ARUP

## Home Fire Sprinkler Coalition Australia

# Fire Sprinklers in Class 1a Buildings

## Fire Engineering Report

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# Contents



## Appendices

# Executive Summary

Arup has been engaged by the Home Fire Sprinkler Coalition Australia (HFSCA) to develop a Fire Engineering Report (FER) to address the installation of a non-required fire sprinkler system installed in accordance with AS2118.5, FPAA101D, HFS102 (pending publication) or other suitable fire sprinkler system in a Class 1a building, as fire sprinklers systems are not a required system under the Part H3 DtS provisions.

The basis of this FER is that the Class 1a home complies with all the fire safety related provisions of the BCA, and that a fire sprinkler system is installed over and above the DtS provisions. There are no requirements for a fire sprinkler system for a Class 1a building under the Deemed-to-Satisfy (DtS) Provisions of the National Construction Code (NCC), Volume Two, Building Code of Australia (BCA) [1]. However, it may be desirable, to go beyond the DtS provisions for fire safety, either because of developer/owner/operator objectives, or because of the risk profile of the occupants.

Given this, there is no DtS departure against the BCA. Nevertheless, this FER has been prepared to provide a Performance Solution to demonstrate that a non-required fire sprinkler system is an appropriate fire safety measure for a Class 1a building. Because the Performance Requirements are already satisfied by the BCA DtS Provisions, the addition of a fire sprinkler system has been assessed against the objectives of Part H3. Furthermore, the Performance Requirements are not directly applicable, as H3P1 relates to fire spread *from* an adjoining fire source *to* the Class 1a building, and H3P2 relates to providing automatic warning to occupants.

This FER is a stand-alone document and is not specific to a particular site, building, or project. As such, it has not undergone the Performance Based Design Brief (PBDB) process, as required by NCC BCA Clause A2G2 (4). Therefore, this FER cannot be applied on specific projects without undertaking a project specific review by the project's stakeholders, including the appropriate regulatory and referral authorities.

# 1. Introduction

## 1.1 General

Arup has been engaged by the Home Fire Sprinkler Coalition Australia (HFSCA) to develop a Fire Engineering Report (FER) to address the installation of an FPAA101D or an HFS102 fire sprinkler systems in a Class 1a building, as automatic fire sprinkler systems are not a required system under the Deemed-to-Satisfy (DtS) Provisions of the National Construction Code (NCC), Volume Two, Building Code of Australia (BCA) [1].

Arup makes all reasonable efforts to incorporate practical and advanced fire protection concepts into its advice. It is to be recognised, however, that fire protection is not an exact science, and that no building design can guarantee freedom from either ignition or fire damage, and enhanced property protection strategies should be considered in consultation with the insurer's requirements.

This report is based on the Fire Safety Objectives outlined in section 2 and Assumptions and Limitations outlined in Appendix A and the references listed in section 4.

## 1.2 Purpose of this Report

The purpose of this report is to provide a Performance Solution to demonstrate that a non-required fire sprinkler system, installed in accordance with AS2118.5, FPAA101D, HFS102 (pending publication) or other suitable fire sprinkler system, is an appropriate fire safety measure for a Class 1a building to meet the objectives of the BCA.

## 1.3 Relevant Legislation

In accordance with all State and Territory legislation, the NCC has legal effect through references in relevant State and Territory building and plumbing legislation, although there are some situations where a State or Territory enforces a variation, addition of deletion.

*'Compliance with the NCC is achieved by complying with (a) the Governing Requirements of the NCC; and (b) the Performance Requirements.'* In turn, the '*Performance Requirements are satisfied by one of the following: (a) Performance Solution; (b) Deemed-to -Satisfy Solution; (c) a combination of (a) and (b).'* A Performance Solution is required to comply with Clause A2G2.

The fire safety objective of this strategy is limited to achieving compliance with the Performance Requirements of the BCA. The relevant BCA is Volume Two of the NCC.

The approach adopted by Arup is generally in accordance with the Australian Fire Engineering Guidelines (AFEG) [2] by adopting global best practice and standards as outlined in Section 1.1.1 of the AFEG. The AFEG document is used as general guidance on the fire engineering analysis process, without strictly following each individual sub-system as outlined in Section 2.3 of the AFEG, which permits different approaches to demonstrate compliance. In addition, the approaches outlined in the earlier International Fire Engineering Guidelines (IFEG) [3], Fire Engineering Guidelines [4], FRV Guideline 33A [5] as well as the Society of Fire Safety Code of Practice [6] are adopted where appropriate.

