local Fire & Rescue New South Wales station be notified.
- Whenever system isolation or significant alterations to egress routes are undertaken the works is to be undertaken outside of peak business hours. Where this cannot be achieved the affected floor should not be occupied other than by essential staff.

Access Control

- Only authorised personnel are permitted to enter the fallow floors. Doors are to be locked and access control is to be initiated.

Fire Brigade Intervention

- Block plans are to be provided at the booster assembly and CIE indicating the extent of sprinkler coverage during construction staging.

Emergency Management Planning

- Evacuation plans are to reflect the evacuation routes during the construction period.
- All staff are to undergo general training or be provided with a specific instruction such that they:
    1. understand changes to evacuation procedures during the interim period;
    2. have knowledge of the location of exits that are available; and
    3. are to assist in the evacuation by encouraging occupants to move as soon as the fire alarm activates and to direct them to the nearest / most appropriate exit.
- Documentary evidence is recommended to be kept and signed by each staff member to confirm that they have been provide with and understand the information related to the interim period evacuation procedures.

Active Precautions

- Fire precautions during construction are to comply with BCA Clause E1.9(a). This requires the following:
    1. not less than one fire extinguisher to suit Class A, B and C fires and electrical fires must be provided at all times on each storey adjacent to each required exit or temporary stairway or exit; and
    2. the required fire hydrants must be commissioned.

9.0 CONCLUSION

The Performance Based Design (Fire) Strategy documented in this report has been developed with the intent of meeting the relevant Performance Requirements of the BCA.

This report has documented the general departures from the DtS Provisions of the BCA that are proposed to be satisfied by way of a Performance Solution and has identified the fire safety features that are required in order to achieve compliance with the relevant Performance Requirements.

Implementation of the fire safety strategy outlined in this report is considered to result in the building being able to comply with the BCA.

Despite this it should be highlighted that this strategy is preliminary only and all parameters suggested herein are subject to consultation with stakeholders during the Fire Engineering Brief process, including the Fire & Rescue NSW.

Demonstration that the strategy will comply with the Performance Requirements will be the subject of a fire engineering assessment to be undertaken later, using fire safety engineering methodologies in accordance with the Australian Fire Engineering Guidelines.

Should the assessment reveal that the proposed systems do not satisfy the performance criteria, additional fire safety systems or modifications to the trial design followed by further assessment would be required.