## 1.4 Approvals Process

This FER is a stand-alone document and is not specific to a particular site, building, or project. It has not undergone the Performance Based Design Brief (PBDB) process, as required by NCC BCA Clause A2G2 (4). Therefore, this FER cannot be applied on specific projects without undertaking a project specific review by the project's stakeholders including the appropriate regulatory and referral authorities.

# 2. Report Context

The basis of this FER is that the Class 1a building complies with all the fire safety related provisions of the BCA, and that a fire sprinkler system is installed over and above the DtS provisions. Given NCC Volume Two BCA does not require a fire sprinkler system to be installed in a Class 1a building, there is no DtS departure. However, it may be desirable to go beyond the DtS provisions for fire safety, either because of developer/owner/operator objectives, or because of the risk profile of the occupants.

Often the installation of fire sprinkler systems in Class 1a buildings can be cost prohibitive depending on the requirements of the fire sprinkler standard being adopted. Given the benefits of the fire sprinkler protection this FER seeks to demonstrate that any automatic fire safety sprinkler system that is reliable, cost-effective, and fit-for-purpose is appropriate for use as a non-required fire sprinkler system in a Class 1a building and will meet the Part H3 Fire Safety Objectives, that address fire safety. The Part H3 introduction states, *this Part is intended to minimise the risk of illness, injury or loss of life occurring due to fire*.

The Objective H3O1 states:

*'The Objective is to—*

*(a) safeguard the occupants from illness or injury by alerting them of a fire in the building so that they may safely evacuate; and*

*(b) avoid the spread of fire.'*

The Functional Statements state:

*'H3F1 Protection from the spread of fire*

*A Class 1 building is to be protected from the spread of fire.'*

*'H3F2 For detection and early warning*

*A Class 1 building is to be provided with safeguards so that occupants ware warned of a fire in the building so that they may safely evacuate.'*

The Part H Performance Requirements are:

*'H3P1 Spread of fire*

*(1) A Class 1 building must be protected from the spread of fire such that the probability of a building not being able to withstand the design heat flux of 92.6 kW/m² for a period of 60 minutes shall not exceed 0.01, when located within 900 mm from the allotment boundary or within 1.8 m from another building on the same allotment from—*

*(a) another building other than an associated Class 10 building; and*

*(b) the allotment boundary, other than a boundary adjoining a road or public space (see Figure H3P1).*

*(2) A Class 10a building must not significantly increase the risk of fire spread between Class 2 to 9 buildings.*

*H3P2 Automatic warning for occupants*

*In a Class 1 building, occupants must be provided with automatic warning on the detection of smoke with an efficacy greater than 0.95 and a reliability greater than 0.95, so that they may evacuate in the event of a fire to a place of safety appropriate to the—*

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

*(b) occupant characteristics; and*

*(c) fire load and combustion characteristics; and*

*(d) potential fire intensity; and*

(e) *fire hazard.'*

# 3. Performance Solution

| Performance Solution | To demonstrate that the installation of a non-required fire sprinkler system installed in accordance with AS2118.5, FPAA101D, HFS102 (pending publication) or other suitable fire sprinkler system in a Class 1a building, meets the Objectives of the BCA, and hence the performance requirements. |
|---|---|
| **Part H DtS Clause being varied** | N/A |
| **Relevant Performance Requirements** | H3O1, H3P2 refer section 3.2 |
| **BCA Analysis Method** | A comparative and absolute, qualitative assessment in accordance with BCA Clause A2G2(1)(a)(b) and A2G2(2)(b)(ii)(d). |
| **Key Hazards** | Refer section 3.3.3 |
| **Acceptance Criteria** | The Performance Solution is considered acceptable if it supports the fire safety objectives and does not adversely affect the Performance Requirements, which are met by compliance with the DtS provisions. |
| **Methodology of Analysis** | The Performance Solution meets the fire safety objective to avoid the spread of fire by considering the characteristics identified in H3P2 i.e. taking the following into account:<br>• function and use of the building; and<br>• occupant characteristics; and<br>• fire load and combustion characteristics; and<br>• potential fire intensity; and<br>• fire hazard. |
| **Relevant Fire Safety Measures** | The following relevant fire safety measures are to be implemented:<br>• All DtS Provisions as specified in NCC BCA Volume Two Part H3.<br>• Fire sprinkler system installed in accordance with a fire sprinkler system standard suitable for a Class 1a building. |

## 3.1 Relevant BCA Provisions

The basis of this Performance Solution is the Class 1a building complies with all relevant BCA Part H3 DtS Provisions as outlined below:

- Clause H3D3: Compliance with Part 9.2 of the ABCB Housing Provisions satisfies Performance Requirement H3P1 for fire separation of external walls.
- Clause H3D4: Compliance with Part 9.3 of the ABCB Housing Provisions satisfies Performance Requirement H3P1 for fire protection of separating walls and floors.
- Clause H3D5: Compliance with Part 9.4 of the ABCB Housing Provisions satisfies Performance Requirement H3P1 for fire separation of garage-top dwellings.
- Clause H3D6: Compliance with Part 9.5 of the ABCB Housing Provisions satisfies Performance Requirement H3P2 for smoke alarms and evacuation lighting. Noting that, a Class 1 building includes a Class 10a private garage located above or below the Class 1 building.

## 3.2 Basis of Performance Solution

Because the Performance Requirements are already satisfied by the BCA DtS Provisions, the additional non-required fire sprinkler system is assessed against the objectives of Part H3. The Objective H3O1 states:

*'The Objective is to—*

*(a) safeguard the occupants from illness or injury by alerting them of a fire in the building so that they may safely evacuate; and*

(b) *avoid the spread of fire.'*

The Performance Requirements are not directly applicable as H3P1 relates to spread from an adjoining fire source to the Class 1a building, and H3P2 relates to providing automatic warning to occupants. Neither of these requirements are directly influenced by the presence of fire sprinklers.

## 3.3 Analysis

### 3.3.1 Function and Use of the Building

The Performance Solution is based on 'typical' Class 1a buildings, as defined by the BCA. 'Typical' has been defined for the purposes of this Performance Solution as dwellings with room sizes not exceeding the room sizes documented in Appendix B.

A **Class 1** building is a dwelling. The Class 1a sub-classification is one or more buildings, which together form a single dwelling including the following:

- A detached house.
- One of a group of two or more attached dwellings, each being a building, separated by a fire-resisting wall, including a row house, terrace house, town house or villa unit.

A Class 1b dwelling has not been included in this assessment as there are often rooms/ spaces within a Class 1b dwellings that exceed 'typical' room sizes in a Class 1a dwelling. If all rooms within a Class 1b dwelling do not exceed the room sizes documented in Appendix B, this Performance Solution can be applied to the Class 1b dwelling.[1]

Class 2, Class 3 and Class 4 buildings are explicitly excluded from this Performance Solution.

### 3.3.2 Occupant Characteristics

Occupants in Class 1a buildings are the residents or associated visitors. It is acknowledged that 'residents' encompass owner-occupiers, assisted living residents, long term renters and potentially short term or holiday renters. These occupants are expected to be familiar with the egress routes from the dwelling, or at least the egress route to the front door. However, residential occupants may be asleep, have a disability, have restricted mobility or have their abilities impaired e.g. may be under the influence of alcohol/medication, which can cause a delay in their response to fire event cues.

Occupant numbers within a Class 1a building can vary as the use of the property changes throughout the day, while the bed capacity can vary depending on how the dwelling is furnished.

[1] Class 1b is one or more buildings which together constitute: (i) a boarding house, guest house, hostel or the like that (A) would ordinarily accommodate not more than 12 people; and (B) have a total area of all floors not more than 300 m² (measured over the enclosing walls of the building or buildings); or (ii) four or more single dwellings located on one allotment and used for short-term holiday accommodation.

### 3.3.3 Fire Hazard [2]

The fire hazard, including fire load, combustion characteristics; and potential fire intensity are identified in this section.

The typical development of a fire, if not extinguished, usually starts with an ignition and an incubation period, which may range from seconds to hours; however, it is very difficult to predict. The incubation period is normally characterised by smouldering combustion, which still produces smoke that may be sufficient to activate smoke alarms and alert occupants. The fire then begins to continuously grow; as the fire grows (growth phase) more smoke will develop and activate smoke alarms and alert occupants if this does not occur in the incubation phase. Once the growth phase of the fire begins, the fire will develop at a rate dependent on its location, the fuel load and ventilation available. If the fire is detected when the fire size is still small, it may be extinguished by the occupants. However, in a dwelling, occupants are not always present in the room of fire origin and/or may be asleep, impaired or otherwise unaware.

The fire load within residential dwellings can vary greatly, as there are no controls on fuel load. A typical house fire will continue to burn until all the fuel load is consumed, or it is starved of oxygen, or the fire is automatically or manually extinguished.

Residential type occupancies, including dwellings (Class 1a buildings), are considered higher risk occupancies compared to non-residential type of occupancies because as there are additional risk factors such as: alcohol and drug use, smoking, disabilities, sleeping, cooking activities, malicious ignition, hoarding behaviour.

Statistics collected and presented in Preventable Residential Fire Fatalities in Australia July 2003 to June 2017 [7] provides an overview of residential fire fatalities in Australia between 2003 and 2017 and serves as a follow-on from a previous study undertaken by Australasian Fire and Emergency Service Authorities Council (AFAC) in 2005. Over this period, there were 900 total residential fire fatalities in Australia, resulting from 810 fire incidents (cases). Key findings from the various data sets used in the study are summarised below:

- Australian and overseas research shows that most residential fire fatalities occur at night and in the early hours of the morning and are more likely to occur during the colder months.
- The cause of fire was not known in 33.8% (304) of cases. Of the cases that were known, 26.7% (161) were caused by smoking materials (cigarettes, pipes, etc) followed by lighter / matches at 12.1% (73) and heater or similar at 11.9% (72).
- The point of ignition origin was identified as the living room in 28.0% (202) of cases and the bedroom in 27.0% (195) of cases; however, the point of ignition was unable to be identified in 24.3% (219) cases. [3]
- The fatalities associated with fire severity are, 36.1% (250) were killed in fires that involved at least one room, and 22.4% (155) of fatalities were from fires that destroyed the entire residence. It is noted that a large number of fires resulting in fatality had an unknown severity in fire, 23.0% (207).

### 3.3.4 Assessment of Non-Required Fire Sprinkler Systems

A number of studies (for example, [8] [9] and [10]) show the presence of fire sprinklers significantly reduces the likelihood of:

- A fire spreading beyond the object or room of fire origin, and
- Injury and fatality in a residential dwelling fire.

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[2] As there is no legislative requirement for Class 1a buildings to have fire sprinkler systems there are only a very small number of homes where fire sprinkler systems are installed, as such it is not possible to undertake a statistical study of just Class 1a buildings to understand the effect of fire sprinkler systems to mitigate the consequences of home fires. Therefore, statistical data includes Class 2 dwellings. This is considered reasonable, given that once inside the dwellings (SOUs) in a Class 2 building the function and use is the same i.e. private residential space.

[3] The location of ignition point was a field where multiple responses were possible, so there were 722 responses from known 681 cases. Of the 39 cases with multiple responses, two had three responses and 37 had two responses. The most common of the latter were rooms below the decedent's room plus other (13 cases) and then bedroom plus living room/ lounge (four cases) and kitchen plus living room/ lounge (two cases).

Furthermore, the comprehensive study by NFPA [9] of fires between 2015 and 2019 found that where homes had fire sprinkler protection:

- 95% of the fires were large enough to activate the sprinklers, which were effective at controlling the fire in 97% of the fires in which they operated.
- In 99.5% of fires, between one to five sprinkler heads activated. In 89.3% of home fires where operating sprinklers were present, only a single head activated.
- There was an 88% reduction in civilian deaths per 1,000 report fires when sprinklers were present, as well as a 28% reduction in civilian injuries and 78% reduction in firefighter injuries.

Activation of the fire sprinklers reduces the amount of smoke, significantly reduces the heat in a compartment, generally prevents flashover, limits fire spread and helps prevent structural failure. Together, this effectiveness of fire sprinklers buys time for residents to safely escape a house fire.

There are several Australian and international standards for home sprinkler systems, for example FPAA101D, FPAA101H, AS2118.5-2008, BS 9251:2021, and NFPA13D. Typically these 'conventional' domestic fire sprinklers systems have a basis of design that requires pressures and flows to operate the most hydraulically disadvantaged two (2) heads. These systems are often cost prohibitive, hence there are limited number of Class 1a buildings that have fire sprinklers installed in them, even though there are quantifiable benefits to fire sprinkler protection.

An alternative is to design for one head operating, to reduce capital and ongoing maintenance costs, potentially increasing the uptake if home sprinkler systems. The Home Fire Sprinkler Coalition Australia (HFSCA) is overseeing the development of a safe, reliable, cost-effective and fit-for-purpose automatic home fire sprinkler system for Class 1a buildings (homes) for Australia conditions (HFS102). The minimum design performance of the HFS102 home fire sprinkler system is for the operation of the most hydraulically disadvantaged single (one) sprinkler head, operating at a flow rate and residual pressure necessary to achieve the desired sprinkler spacing (coverage) in accordance with the sprinkler head's listing.[4]

The basis of design for these various domestic fire sprinkler systems are summarised in Appendix B.2.

The objective of the HFS102 system (pending publication) is:

*The objective of this home fire sprinkler system, when activated, is to increase life safety for occupants of domestic single dwellings (as defined in the NCC as Class 1a) by increasing the available safe egress time in the event of a fire. While achieving this objective, this fire sprinkler system also provides property protection for the dwelling and its contents.*

*The primary purpose of the home fire sprinkler system is to increase the period of occupant tenability in the early stages of a home fire to maximise the opportunity for safe evacuation. The system is not specifically designed to protect property, although it may control and extinguish a fire.*

The main difference between the HFS102 system and the other 'conventional' domestic fire sprinkler systems addressed in this performance solution is that the basis of design is the number of sprinklers assumed to be in simultaneous operation is one (for HFS102), compared to two (for AS 2118.5 etc.). The efficacy of the HFS102 fire sprinkler system has been studied during HFS102's development, with the research and assessment documented in the Automatic Fire Sprinkler System for Class 1A Homes - Sprinkler System Efficacy Study. [11].

This study identified that the typical coverage of a residential sprinkler head is 24m² and that typical room sizes in a residential dwelling in Australia are less than 24m². With respect to the efficacy of the fire sprinkler system, the majority of rooms/spaces in a residential dwelling will therefore achieve sprinkler coverage with one head. In these cases, the number of sprinkler heads activating is most likely going to be limited to the one sprinkler head in the room. In these cases, the HFS102 system has equivalent performance

[4] There are other aspects of the proposed HFS102 system which deviate from the various 'conventional' domestic sprinkler system standards; however, these aspects are not considered to impact the performance at the fire sprinkler head.

to an AS2118.5 domestic sprinkler system. As noted above, the ignition point of 27% of fires with fatalities is the bedroom, and even ‘large’ master bedrooms are ~21m².

For larger houses/ houses with large or open living spaces, these spaces can exceed 24m². In such scenarios, multiple fire sprinklers may activate, resulting in pressure and flow at each sprinkler head being a fraction of the sprinkler head’s listed pressure and flow. This can also occur with an AS2118.5 fire sprinkler system if there are more than two sprinkler heads in a space/ room. The study demonstrated that, where multiple sprinkler heads activated, the HFS102 fire sprinkler system continued to control the fire size, reduce the temperatures within the room and maintained conditions in the room such that flashover did not occur.

## 3.4 Conclusion

The objective of domestic fire sprinkler systems aligns with the fire safety objectives of Part H3, H3O1. As demonstrated by the assessment above, a dwelling with sprinklers improves the Performance Requirement outcomes compared with dwelling that complies only with the DtS provisions of Part H3 i.e. has no fire sprinklers. The presence of fire sprinklers can significantly prolong tenable conditions and *limit fire spread*, so occupants are more likely to be provided with conditions *so that they may safely evacuate* for a longer period of time compared to a dwelling with no fire sprinkler protection.

# 4. References


[1] ABCB, NCC 2022 Volume Two - Building Code of Australia, 2022.

[2] ABCB, Australian Fire Engineering Guidelines, Canberra: Australian Building Codes Board, 2021.

[3] ICC, NRC, DBH, ABCB, International Fire Engineering Guidelines Edition 2005, Canberra: ABCB, 2005.

[4] Fire Code Reform Centre Limited, Fire Engineering Guidelines, First Edition, Sydney, 1996.

[5] FRV Fire Safety Advisory, FRV Fire Safety Guideline GL-33A : Application for an Internal Review of FRV's Descision in Relation to a Submitted Fire Engineering Brief, Melbourne: FRV Fire Safety Advisory, 2022.

[6] Engineers Australia Society of Fire Safety , Code of Practice for Fire Safety Design, Australia, 2003.

[7] L. Coates, G. Kaandorp, J. Harris, J. V. Leeuwen, A. Avci, J. Evans, S. George, A. Gissing, D. R. V. D. Honert and D. K. Haynes, "Preventable residential fire fatalities in Australia July 2003 to June 2017," Bushfire and Natural Hazards CRC, Melbourne, 2019.

[8] M. Ahrens and R. Maheshwari, "Home Structure Fires," National Fire Protection Association , 2021.

[9] M. Ahrens, "US Experience with Sprinklers," National Fire Protection Association, 2021.

[10] M. Runefors, N. Johansson and P. V. Hees, "How could the fire fatalities have been prevented? An analysis of 144 cases during 2011–2014 in Sweden: An analysis," *Journal of Fire Sciences,* 2016.

[11] Arup, "Automatic Fire Sprinkler System for Class 1A Homes Sprinkler System Efficacy Study Revision 02," Sydney, Australia, 8 October 2024.

[12] ABCB, NCC 2022 Volume Three - Plumbing Code of Australia, 2022.

[13] ABCB, NCC 2022 Volume One - Building Code of Australia, 2022.

# Appendix A

## Assumptions and Limitations

## General Assumptions

The general assumptions underlying the assessment are identified below. In addition, any detailed assumptions used as inputs to the analysis are listed below. Assumptions may include simplifications of building performance or human behaviour based on engineering judgement or accepted approaches, which are necessary to enable the issues in question to be rationally addressed. The assumptions are reported so that users of the report are made aware of them and their applicability can be reviewed.

Limitations are defined as boundaries to the applicability of the results or the assessment.

Given the unique and variable nature of deliberate fire scenarios (i.e. arson), the assumptions and limitations related specifically to arson events have been discussed separately below.

Any change to the building design or use may mean that the assumptions are not valid, in which case the report is to be reviewed by a suitably qualified Fire Safety Engineer and/or Building Surveyor. The conclusions of this report may not be valid if the assumptions are incorrect.

The following assumptions have been made in this report:

- All fire safety aspects of the development that are not addressed within this report comply with the Provisions of the BCA or the relevant code requirements at the time of construction, unless otherwise noted.
- The assessment and analysis are based on the assumption that the development is complete and operational.
- All fire safety systems and management strategies will be maintained in accordance with relevant Building Regulations and Australian Standards, and any particular requirements of this report.
- Any significant changes to the design drawings and/or specifications will be referred to the Relevant Building Surveyor and/or Fire Safety Engineer for review prior to acceptance.
- It is assumed that the DtS departures currently identified for the project works are consistent with the architectural drawings.

## Limitations

Any limitations which are not complied with may invalidate the conclusions of this report, and hence are to be referred to a suitably qualified Fire Safety Engineer and/or Building Surveyor for review.

Any change in the building, occupant characteristics or fuel conditions outside the parameters of this report may invalidate the conclusions of this report.

The conclusions of this report may not apply if all requirements are not fully implemented as described in this report.

Issues related to the protection of the building during construction, renovation or demolition are excluded from the scope of this report.

Arup makes all reasonable efforts to incorporate practical and advanced fire protection concepts into its advice. It is to be recognised, however, that fire protection is not an exact science, and that no building design can guarantee freedom from either ignition or fire damage.

The brief from the client is that the design is to comply with the Building Regulations in relation to fire safety. There is no specific consideration any other objectives for the fire safety design. Hence, protection of the building fabric and contents, minimisation of business interruption, environmental protection and any other issues that are not fire safety requirements of the Building Regulations or applicable Occupational Health and Safety (OHS) legislation are not considered in this report.

This report does not address insurance issues. It is recommended that relevant insurers are advised of the contents of this report, so that insurance issues can be appropriately addressed between the building owner and/or operator and their insurer.

Issues related to workplace health and safety or community protection are outside the scope of this report, except where directly relevant to the Performance Solutions presented.

Note that the figures and diagrams used within this report are indicative and serve the purpose of supporting the fire engineering strategy. Some of the drawings may have been updated and this strategy is based on the drawings referenced above; however, where the intent of the strategy is unchanged, the figures in this report may not have been updated.

## Arson

The client has not indicated that the subject class of building is considered a likely target for organised terrorist or criminal arson attack and has not requested that deliberate large-scale malicious arson events be included in our fire engineering assessment of Performance Solutions.

However, in accordance with the Australian Fire Engineering Guidelines (AFEG) [2], fire engineers are required to consider the possibility of single ignition arson events, in addition to accidental fires. There are two basic approaches under accepted practice for the consideration of arson i.e. prevention or protection. Either of these approaches is acceptable in accordance with the AFEG, as described by Costello and Gildersleeve.

- The “Protective” approach would involve assessing the impact of escalating the design fire scenarios to test the sensitivity to accelerated fire growth rates, failure of sprinklers, fires occurring in unlikely locations etc which would potentially lead to more onerous requirements being placed on the design.
- The “Preventive” approach would aim to minimise the possibility of a malicious attack, by use of suitable security measures.

The client prefers not to adopt the protective approach and therefore prefers to rely on building security and/or operational measures to reduce the risk of arson. The specification of suitable measures lies outside the scope of this report; however, the reader is directed to the UK arson prevention website and the recommendations contained in the Fire Protection Association handbook on the Prevention and Control of Arson.

# Appendix B

## Supporting Information

# B.1 Australian Guide to Average Room Sizes

A selection of room sizes by room type as provided in an Australian guide to residential room sizes (https://buildsearch.com.au/average-room-size).

| Room Type | Small | | | Large | | | Average |
|---|---|---|---|---|---|---|---|
| | Width [m] | Length [m] | Area [m²] | Width [m] | Length [m] | Area [m²] | Area [m²] |
| Master Bedroom | 3.0 | 3.1 | 9.3 | 5.0 | 4.2 | 21.0 | 15.2 |
| Minor Bedroom | 2.8 | 2.5 | 7.0 | 4.0 | 3.3 | 13.2 | 10.1 |
| Living | 4.2 | 3.4 | 14.3 | 5.5 | 5.0 | 27.5 | 20.9 |
| Kitchen | 3.0 | 2.4 | 7.2 | 4.8 | 3.6 | 17.3 | 12.2 |
| Dining | 3.0 | 2.3 | 6.9 | 4.5 | 5.0 | 22.5 | 14.7 |
| Lounge | 4.0 | 3.4 | 13.6 | 5.5 | 5.0 | 27.5 | 20.6 |
| Other living spaces (e.g. games room) | 3.3 | 4.0 | 13.2 | 5.8 | 5.8 | 33.6 | 23.4 |
| Bath | 1.5 | 2.0 | 3.0 | 3.2 | 3.0 | 9.6 | 6.3 |
| Toilet | 0.9 | 1.3 | 1.1 | 1.3 | 1.8 | 2.3 | 1.7 |
| Laundry | 1.6 | 2.0 | 3.2 | 2.4 | 3.4 | 8.2 | 5.7 |
| Garage | 5.4 | 5.4 | 29.2 | 6.2 | 6.2 | 38.4 | 33.8 |

# B.2 Summary of Domestic Sprinkler System Standards

| Sprinkler Standard | Design Criteria | Sprinkler Coverage |
|---|---|---|
| HFS102 Design<br>(Pending publication)<br>Automatic fire sprinkler system for Class 1a homes | The minimum design performance of the HFS102 home fire sprinkler system is for the operation of the most hydraulically disadvantaged single (one) sprinkler head, operating at a flow rate and residual pressure necessary to achieve the desired sprinkler spacing (coverage) in accordance with the sprinkler head's listing. | Sprinkler spacing (coverage) in accordance with the sprinkler head's listing |
| FPAA101D-2021<br>Automatic fire sprinkler system design and installation – drinking water supply | Home sprinkler systems shall be hydraulically designed to provide a flow of at least 50 L/min from each sprinkler. The sprinkler coverage, minimum pressure and flow requirements for approved home sprinklers (see Clause 4.3.1) shall be in accordance with the sprinkler approval listing details specified in the manufacturer's data sheets. The number of sprinklers assumed to be in simultaneous operation shall be **two**.<br>The design flow for the sprinkler system shall be not less than 100 L/min plus an additional 12 L/min for possible simultaneous domestic demand from such appliances as washing machines and dishwashers. | In accordance with the sprinkler approval listing details specified in the manufacturer's data sheets. |
| FPAA101H-2018<br>Automatic fire sprinkler system design and installation – hydrant water supply | N/A - Not included as homes do not have fire hydrant systems. | N/A |
| AS2118.5-2008<br>Automatic fire sprinkler systems, Part 5: Domestic sprinkler systems | Home sprinkler systems shall be hydraulically designed to provide a flow of at least 50 L/min from each sprinkler. The sprinkler coverage, minimum pressure and flow requirements for approved home sprinklers (see Clause 4.3.1) shall be in accordance with the sprinkler approval listing details specified in the manufacturer's data sheets.<br>The design flow for the sprinkler system shall be not less than 100 L/min (determined by multiplying the unit sprinkler flow (see Clause 4.2.1) by two)—<br>(a) plus an additional 12 L/min for possible simultaneous domestic demand from such appliances as washing machines and dishwashers; or<br>(b) alternatively, for independent systems only, a priority valve may be installed to shut off the domestic demand at the time of sprinkler operation. | Maximum coverage area per sprinklers 24.0m² |
| BS9251:2021<br>Sprinkler systems for residential and domestic occupancies. Code of Practice | The minimum design discharge densities, number of design sprinklers capable of operating simultaneously in a compartment (sprinkler) and duration of supply should be in accordance with Table 2. For all categories, the number of design sprinklers should be determined by the maximum number of sprinklers in any compartment (sprinkler) (see 3.10), up to the maximum in accordance with Table 2.<br>The density of water delivered by each sprinkler should be calculated by the physical area of coverage, as opposed to the maximum area of the data sheet. In all cases, the manufacturer's minimum head pressure for the corresponding coverage area should be met or exceeded (see Annex B, B.7).<br>Table 2 for Category 1 system (Single family dwellings):<br>• Minimum discharge density: 2.1 mm/min*<br>• Number of sprinklers: 1 or 2<br>• Minimum duration of supply: 10 min | The manufacturer's minimum head pressure for the corresponding coverage area should be met or exceeded |

| Sprinkler Standard | Design Criteria | Sprinkler Coverage |
|---|---|---|
| | *Footnote relating to increased requirements for ‘higher ‘than normal risk profiles’ | |
| NFPA13D-2025<br>Standard for Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes | The system shall be provided at least the flow required to produce a minimum discharge density of 2.0mm/min or the sprinkler listing, whichever is greater, to the design sprinklers.<br>For each of the situations, the number of sprinklers in the design shall be all of the sprinklers within the compartment. Up to a maximum of two sprinklers, that require the greatest hydraulic demand. | Sprinklers shall be installed in accordance with their listing where the type of ceiling configuration is referenced in the listing. |
| NZS4517-2010<br>Fire sprinkler systems for domestic occupancies | Sprinklers other than residential type shall be installed only when allowed by 4.4.1.<br>Areas where residential sprinklers are used:<br>• No. sprinklers in the room – 1: 1 sprinkler operating at the listed pressure.<br>• No. sprinklers in the room – more than 1: 2 sprinklers operating at the listed pressure. | Maximum area of coverage 21m² - depending on sprinkler type and orifice pressure. |

## B.3 HFS102 Fire Sprinkler System Efficacy Study

The efficacy of the HFS102 fire sprinkler system has been studied during HFS102's development, with the research and assessment documented in the Automatic Fire Sprinkler System for Class 1A Homes - Sprinkler System Efficacy Study by Arup.

https://homefiresprinklers.org.au/wp-content/uploads/2024/10/HSCA-Report_Arup_Final-2.pdf

# Appendix C

## NCC Volume Three - State and Territory Variations and Additions

# C.1 Schedule 10 Victoria

Clause VIC B4D2 (3) in the Victorian Appendix of Volume Three of the NCC [12], which covers plumbing and drainage requirements for all building classifications, makes reference to automatic fire sprinkler systems installed in Class 1 buildings.

VIC B4D2(3) states that:

*'When installed in Class 1 or Class 10 buildings and structures, an automatic fire sprinkler system must be in accordance with AS2118.1, AS2118.4 or AS2118.5 as appropriate.'*

It is noted that AS2118.1 and AS2118.4 are for Class 2 – 9 buildings and may not appropriate for use in a Class 1a building, as the infrastructure and maintenance requirements are cost prohibitive in a Class 1a context. Therefore, under the Victorian Appendix, to comply with the Volume Three DtS provisions only an AS2118.5 system (or no system) would be permitted in a Class 1a building. As such, a Performance Solution against the relevant NCC Volume Three Performance Requirements would be required to permit the installation of an alternative fire sprinkler standard [5].

This FER **does not address** the Volume Three Performance Requirements as they do not relate to the NCC fire safety objectives, an appropriately qualified person would be required to address the Volume Three Performance Requirements, as appropriate.

[5] This is inconsistent with NCC Volume One BCA [8] which also permits fire sprinkler systems installed in accordance with FPA Australia Technical Specifications FPAA101H and FPAA101D.